TOWN OF NANTUCKET
NATURAL HAZARD MITIGATION PLAN

FEBRUARY 2019
ADOPTED MARCH 8, 2019

MMI #2967-09

Prepared For:

Town of Nantucket
16 Broad Street
Nantucket, Massachusetts 02554

Prepared By:

MILONE & MACBROOM

Milone & MacBroom, Inc.
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773

CERTIFICATE OF ADOPTION
TOWN OF NANTUCKET SELECT BOARD

A RESOLUTION ADOPTING THE TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN UPDATE, 2019

WHEREAS, the Town of Nantucket has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and,

WHEREAS, the Nantucket Select Board (previously called Board of Selectmen) approved the previous version of the Plan in 2007; and,

WHEREAS, the Town of Nantucket has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its Natural Hazard Mitigation Plan Update, 2019 under the requirements of 44 CFR 201.6; and,

WHEREAS, committee meetings were held, and public input was sought in 2017 and 2018 regarding the development and review of the Natural Hazard Mitigation Plan Update, 2019; and,

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for the Town of Nantucket; and,

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact the Town of Nantucket, with the effect of protecting people and property from loss associated with those hazards; and,

WHEREAS, adoption of this Plan will make the Town of Nantucket eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Select Board:

1. The Plan is hereby adopted as an official plan of the Town of Nantucket;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Select Board.

Adopted this 8th day of March, 2019 by the Select Board of Nantucket, Massachusetts

Select Board Chair

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of the Town of Nantucket this 8th day of March, 2019.

Nancy S. Holmes

Town Clerk

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

Samantha C. Phillips, Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

Dear Director Phillips:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division, Risk Analysis Branch has approved the Town of Nantucket Natural Hazard Mitigation Plan effective **March 15, 2019** through **March 14, 2024** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

With this plan approval, the jurisdiction is eligible to apply to the Massachusetts Emergency Management Agency for mitigation grants administered by FEMA. Requests for mitigation funding will be evaluated according to the specific eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in your community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

The plan must be updated and resubmitted to the FEMA Region I Mitigation Division for approval every five years in order to remain eligible for FEMA mitigation grant funding.

Thank you for your continued dedication to public service demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Melissa Surette at (617) 956-7559 or Melissa.Surette@fema.dhs.gov.

Sincerely,

Paul F. Ford
Acting Regional Administrator

PFF: ms

cc: Sarah White, State Hazard Mitigation Officer, MEMA
Jeffrey Zukowski, Hazard Mitigation Planner, MEMA
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA

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ACKNOWLEDGEMENTS

This plan update was prepared with the participation of the Town of Nantucket and its many Departments. The following individual is the local plan coordinator and should be contacted with questions or comments regarding the plan:

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hbackus@nantucket-ma.gov

Additionally, the Nantucket Emergency Management Agency may be contacted with questions or comments regarding Emergency Management in Nantucket:

Nantucket Emergency Management (Police Department)
4 Fairgrounds Road
Nantucket, MA 02554
Chief William Pittman, Emergency Management Director
wpittman@police.nantucket-ma.gov
508-228-1212
Sergeant Brendan Coakley, Emergency Management Coordinator
bcoakley@police.nantucket-ma.gov
508-325-4100 x5387

Finally, in addition to the two listed above, the following individuals were instrumental to the development of the 2018 Nantucket Hazard Mitigation Plan Update, and we thank them for their time and input:

Name	Position	Contact Information
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The consulting firm of Milone & MacBroom, Inc. (MMI) prepared the plan update, building upon the initial work completed in 2007. Over time, there has been new information assembled and many changes regarding planning requirements for local hazard mitigation plans. Thus, this plan has been reformatted and updated from the original plan. Updates were made by conducting interviews with Town staff and collecting input during public workshop sessions.

Once reviewed and approved by the Town, the plan be formally submitted to the State and FEMA for an additional level of review and approval.

Mr. David Murphy, P.E, CFM, Associate
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Document Version History

Date	Version
May 2018	Draft for Municipal Review
November 2018	Draft for MEMA
December 2018	Final draft for FEMA
January 2019	Updated draft for FEMA
February 2019	Additional edits
March 2019	Final for Municipal Adoption
May 2019	Added Navigation Bookmarks to PDF

EXECUTIVE SUMMARY

Town of Nantucket Hazard Mitigation Plan Update, 2019

The Town of Nantucket has prepared this Hazard Mitigation Plan (HMP) to identify natural hazards and risks, infrastructure vulnerabilities, existing capabilities, and activities that can be undertaken by the community to prevent loss of life and reduce property damages associated with identified hazards. It represents actions and priorities that should be considered and addressed in the following five years (2019 to 2023) and will be updated on a regular basis. The Federal Disaster Mitigation Act of 2000 requires local communities to have a FEMA-approved mitigation plan in order to be eligible to receive Pre-Disaster Mitigation Program grants and Post-Disaster Hazard Mitigation Grant Program funds under the Hazard Mitigation Assistance program. This Plan will also help Nantucket identify projects and activities eligible for funding from other sources including a range of State of Massachusetts grants and the Town's Capital Improvement funds.

The Nantucket Planning & Land Use Services (PLUS) Office, with assistance from the Nantucket Emergency Management Agency, will administer this HMP under the authority of the Board of Selectman. Holly Backus, Land Use Specialist at PLUS, will be the Local Coordinator of the Hazard Mitigation Plan, and the Chief of Police and Emergency Management Director (a single position) will be the deputy Local Coordinator. PLUS will coordinate with responsible departments and ensure that the recommendations of this HMP are considered or enacted.

This HMP is an update to the previous Nantucket HMP, adopted in 2007. Information sources used to update this version of the plan included:

- ❑ Project initiation meeting on September 18, 2017.
- ❑ Public meeting on October 23, 2017.
- ❑ Public meeting geared toward stakeholders was held on November 27, 2017.
- ❑ Interviews with Town staff and others were held by phone between December 4 and December 12, 2017.
- ❑ A public online-survey between October 20 and December 15, 2017.
- ❑ Feedback from Town staff on winter storm events in early 2018.

Key changes since the previous edition of the HMP include the following:

Vision

In meetings with municipal staff, a plan vision was developed. The vision of this Hazard Mitigation Plan is "To mitigate the detrimental impacts of natural hazards to Nantucket while maintaining and enhancing the Island's quality of life, historic essence, aesthetic beauty, and natural and habitat resources."

Goals

The previous HMP's eight goals have been reclassified as objectives aimed at achieving five new, central goals. The new goals are:

- ❑ **Reduce** the loss of or damage to life and property caused by natural disasters.
- ❑ **Protect** Town infrastructure, and natural, cultural, historic and economic resources from natural disasters.
- ❑ **Maintain** the Island's emergency response capabilities.
- ❑ **Reduce** public and private natural disaster damage and insurance **costs**.
- ❑ **Reduce** the **social**, **emotional**, and **economic** disruption associated with a natural disaster.

Objectives

The eight goals from the previous HMP have been retained in this update as objectives, and two new objectives have been added. Objectives are now as follows:

- ❑ Increase access to and awareness of funding sources for hazard mitigation projects.
- ❑ Identify mitigation initiatives to be implemented if and when funding becomes available.
- ❑ Connect hazard mitigation planning to other community planning efforts.
- ❑ Improve the mechanisms for pre- and post-disaster decision making efforts.
- ❑ Improve the ability to implement post-disaster recovery projects
- ❑ Enhance and preserve natural resource systems.
- ❑ Inform protection of historic resources.
- ❑ Inform efforts to build resilience.
- ❑ Educate residents and policy makers about natural hazard risk and vulnerability.
- ❑ Complement future Community Rating System efforts.

Additionally, five specific areas of concern have been listed to help guide mitigation efforts; these are:

- ❑ Access To The Mainland
- ❑ Isolation Within The Island
- ❑ Historic Resources
- ❑ Power Supply Resiliency
- ❑ Climate Change

New Emergency Management Organizational Framework

The Nantucket Emergency Management Agency (NEMA), through the Fire Department, coordinated and oversaw the development of the initial 2007 Hazard Mitigation Plan. Since that time, Nantucket has reorganized its government structure and NEMA is now operated from the Nantucket Police Department. The Police Chief is the Emergency Management Director and a Police Sergeant is the Emergency Management Coordinator.

The Comprehensive Emergency Management Plan (CEMP) was prepared in 2013 and is being updated in 2018. It provides a framework wherein the community can plan and perform their respective emergency functions during a disaster or emergency situation on the local, state or national level. The CEMP takes an all-hazards approach, addressing both natural and technological (man-made) hazards. The plan is an important component in community

Homeland Security efforts, building on an all-hazards foundation. The CEMP supersedes any previous emergency plans promulgated for this purpose. It is structured in four parts. Part I deals with the Basic Plan. Part II deals with the Emergency Management Response Organization. Part III deals with Emergency Management Processes and Protective Procedures. Part IV deals with natural and technological hazards.

The Hazard Mitigation Plan coordinator position has been shifted away from NEMA, and responsibility for ongoing maintenance of and updates to the plan has been given to the Department of Planning and Land Use Services (PLUS).

PLUS was established in 2012 by consolidating the former Code Enforcement Department with the offices of Planning and Zoning. PLUS consists of the Building Division (previously the Building Department), the Planning Division and Zoning Board of Appeals (previously the Department of Planning & Zoning) and the Historic District Commission. Within the Planning Division is the Energy Office, Planning & Economic Development Commission, and Planning Board.

New Planning Capabilities and Resources

Nantucket has completed many initiatives that support updates to the HMP including a Coastal Management Plan, Harbor Action Plan, and an Island-wide Master Plan and associated neighborhood plans.

The Master Plan, completed in 2009, identifies the Downtown neighborhood as the symbolic center of the Island, but the Mid-Island area as a node for current and future growth and development. Natural and cultural resources are highlighted, emergency services needs are noted, and a number of policies recommended that address various natural hazards. Area plans were developed as part of the Master Plan process for the neighborhoods of Madaket, Mid Island, Siasconset, Tom Nevers, and Surfside. These neighborhood plans each include many actions relevant to Hazard Mitigation.

The Harbor Action Plan, adopted 2009, addresses issues related to maintaining the operation of Nantucket's harbors and connection to the mainland, both under typical conditions and in response to storm events.

The Nantucket Coastal Management Plan, adopted in 2015, establishes priorities and procedures for protecting and managing town-owned infrastructure, access points, and roads adjacent to the coastline. The CMP lists many Coastal Management Principles, including five relevant to coastal hazards and erosion. A number of specific actions relevant to natural hazards, including a recommendation to update the Hazard Mitigation Plan, are listed in the CMP.

Nantucket has updated its Flood Hazard Overlay District regulations (Zoning 139-12 (A)) to be in line with Massachusetts state standards.

The Center for Coastal Studies at Provincetown with funding from the Massachusetts Office of Coastal Zone Management prepared a GIS based model for simulating storm-related inundation using actual topographical information and water levels from previous storm events as recorded in Nantucket Harbor. This report was provided in 2009 and the data are available on the Town's public facing website *https://nantucketma.mapgeo.io*.

A report of actions and priorities to protect critical infrastructure in the downtown area of Nantucket was prepared by Worcester Polytechnic Institute in 2015. The report provides a very thorough examination of vulnerabilities to public and privately-operated infrastructure due to storm surge. Recommended actions and alternatives to reduce and eliminate the risks of loss/failure are provided.

Recently, the State of Massachusetts launched a website that provides information on shoreline trends, including erosion and accretion rates for use by coastal managers, shorefront landowners, and potential property buyers. The Massachusetts Ocean Resource Information System (MORIS) is a very robust GIS based online mapping tool with data layers and high-resolution imagery. MORIS coverage includes all of Nantucket. *https://www.mass.gov/service-details/massachusetts-shoreline-change-project* The site is hosted by the Office of Coastal Zone Management and is intended to distribute scientific data that will support local land-use decisions by coastal management professionals and the others interested in the data and maps.

Climate/Coastal Resilience Plan

Like other coastal communities, Nantucket has recognized the growing need for a broader range of planning related to climate change, coastal resilience and community resilience planning. In December 2017, the Town began working with the consulting firm Milone & MacBroom, Inc., to begin examining policy and regulatory tools that can be implemented to ensure the continued resilience of the Island in the face of rising seas and increasingly severe and frequent coastal storms. The document will include and implementation plan for integration of recommendations into the municipal code the town's Master Plan, and other town plans (including this HMP). The plan will also be a first step in a more comprehensive climate resilience plan process that will follow the Massachusetts Municipal Vulnerability Planning (MVP) program framework and will make the Town a certified MVP community.

Historic Storm and Water Level Events in 2018

Nantucket experienced two major nor'easters in the first three months of 2018. Winter Storm Grayson, in January, brought water levels in Nantucket Harbor up to 5.27 feet NAVD88, and winds up to 76 mph. High water volumes and extreme cold temperatures may have contributed to the failure of a 16-inch diameter sewer force-main from the downtown pump station and the resulting discharge of sewage directly into the harbor until emergency repairs were completed.

In March 2018, Winter Storm Riley brought a long-lasting surge driven by strong winds to Nantucket Harbor, with water peaking at 4.69 feet NAVD88. Wind gusted as high as 89 mph, and waves damaged a bridge and caused erosion. Flood levels from these storms were among the highest ever recorded; Winter Storm Grayson had the second highest coastal flood crest on record in Nantucket, while Winter Storm Riley, over the course of three high tides, had the fourth, fifth, and seventh-highest crests on record. Incredibly, a blizzard on January 30, 2018, brought the tenth-highest recorded storm surge ever measured in Nantucket Harbor, meaning five of the top ten flood elevations measured in Nantucket history occurred in the first three months of 2018. The top ten historic flood crests are summarized below (source: NOAA), with 2018 events bolded. All values in feet NAVD88.

1. *5.78 feet on 10/30/1991 - Perfect Storm*
2. ***5.27 feet on 01/04/2018 - Winter Storm Grayson***
3. ***5.12 feet on 01/27/2015 - Winter Storm Juno***
4. ***4.69 feet on 03/03/2018 - Winter Storm Riley***
5. ***4.61 feet on 03/03/2018 - Winter Storm Riley***
6. *4.58 feet on 12/12/1992 - nor'easter*
7. ***4.53 feet on 03/02/2018 - Winter Storm Riley***
8. *4.48 feet on 01/03/2014 - blizzard*
9. *4.25 feet on 01/02/1987 - nor'easter*
10. ***4.25 feet on 01/30/2018 - blizzard***

Community Profile

The Town of Nantucket consists of 48 square miles of land and approximately 88 miles of shoreline and includes the islands of Nantucket, Tuckernuck, and Muskeget. Key physical features include high bluffs, long systems of beaches and dunes, several north-south trending elongated ponds that are typically cut off from the ocean by narrow beaches, extensive moorlands, and numerous areas of tidal wetlands. Nantucket does not have many non-tidal fresh watercourses.

Nantucket's main population and economic centers are located in the Downtown/Brant Point, 'Sconset, Madaket, and Mid-Island Areas; ongoing development is focused mostly on the Mid-Island area. 55% of the total land area of Nantucket is conservation land. The Town is home to between 10,172 (according to the 2010 Census) and 17,200 (according to the Nantucket Data Platform) permanent residents, with seasonal tourism boosting the population to over 46,000 at times. The Island is accessible via two ferry lines that dock in the Downtown, and the airport.

Natural Hazard Profile

Natural hazards addressed in this Plan include inland flooding, coastal flooding, hurricanes and tropical storms, shoreline change and erosion, summer storms and tornadoes, winter storms, wildfires, and earthquakes. The effects of climate change, including rising sea levels and intensifying precipitation extremes, are also discussed within the context of each hazard. For each of these natural hazards, the Plan presents risk-locations, likelihood of occurrence, and potential for loss of life and property, with the understanding that a particular type of damage can be caused by a variety of hazard effects, which in turn can be caused by a variety of hazard events (for example, the hazard event of a hurricane and a winter storm can each cause the hazard effect of both high wind and high precipitation, and either of those can cause tree limbs to fall on utility lines and take out power).

The primary hazards for Nantucket are coastal flooding, erosion, shoreline change, and high winds. The Downtown and Brant Point neighborhoods, along with Madaket and Codfish Park, are particularly at risk to coastal inundation. Erosion is a major concern along the southern shore of the Island, where it threatens key airport and wastewater treatment infrastructure, and in 'Sconset on the eastern end of the Island. High winds are a concern across the entire Town.

Flooding

There are very few inland watercourses on Nantucket that pose a risk of flooding; these are:

- Phillips Run
- Sesachacha Pond (areas west and southwest of the pond)
- Miacomet Pond Tributary

Flooding in areas that are not along watercourses but are unable to support effective gravity drainage to an outfall is a more significant problem. This type of flooding, often called flash-flooding or urban flooding, is common in the more developed areas of the Island including the Downtown and Mid-Island neighborhoods, and in particular Airport Road, Raceway Road, and Somerset Road. Loss of access due to flooded roads is also a concern, in particular in 'Sconset.

Nantucket has 1,136 buildings located within coastal FEMA flood hazard zones (AE and VE zones), including a number of critical facilities. Particularly at-risk areas include Downtown and Brant Point, Madaket, Polpis and Wauwinet, and Codfish Park in 'Sconset.

In addition to the risk of severe storm flooding represented by FEMA flood hazard zones, Nantucket is concerned about two less-severe forms of flooding, which they define as follows:

- **Nuisance Flooding** is a combination of poor local storm water drainage and high tides that cause flooding to a depth of several inches in some location a few times per year. Nuisance flooding can occur on days without precipitation or high winds and is sometimes referred to as "sunny day flooding."
- **High Tide Flooding** is caused when higher-than-normal tides, typically related to storm events, flood low-lying areas. These events are less frequent and more extensive than nuisance flooding, and cause inconveniences such as road closures, overwhelmed drainage systems, and compromised infrastructure.

Nantucket's capabilities to mitigate flooding include **participation in the National Flood Insurance Program** (the most recent FIRM and FIS for Nantucket was made effective August 5, 2014), **regulations and codes** that restrict development near hazard areas and require buildings be built to certain standards, and ongoing **Drainage System Upgrades,** especially a long-term upgrade of the downtown drainage infrastructure. Nantucket's land conservation organizations own, and continually pursue acquisition of additional, coastal land that will be preserved as **open-**space, decreasing the exposure of residents to coastal hazards

Sea Level Rise, Shoreline Change, and Erosion

The entire shoreline of Nantucket is vulnerable to sea level rise, shoreline change, and erosion. Areas of particular concern include 'Sconset, the Island's southern shore near Madaket, and Cliff

Beach along the north shore. A continuing trend of rising sea levels exacerbates coastal flooding hazards, and also increase problems created by inland flooding by diminishing the capacities of drainage infrastructure.

While erosion and other shoreline changes tend to affect a small number of structures slowly over time, the high-energy coastal waters make the highly-dynamic Nantucket coastline susceptible to relatively rapid erosion that threatens important transportation routes and other infrastructure. A particularly at-risk location for exposure to erosion and direct wave action is Millie's Bridge, the only connection between Smith Point and the rest of the Island. This bridge provides access to approximately 52 homes. The southern edge of the airport, at the end of runway 6-24, as well as both of the locations for the Town's wastewater treatment facilities, are also threatened by erosion.

The Town has historically mitigated coastal erosion and shoreline change through **beach and dune nourishment** projects, **bank stabilization** projects, **public education**, and passive owner-driven **retreat** of property from the shoreline. The Town is developing a Community and Coastal Resilience Plan following the guidelines of the State of Massachusetts and build upon information in this Hazard Mitigation Plan.

High Wind Events (Hurricanes, Tropical Storms, Nor'easters, Tornadoes)

The entire Town is at risk from high wind events, with Nor'easters posing the most frequent threat, followed by tropical storms. The location of Nantucket at the extreme southeast corner of the New England region, protruding into the Atlantic Ocean toward the north-northeast path taken by many tropical systems, places it in the potential path of many tropical storms and hurricanes. Tornadoes and other summer-storm-related high wind events are relatively rare on Nantucket.

Most of Nantucket is shrubby, with only 'Sconset and the Downtown particularly at risk to damage from high winds due to heavily treed landscapes and high residential densities. In the winter, high winds create a significant snow-drift problem, with a number of roads regularly experiencing snow depths that make them impassible, despite actions that have been taken in recent years to reduce the drifts.

Wind-hazard mitigation capabilities focus on **building code** enforcement and **public warning systems**.

Winter Storms

Aside from drifting snow, winter precipitation and cold-weather conditions can cause problems for Nantucket, many of which are similarly transportation-related. There is a high propensity for traffic accidents during heavy snow and even light icing events. Prolonged cold and wind can push ice into the harbor or freeze the harbor itself, cutting off access to the mainland.

Nantucket's winter storm mitigation capabilities include **flood and harbor damage prevention** programs, **snow and ice removal** procedures, and installation of **wind-breaks** along vulnerable roads.

Wildfire

Nantucket is at a higher risk of wildfire than other parts of Massachusetts because of its rural character, extensive wildland/urban interface areas, isolation from mutual aid assistance, and dry sandy soil. Areas at risk on the Island include Maddequet, Mid-Island, Quaise, Polpis, Wauwinet, Quidnet, and Tom Nevers. Many areas are not served by the public water supply and therefore do not benefit from fire suppression.

Wildfire mitigation capabilities include **mutual aid agreements** between the Fire Department, the airport, and land conservation and management groups. **Public education**, **prescribed burning**, and maintenance of **fire cuts** in forested area are also capabilities.

Earthquake

Nantucket is within the area of lowest risk for earthquakes in the State; the potential for a damaging earthquake to occur in Nantucket in any given year is low. The fact that wood construction is preferred to masonry further limits the Town's vulnerability.

Mitigation capabilities include enforcement of **building codes**, **public education**, and general preparation for **isolating** events

Loss Estimates

Loss estimates were calculated for each hazard type using a number of sources and tools. When applicable, these estimates were annualized. Non-annualized loss estimates include estimates from specific historical events or models of events of specific magnitudes; these losses are included in the plan but not in the annualized loss table below. Annualized loss estimates for all hazards are summarized in Table ES-1; each row presents estimates from a different set of data and taken as a whole present a range of potential annualized hazard costs. Annualized losses are estimated to be between \$700 and \$12,000 from inland flooding, \$16,000 and \$412,000 from coastal flooding, \$520 and \$10-million for hurricanes, \$200 and \$500 for summer storms, \$22,000 and \$75,000 for winter storms, \$2,000 and \$9,000 for wildfires, and \$41,000 for earthquakes. These wide ranges, along with the non-annualized loss estimates provided in the plan, are a first step towards considering the relative impacts of different hazards on the community and can help prioritize mitigation actions and contextualize mitigation costs. More detailed analysis would be required to perform a true benefit-cost analysis of specific mitigation actions.

Table ES-1: Annualized Loss Estimates for All Hazards

Source	Annualized Estimated Loss						
	Inland Flood	Coastal Flood	Hurricane	Summer Storms	Winter Storm	Wildfire	Earthquake
HAZUS-MH[1]	no annual	no annual	$10,026,000	-	-	-	-
PA & NFIP[2]	$11,597	$411,705	$521	-	$74,497	-	-
NCEI[3]	$714	$16,143	$7,857	$194	$21,905	-	-
State HMP[4]	-	-	-	-	-	$2,000	$40,802
Town Estimates[5]	-	-	-	$524	-	$8,699	-

Mitigation Strategies and Actions

Nantucket has an appropriate variety of formal and informal hazard mitigation capabilities. The Plan update identifies and assesses these existing capabilities and proposes new strategies that address identified gaps in current mitigation efforts. An updated list of mitigation strategies and actions that the Town will attempt to achieve over the next five years is also included. This list of actions was prioritized through a combination of municipal input and used of the "STAPLEE" method, as outlined in FEMA planning documents such as Developing the Mitigation Plan (FEMA 386-3) and Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic, and Environmental" criteria for making planning decisions. Each proposed mitigation strategy was evaluated according to each of the STAPLEE criteria and quantitatively assigned a score. The top-priority actions are listed in Table ES-2.

It is understood that not all mitigation actions may be able to be completed in the next five years depending on the ability to obtain grant funding, availability of local funding and staff time, and/or permission from pertinent property owners. Nantucket plans to conduct an annual Hazard Mitigation Plan maintenance process to review the status of proposed mitigation actions.

In addition to these top-priority actions, the Town plans to focus on the two actions *"Implement a project to map the near shore sand and sediment transport to develop a sand-budget model for monitoring island wide coastal erosion. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep. Mapping in high resolution monitors the movement of sand shoals and identifies location of marine habitat on the sea floor"* and

[1] HAZUS-MH is FEMA's loss estimation methodology software for flood, wind, and earthquake hazards.
[2] Public Assistance (PA) reimbursements and NFIP (National Flood Insurance Program) claim payments. Note that PA funding is only granted for public projects, while NFIP claims are only granted for private property; therefore, the two are considered as a single unit ("PA & NFIP").
[3] The National Centers for Environmental Information (NCEI) maintains a database of historic storm events across the country.
[4] The State Hazard Mitigation Plan includes loss estimates developed from a variety of sources.
[5] Additional estimates were developed through personal communication with municipal officials.

Table ES-2: Top Priority Mitigation Actions

Action Code	Strategy	Inland Flood	Coastal Flood	Hurricane	Summer Storm	Winter Storm	Wildfire	Earthquake
		Hazards Mitigated						
SC1	Complete the Community/Coastal Resilience Plan and Become an MVP Community	X	X	X	X	X	X	X
F10	Participate in a limited public-private partnership with Nantucket Engineering & Survey to complete a study of the Fulling Mill Brook watershed, in particular the hydrologic conditions at Polpis Road, to identify alternatives for improvements to this area.	X	X	X	X	X		
WF2	Complete mutual aid agreement with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.						X	
A5	Review the Nantucket Intermediate School and the Elementary School and determining their abilities to serve as emergency shelters.	X	X	X	X	X	X	X
A10	Conduct a targeted hazard vulnerability assessment of historic structures and offer technical assistance to property owners.	X	X	X	X	X	X	X
F6	Develop a comprehensive storm water management plan that addresses needs and priorities to reduce flooding and improve drainage. Include a funding model and possible revenue sources to sustain ongoing maintenance and capital improvements. The Plan should review policy and regulations that govern the discharge of water into the Town's ROW and those that have direct connection to the Town's storm drainage system. The rising sea level and water table is leading to more sump pumps discharging into the drains or on the roadway.	X	X	X	X	X		
F19	Relocate important hard-copies of Town records (including Finance Department records and Health Department records) to a new storage location outside of the SFHA (currently located on Washington Street)	X	X					
F25	Develop a protocol or formal Standard Operating Procedure for opening and closing of the tide gate at Children's Beach boat ramp. Work with local citizens to make sure they are aware of the protocol.		X					
WS1	Develop local capacity for housing emergency equipment and personnel in Madaket village during a storm, in case of isolation due to road closure.			X	X	X		

"Implement a project to map the harbor floors (Madaket, Polpis and Nantucket) to measure and monitor sediment transport. Information will be used to develop dredging and disposal plan, as well as the Harbor management Plan. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep." These two actions will help position the Town for improved erosion and sand management in relation to beach nourishment and other projects that may arise.

1 INTRODUCTION

1.1 Background and Purpose

Defined by FEMA, the term hazard means "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.[6]" In a simpler context, a hazard may be described as a condition with the potential for harm to the community or environment. In the context of disasters, hazard mitigation is commonly defined as any sustained action that reduces or eliminates long-term risk to people, property, and resources from hazards and their effects.

Examples of hazard mitigation actions include outreach programs that increase risk awareness, projects to protect critical facilities, and the removal of structures from flood hazard areas. Local mitigation actions and concepts can be incorporated into land use plans and building codes.

The primary purpose of a hazard mitigation plan (HMP) is to identify natural hazards and risks, existing capabilities, and activities that can be undertaken by a community to prevent loss of life and reduce property damages associated with the identified hazards. In addition to natural hazards, the Town has considered selected technological hazards and human-caused threats to the community in the plan. Technological hazards result from accidents or the failure of systems and structures, such as hazardous materials spills or pollution of the water supply. Public safety and property loss reduction have been the traditional driving forces behind this plan. However, careful consideration also must be given to the preservation of history, culture and the natural environment of the region. The plan is relevant not only in emergency management situations, but also should be used within the community's land use, environmental, and capital improvement frameworks.

The 2018 HMP presents hazard mitigation actions and priorities that will be considered and addressed in the following five years (2019 to 2023); the plan will be updated on a regular basis.

The Nantucket Planning & Land Use Services Office (PLUS), with assistance from the Nantucket Emergency Management Agency, will administer this HMP under the authority of the Board of Selectman. Holly Backus, Land Use Specialist at PLUS, will be the Local Coordinator of the Hazard Mitigation Plan, and the Chief of Police and Emergency Management Director (a single position) will be the Deputy Local Coordinator. PLUS will coordinate with responsible departments and ensure that the recommendations of this HMP are considered or enacted.

[6] FEMA, Multi Hazard Identification and Risk Assessment, 1997, p. xxi

The Disaster Mitigation Act

The Disaster Mitigation Act of 2000 (DMA), commonly known as the 2000 Stafford Act amendments, was approved by Congress and signed into law in October 2000, creating Public Law 106-390. The purpose of the DMA is to establish a national program for pre-disaster mitigation and streamline administration of disaster relief.

The DMA requires local communities to have a Federal Emergency Management Agency (FEMA)-approved mitigation plan in order to be eligible to receive post-disaster Hazard Mitigation Assistance (HMA).

The HMA "umbrella" contains three competitive grant programs deigned to mitigate the impacts of natural hazards: the Pre-Disaster Mitigation (PDM) grant program, the Hazard Mitigation Grant Program (HMGP) for post-disaster mitigation activities, and the Flood Management Assistance (FMA). *Note that HMA programs are funded at the discretion of Congress.* These programs are briefly described below.

Pre-Disaster Mitigation (PDM) Program

The PDM program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through pre-disaster mitigation planning and the implementation of feasible, effective, and cost-efficient mitigation measures.

Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. PDM funds should be used primarily to support mitigation activities that address natural hazards. In addition to providing a vehicle for funding, the PDM program provides an opportunity to raise risk awareness within communities.

Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration.

The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.

Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). FEMA provides FMA funds to assist States and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP.

The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. Three types of grants are available under FMA. These are Planning, Project, and Technical Assistance grants.

Changes Since 2007

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss (two or more NFIP claims of more than $1,000) and severe repetitive loss properties have been modified
- Cost-share requirements have changed to allow more Federal funds for properties with repetitive flood claims and severe repetitive loss properties; and
- There is no longer a limit on in-kind contributions for the non-Federal cost share.

Effective August 15, 2013, acquisitions and elevations will be considered cost-effective if the project costs are less than $276,000 and $175,000, respectively. Structures must be located in Special Flood Hazard Areas (the area of the 1-percent-annual-chance flood). The benefit-cost analysis (BCA) will not be required.

The NFIP provides the funding for the FMA program. The PDM and FMA programs are subject to the availability of appropriation funding, as well as any program-specific directive or restriction made with respect to such funds.

One important change to the PDM, HMGP, and FMA programs since the adoption of the initial Nantucket Hazard Mitigation Plan is that "green open space and riparian area benefits can now be included in the project benefit cost ratio (BCR) once the project BCR reaches 0.75 or greater." The inclusion of environmental benefits in the project BCR is limited to acquisition-related activities.

Table 1-1 presents potential mitigation project and planning activities allowed under each FEMA grant program described above as outlined in the most recent HMA Unified Guidance document. Many of the strategies and actions developed in this plan fall within the above list of eligible activities.

Table 1-1: Eligible Mitigation Project Activities by Program

Eligible Activities	HMGP	PDM	FMA
1. Mitigation Projects	✓	✓	✓
Property Acquisition and Structure Demolition	✓	✓	✓
Property Acquisition and Structure Relocation	✓	✓	✓
Structure Elevation	✓	✓	✓
Mitigation Reconstruction	✓	✓	✓
Dry Floodproofing of Historic Residential Structures	✓	✓	✓
Dry Floodproofing of Non-residential Structures	✓	✓	✓
Generators	✓	✓	
Localized Flood Risk Reduction Projects	✓	✓	✓
Non-localized Flood Risk Reduction Projects	✓	✓	
Structural Retrofitting of Existing Buildings	✓	✓	✓
Non-structural Retrofitting of Existing Buildings and Facilities	✓	✓	✓
Safe Room Construction	✓	✓	
Wind Retrofit for One- and Two-Family Residences	✓	✓	
Infrastructure Retrofit	✓	✓	✓
Soil Stabilization	✓	✓	✓
Wildfire Mitigation	✓	✓	
Post-Disaster Code Enforcement	✓		
Advance Assistance	✓		
5 Percent Initiative Projects	✓		
Aquifer and Storage Recovery**	✓	✓	✓
Flood Diversion and Storage**	✓	✓	✓
Floodplain and Stream Restoration**	✓	✓	✓
Green Infrastructure**	✓	✓	✓
Miscellaneous/Other**	✓	✓	✓
2. Hazard Mitigation Planning	✓	✓	✓
Planning Related Activities	✓		
3. Technical Assistance			✓
4. Management Cost	✓	✓	✓

Source: Table 3 – HMA Unified Guidance document, February 27, 2015

*** indicates that any proposed action will be evaluated on its own merit against program requirements. Eligible projects will be approved provided funding is available.*

1.2 Hazard Mitigation Vision, Goals, and Objectives

To frame the development and implementation of this Hazard Mitigation Plan ("Plan" or "HMP"), municipal officials identified a Vision, a set of Goals, and a suite of supporting Objectives, for the Plan.

Vision:

To mitigate the detrimental impacts of natural hazards to Nantucket while maintaining and enhancing the Island's quality of life, historic essence, aesthetic beauty, and natural and habitat resources.

Goals:

- ❑ **Reduce** the loss of or damage to life and property caused by natural disasters.
- ❑ **Protect** Town infrastructure, and natural, cultural, historic and economic resources from natural disasters.
- ❑ **Maintain** the Island's emergency response capabilities.
- ❑ **Reduce** public and private natural disaster damage and insurance **costs**.
- ❑ **Reduce** the **social**, **emotional**, and **economic** disruption associated with a natural disaster.

Objectives:

Development, adoption, and implementation of this hazard mitigation plan will:

- ❑ **Increase access to and awareness of funding sources for hazard mitigation projects.** Certain funding sources, such as the PDM and the HMGP, may be available if the hazard mitigation plan is in place and approved.
- ❑ **Identify mitigation initiatives to be implemented if and when funding becomes available.** This HMP will identify a number of mitigation recommendations, which can then be prioritized and acted upon as funding allows.
- ❑ **Connect hazard mitigation planning to other community planning efforts.** This HMP can be used to guide community development through inter-departmental coordination.
- ❑ **Improve the mechanisms for pre- and post-disaster decision making efforts.** This plan emphasizes actions that can be taken now to reduce or prevent future disaster damages. If the actions identified in this plan are implemented, damage from future hazard events can be minimized, thereby easing recovery and reducing the cost of repairs and reconstruction.
- ❑ **Improve the ability to implement post-disaster recovery projects** through development of a list of mitigation alternatives ready to be implemented.
- ❑ **Enhance and preserve natural resource systems.** Natural resources, such as wetlands and coastal floodplains, provide protection against disasters such as floods and hurricanes. Proper planning for and protection of natural resources can provide hazard mitigation at substantially reduced costs.
- ❑ **Inform protection of historic resources.** Historic resources present unique challenges with regards to protection and recovery from natural hazard events.

- **Inform efforts to build community and social resilience.** As Nantucket faces an uncertain future, this Plan will help guide development of systems allowing the community to resist, absorb, recover from, and adapt to, natural disasters and changing baselines.
- **Support efforts to build economic resilience.** Nantucket is a small island with an economy driven primarily by tourism. This plan will help identify and prioritize locations for action that are fundamental to sustain the local economy, tourism and tax base.
- **Educate residents and policy makers about natural hazard risk and vulnerability.** Education is an important tool to ensure that people make informed decisions that complement Nantucket's ability to implement and maintain mitigation strategies.
- **Complement future Community Rating System efforts.** Implementation of certain mitigation measures may increase a community's rating, and thus the benefits that it derives from FEMA.

In addition to the general objectives listed above, Town personnel have highlighted a number of specific concerns and interests to be listed as priorities in this Plan. These are as follows:

- **Access to the Mainland:** freight and vehicular traffic, as well as nearly all individual travel, between the island and the mainland occurs via ferries that must travel through a relatively narrow channel around Brant Point, and that dock at one of two wharfs downtown. The incapacitation of this mode of transportation by a natural disaster, through damage to the wharfs or blockage of the channel, would present a major obstacle to response and recovery operations. Ensuring continued access to the mainland following hazard event is a high priority for Nantucket
- **Isolation Within the Island:** Many roads on Nantucket are threatened by erosion or inundation, and the inability to travel along some of those roads would lead to isolation of certain neighborhoods during or following hazard events.
- **Historic Resources:** As noted previously, Historic resources present unique challenges with regards to hazard mitigation due in part to the impacts that many mitigation actions would have on their historic characters. The entire island of Nantucket is listed as a National Historic Landmark, and both the downtown area and the ‘Sconset neighborhoods are locally-designated historic districts. Both districts are essential parts of the Town’s economy and culture, and both are highly vulnerable to natural disasters, especially flooding and erosion.
- **Power Supply Resiliency:** Most of Nantucket’s electric power is sourced from the mainland through underwater cables. As part of ongoing climate adaptation and resiliency efforts, the Town is pursuing and implementing a range of initiatives aimed at increasing the Island’s capacity to generate and store electricity on-island using renewable energy technologies. These efforts will mitigate potential impacts of natural disasters on the Town’s electric grid by providing emergency power generation, local power storage on batteries, and localized power distribution through microgrids.

- **Water Supply Resiliency**: The Town operates the Wannacomet Water Company that supplies drinking water to the public. Water is pumped from three different groundwater wells located in Nantucket's Sole Source Aquifer from two different levels at locations in mid-island. On the eastern end of the island, the Siasconset Water Department (operated by Wannacomet Water Company) draws water from a sole source aquifer using two well systems in the Siasconset area. The water company uses resilience planning to address vulnerabilities such as having standby generators installed and used when there is a loss of electric power supply. Additional resiliency measures are being planned to protect the aquifer and well head locations from contamination due to a hazardous material spill and pollution.
- **Climate Change:** As an island community, Nantucket recognizes the present and future effects that climate change will have on the Town. An important priority that will be brought into mitigation of many natural hazards will be addressing these impacts, including sea level rise and the increased severity and frequency of coastal flooding, erosion, high wind events, precipitation events, and droughts.
- **Evaluation of the Storm Water Pump System:** In 2009 the Town made improvements to the Children's Beach storm water system draining the Brant Point watershed including the installation of a tide gate and pump system to reduce the duration and frequency of street flooding. Operational and performance issues were recorded with the pump system later that year and enhancements were made in 2011. Additional problems have plagued the system in 2017 and 2018 including two pump failures and complete loss of pumping capability during flooding events in early 2018. During seasonal high tide events, water was observed backflowing through the system and into the streets, questioning the effectiveness of the tide gate and check valves. In June 2018, DPW hired an engineering firm to review this system and provide recommendations for improvements.
- **Children's Beach Boat Ramp:** provides popular access to the Harbor and a manually positioned flood gate that can be closed to reduce tidal flooding of the Brant Point area. Closure of the gate is performed by DPW and coordinated with the Harbor Master to ensure sufficient opportunity for owners/captains to remove their boats from the water. During several storm events in the winter of 2018, the gate was closed and reinforced following the standard practice; however, on several occasions private individuals have opened the gate during a storm's low tide to more rapidly drain the area and have not returned to close the gate before the next high tide cycle. The 2018 winter storms spanned several tide cycles, and these behaviors led to flooding of the area, exacerbated by not having the pump station fully operational. An improved protocol or formal Standard Operating Procedure should be considered for opening and closing of the tide gate at Children's Beach boat ramp.
- **Roadbed Construction Material for Emergency Use:** The rapid succession of 2018 winter storms depleted all on-island rip-rap and gravel needed to reopen a key section of roadway. Post-storm material transport was hampered by continued rough seas. In addition to what is generally available from local contractors, The Town may consider having selected types

and quantities of construction materials stored at the DPW yard and reserved for emergency use.

- **Sanitary Sewer Collection System:** The Town of Nantucket is required by an Order for Compliance on Consent, Docket No. CW A-AO-R01-FY17-02, the United States Environmental Protection Agency (USEPA) Region 1 versus the Town of Nantucket, MA, to complete a Capacity, Management, Operation and Maintenance (CMOM) Program for its Sanitary Sewer Collection System for the Town Sewer District and Siasconset Sewer District. The CMOM Program is intended to help the Town be proactive versus reactive to operation and maintenance of its sewer systems, and thus prevent costly repairs and potential violations to the Clean Water Act. The CMOM program will be a tool for the Town for budgeting future Capital Improvement Projects.

1.3 Identification of Hazards and Document Overview

As stated in Section 1.1, the term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. The following have been identified as natural hazard events that can affect the Town of Nantucket:

- Inland Flooding
- Coastal Flooding
- Hurricanes and Tropical Storms including High Wind Events
- Sea Level Rise, Shoreline Change, and Erosion
- Summer Storms and Tornadoes
- Winter Storms
- Wildfires
- Earthquakes

The hazards profiled in the Massachusetts 2013 State Hazard Mitigation Plan but not addressed in the Nantucket Hazard Mitigation Plan Update are drought, extreme temperatures, and tsunamis. These natural hazards are the lowest-ranked of those discussed in the state's plan, as shown in table 5-1 from that document. Drought is found to have a low frequency with a likely severity level of "minor" statewide. Extreme temperatures are found to have a medium frequency with a minor likely severity level. Tsunamis are found to have a very low frequency with an extensive likely severity. Furthermore, no annual estimated losses are provided for drought, extreme temperatures, or tsunamis in the 2013 state plan, underscoring their low ranks. As such, their inclusion was considered not necessary in the Nantucket Hazard Mitigation Plan Update.

This document has been prepared with the understanding that a single *hazard effect* may be caused by multiple *hazard events*. For example, flooding may occur as a result of frequent heavy rains, a hurricane, or a winter storm. Table 1-2 relates natural hazard effects to their causes.

Table 1-2: Effects of Natural Hazards

Natural Hazard	Causes: Hurricanes & Tropical Storms	Sea Level Rise & Shoreline Change	Summer Storms & Tornadoes	Winter Storms	Wildfires	Earthquakes	Dam Failure
Inland Flooding	X		X				X
Flooding from Poor Drainage	X	X	X				
Coastal Flooding	X	X		X			
Storm Surge	X			X			
Coastal Erosion	X	X		X			
Wind	X		X	X			
Falling Trees/Branches	X		X	X			
Lightning	X		X				
Hail			X				
Snow				X			
Blizzard				X			
Ice				X			
Fire/Heat					X		
Smoke					X		
Shaking						X	
Dam Failure						X	X
Power Failure	X		X	X	X	X	

Table 1-3 and Table 1-4 rank the hazard events and hazard effects that impact Nantucket based on size of the area impacted by the hazard, the frequency of occurrence of the hazard, and the magnitude or severity of the hazard. The analysis performed to determine this ranking took into account historic trends and damages (from the NOAA NCEI database) and hazard zone maps.

Table 1-3: Hazard Event Ranking

Natural Hazard Event	Location 1 = small 2 = medium 3 = large	Frequency of Occurrence 0 = unlikely 1 = possible 2 = likely 3 = highly likely	Magnitude/ Severity 1 = limited 2 = significant 3 = critical 4 = catastrophic	Rank
Winter Storms	3	3	3	9
Hurricanes & Tropical Storms	3	1	4	8
Sea Level Rise & Shoreline Change	2	3	2	7
Coastal Flooding	2	3	2	7
Summer Storms and Tornadoes	2	3	2	7
Earthquakes	3	0	2	5
Wildfires	1	2	1	4
Inland Flooding	1	1	1	3

Location

1 = small	isolated to specific area during one event
2 = medium	multiple areas during one event
3 = large	significant portion of the town during one event

Frequency of Occurrence

0 = unlikely	less than 1% probability in the next 100 years
1 = possible	between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely	between 10 and 100% probability in the next year; or at least on chance in next 10 years
3 = highly likely	near 100% probability in the next year

Magnitude / Severity

1 = limited	injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant	injuries and / or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical	injuries and / or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA NCEI

Table 1-4: Hazard Effect Ranking

Some effects may have a common cause; for example, a hurricane causes high winds, inland flooding, and a storm surge. Some effects may have similar causes; for example, hurricanes and nor'easters both cause storm surges.

Natural Hazard Effect	Location	Frequency of Occurrence	Magnitude/ Severity	Rank
	1 = small 2 = medium 3 = large	0 = unlikely 1 = possible 2 = likely 3 = highly likely	1 = limited 2 = significant 3 = critical 4 = catastrophic	
Nor'easter Winds	3	3	2	8
Snow	3	3	2	8
Blizzard	3	3	2	8
Hurricane Winds	3	1	3	7
Ice	3	2	2	7
Nor'easter Storm Surge	2	3	2	7
Coastal Flooding	2	2	2	6
Coastal Erosion	2	3	1	6
Thunderstorm & Tornado Winds	2	2	2	6
Shaking	3	0	2	5
Hurricane Storm Surge	2	1	2	5
Flooding from Poor Drainage	1	3	1	5
Lightning	1	3	1	5
Inland Flooding	1	2	1	4
Falling Trees/Branches	1	2	1	4
Hail	1	2	1	4
Fire/Heat	1	2	1	4
Smoke	1	2	1	4

<u>**Location**</u>

1 = small	isolated to specific area during one event
2 = medium	multiple areas during one event
3 = large	significant portion of the town during one event

<u>**Frequency of Occurrence**</u>

0 = unlikely	less than 1% probability in the next 100 years
1 = possible	between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely	between 10 and 100% probability in the next year; or at least on chance in next 10 years
3 = highly likely	near 100% probability in the next year

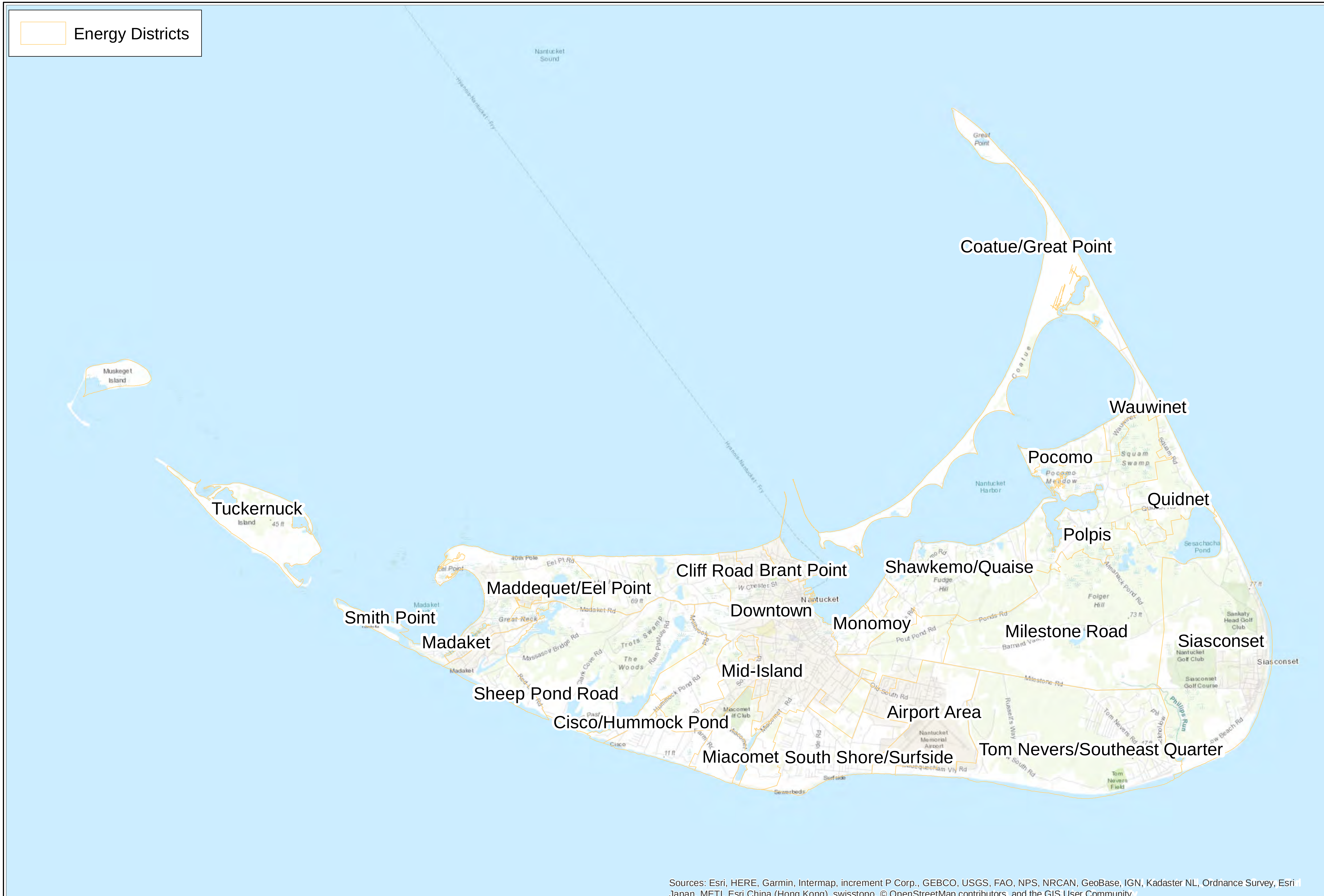
<u>**Magnitude / Severity**</u>

1 = limited	injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant	injuries and / or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical	injuries and / or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA NCEI

Table 1-5: Geography of Hazard Effects

Neighborhoods & Areas	Total Population	Relative Property Values	Inland Flooding	Poor Drainage Flooding	Coastal Flooding	Storm Surge	Coastal Erosion	Wind	Falling Trees/Branches	Lightning	Hail	Snow	Blizzard	Ice	Wildfire Heat	Wildfire Smoke	Shaking
Central Nantucket																	
Downtown	High	High		X	X	X		X	X	X	X	X	X	X			X
Brant Point	High	High		X	X	X		X		X	X	X	X	X			X
Cliff Road Area	Moderate	High					X	X		X	X	X	X	X	X	X	X
Mid-Island	High	Moderate	X	X				X	X	X	X	X	X	X	X	X	X
Monomoy	Moderate	High				X		X		X	X	X	X	X			X
Airport/Old South Road	Moderate	Moderate		X				X		X	X	X	X	X	X	X	X
Surfside/South Shore	High	Moderate			X	X	X	X		X	X	X	X	X			X
Miacomet	Moderate	Moderate			X	X	X	X		X	X	X	X	X			X
Cisco/Hummock Pond	Moderate	Moderate			X	X	X	X		X	X	X	X	X			X
Northeast Nantucket																	
Polpis	Low	High			X	X		X		X	X	X	X	X	X	X	X
Pocomo	Low	Moderate				X	X	X		X	X	X	X	X	X	X	X
Shawkemo/Quaise	Low	Moderate				X	X	X		X	X	X	X	X	X	X	X
Wauwinet	Low	Low				X	X	X		X	X	X	X	X	X	X	X
Coatue	Low	Low				X	X	X		X	X	X	X	X			X
Great Point	Low	Low				X	X	X		X	X	X	X	X			X
Quidnet	Low	High				X	X	X		X	X	X	X	X	X	X	X
Southeast Nantucket																	
Milestone Road	Low	Low	X					X		X	X	X	X	X			X
Siasconset	High	High			X	X	X	X	X	X	X	X	X	X			X
Tom Nevers/Southeast Quarter	High	High	X			X	X	X		X	X	X	X	X	X	X	X
Western Nantucket																	
Madaket	High	High	X		X	X	X	X		X	X	X	X	X			X
Sheep Pond Rd	Low	High				X	X	X		X	X	X	X	X	X		X
Smith Point	Moderate	Moderate			X	X	X	X		X	X	X	X	X			X
Maddequet/Eel Point	Moderate	Moderate	X					X		X	X	X	X	X	X		X
Tuckernuck	Low	Moderate			X	X	X	X		X	X	X	X	X	X	X	X
Muskeget	Low	Low			X	X	X	X		X	X	X	X	X	X		X



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SOURCE(S): Town of Nantucket

LOCALITIES AND NEIGHBORHOODS

TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN

NANTUCKET, MASSACHUSETTS

Map By: NBS
MMI#: 2967-09
MXD: U:\Y\2967-09\Maps\Fig1_1LocationsNeighborhoods.mxd
1st Version: 08/28/2017
Revision: 11/06/2018
Scale: 1 in = 6,928 ft

FIGURE 1-1

To identify current vulnerabilities and potential mitigation strategies associated with hazard events, each hazard event has been individually discussed in a separate chapter. The exception is flooding. The hazard effects of coastal and non-coastal flooding have been addressed individually in two separate chapters prior to the chapters dedicated to discussing their causes.

After the introductory chapter, this document continues with a general discussion of the Town of Nantucket's community profile, including the physical setting, demographics, development trends, governmental structure, and sheltering capacity. Next, each chapter of this Plan pertaining to a natural hazard is broken down into six or seven different parts. These are *Setting*; *Hazard Assessment*; *Historic Record*; *Existing Capabilities*; *Vulnerabilities and Risk Assessment*; *Mitigation Strategies and Action*; and *Recommended Actions*. These are described below.

- ***Setting*** identifies the general areas of Nantucket that are at risk from the hazard.
- ***Hazard Assessment*** describes the specifics of a given hazard, including characteristics and associated effects. Associated return intervals, probability and risk, and relative magnitude are also discussed.
- ***Historic Record*** is a discussion of past occurrences of the hazard, and associated damages.
- ***Existing Capabilities*** gives an overview of the measures that the Town is currently undertaking to mitigate the given hazard. These may take the form of ordinances and codes, structural measures such as seawalls and jetties, or public outreach initiatives.
- ***Vulnerabilities and Risk Assessment*** focuses on the specific areas at risk to the hazard. Specific land uses in the given areas are identified. Critical buildings and infrastructure that would be affected by the hazard are also identified.
- ***Mitigation Strategies and Actions*** identifies mitigation alternatives.
- ***Recommended Actions*** is a list of the recommended mitigation measures that would be beneficial to protect against a given hazard, based on social, technical, administrative, political, legal, economic, and environmental factors (i.e. the "STAPLEE" method).

This document concludes with a strategy for implementation of the Hazard Management Plan, including a schedule, a program for monitoring and updating the plan, and a discussion of technical and financial resources.

1.4 Documentation of the Planning Process

Holly Backus of the Planning & Land Use Services (PLUS) Department coordinated the development of this Hazard Mitigation Plan Update. The following individuals were also involved with the update:

- Chief William Pittman - Police Department (Emergency Management Director)
- Sergeant Brendan Coakley - Police Department (Emergency Management Coordinator)
- Chuck Larson - Manager of Strategic Projects
- Dave Fronzuto - Emergency Management Coordinator (Retired)
- David Gray Sr. - Director, Sewer Department
- Diane O'Neil - Nantucket Public Schools

- Elizabeth Gibson - Town Manager
- Jeff Carlson - Natural Resources Coordinator
- Lauren Sinatra - Energy Coordinator
- Martha Lake-Greenfield - Nantucket Cottage Hospital
- Michael Burns, AICP - Transportation Planner / Planning
- Michael Cozort - Nantucket Public Schools
- Nathan Porter - GIS Coordinator
- Rob McNeil - Director, Public Works Department
- Roberto Santamaria - Health Director, Health Department
- Stephen Murphy - Chief, Fire Department

During the development of the initial HMP adopted in 2007, representatives from the Building Department, the Marine Resources Department, the Wannacomet Water Company, and Nantucket Airport were also involved.

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the Town of Nantucket, as well as to identify areas that should be prioritized for hazard mitigation. The following is a list of meetings that were held or attended to develop this Hazard Mitigation Plan Update:

- ***A project initiation meeting was held September 18, 2017.*** This meeting addressed the scope of services necessary to develop this HMP. Significant input was provided by the project team about the HMP update, including changes to the Towns capabilities and vulnerabilities with respect to each of the hazards covered by the HMP. Actions to include moving forward were also discussed.

- **A public meeting was held on October 23, 2017 at 6 pm.** All residents of the Island were invited to attend. The meeting discussed the basics of hazard mitigation planning and the purpose and process for developing local plans. Residents were invited to share their specific concerns and recommendations.

- **A public meeting geared toward stakeholders was held on November 27, 2017 at 6 pm.** This meeting was advertised to stakeholders with whom relationships had been formed during development of the previous HMP, such as:
    - Chamber of Commerce
    - Civic League
    - Sustainable Nantucket
    - Nantucket Conservation Foundation
    - Nantucket Land Council
    - Trustees of Reservation
    - The ‘Sconset Trust
    - Nantucket Preservation Trust
    - ‘Sconset Beach Preservation Fund

- Rotary Club
- UMass Field Station
- Nantucket Land Bank

- ❑ ***Interviews*** with Town staff and other attendees of the initiation meeting were held by phone between December 4 and December 12, 2017. Participants were asked to give input on hazard mitigation based on their specific areas of expertise, and from the perspectives of their specific roles. Individuals interviewed were:
  - Chamber of Commerce
  - Diane O'Neil
  - Jeff Carlson
  - Steve Murphy
  - Nathan Porter
  - Robert McNeil
  - Chuck Larson
  - Holly Backus
  - Lauren Sinatra
  - William Pittman
  - Brendan Coakley
  - Martha Lake-Greenfield
  - Libby Gibson (Town Manager)
  - Gregg Tivnan (Assistant Town Manager)
  - Brian Turbitt (Director of Municipal Finance)
- ❑ Results of this survey are discussed below.
- ❑ ***Updates to this Hazard Mitigation Plan were made after recovery of the Winter 2018 storm events, using experience gained by staff and lessons learned.***

Appendix B contains copies of meeting minutes and other records that document the development of this Hazard Mitigation Plan. Appendix C contains results of the online survey; these are also summarized below.

<u>Online Survey</u>

A public survey was posted online through the website www.surveymonkey.com. The primary goal of the survey was to educate local officials of the general public awareness regarding natural hazards, with the secondary goal being to collect information that may lead to potential mitigation strategies. The survey was posted from October 20 through December 15, 2017. The survey was advertised on the Nantucket town website, the local newspaper “The Inquirer and Mirror,” website (www.ack.net) Public (www.publicnow.com), and on the Nantucket Coastal Conservancy Facebook page.

The responses provide an indication of the public perception regarding the level of risk, awareness of natural hazard mitigation planning, and emergency response on Nantucket. Some write-in responses deemed relevant to this plan are included in this summary.

Respondent Information

A total of 113 responses were collected, with respondents mostly concentrated in the Madaket, Mid-island, and Surfside areas (see Figure 1-2, to the right). Individual neighborhoods were represented as shown in Figure 1-3; note that many survey respondents work in Madaket and Downtown. A majority of respondents have lived on Nantucket (or maintained a seasonal residence on Nantucket) for more than 10 years; see Table 1-6, below.

Figure 1-2: Residences of Survey Respondents

Table 1-6: For how long have you lived or worked on Nantucket?

Years	# Responding
Less than 1	3
1-2	0
2-5	14
5-10	13
10-30	39
> 30	41

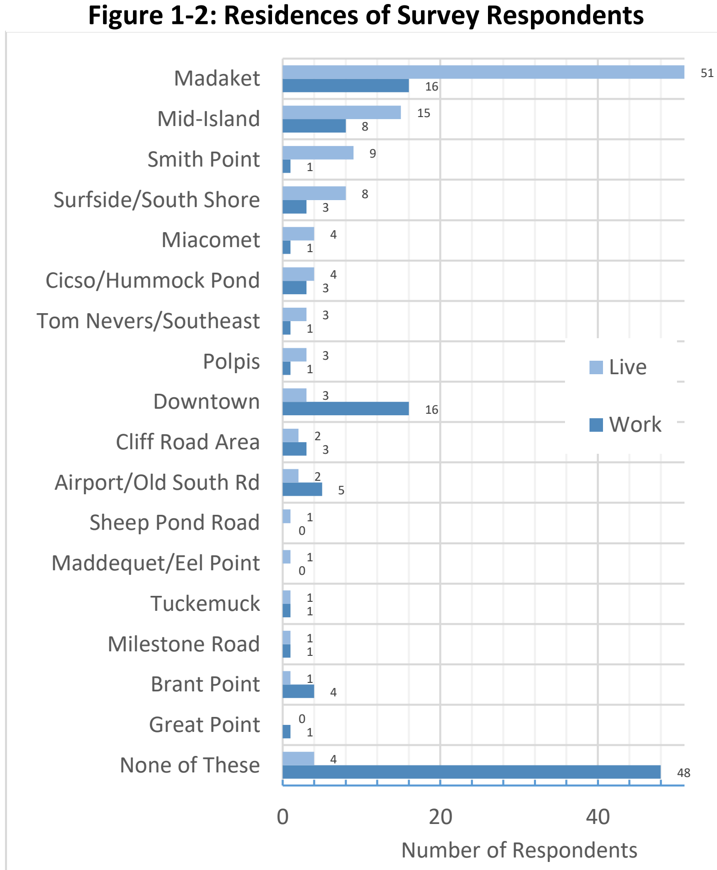


Figure 1-3: Home & Work Locations of Respondents

Awareness

Only 44 respondents (39%) were aware that Nantucket maintains an HMP.

Participants were asked which recent events, if any, have generated awareness of natural hazards. Table 1-7 summarizes the responses. The majority of respondents reported that Tropical Storm Jose in September of 2017 raised their awareness.

Table 1-7: Contributors to Awareness of Natural Hazards

Events	Number Selecting
Tropical Storm Jose in September 2017	64
Winter Storm of February 2016	52
Winter Storms of February 2013 and January 2015	56
"Superstorm" Sandy in October 2012	47

Many respondents noted other events or trends that had raised their awareness; these write-in responses included:

- A wind and rain storm from October 30 to November 1, 2017 (4 responses)
- Awareness of climate change and sea level rise (4 responses)
- The Perfect Storm or Unnamed Storm of 1991 (4 responses)
- Awareness of Erosion, including through Inquirer & Mirror coverage (3 responses)
- Hurricane Bob in 1991 (3 responses)
- The ongoing California wildfires in November and December of 2017
- Snow events of February 2014
- History of wildfires on Nantucket
- Rising groundwater table in the Cisco area causing home flooding every 3-4 years
- Hurricane Katrina in 2005
- Have been aware of Natural Hazards for a long time (2 responses)

Note that the responses above have been edited for clarity and are not verbatim.

The next question asked responders to rate hazards on a scale of 1 (low threat) to 3 (high threat), indicating the level of perceived threat or concern each presents to their homes or to the functions of their businesses. Responses are presented in Table 1-8.

Table 1-8: Perception of Hazard Threat Level

Hazard	Threat level (Number Selecting)			Average Rating
	Low (1)	***Moderate (2)***	***High (3)***	
Hurricanes and Tropical Storms	2	27	64	2.67
Other High Wind	4	39	49	2.49
Winter Storms (including snow or ice) and Blizzards	12	47	34	2.24
Sea Level Rise	23	25	42	2.21
Flooding from the Coast	27	22	41	2.16
Erosion (coastal)	33	7	47	2.16
Direct Damage from Wave Action (coastal)	41	12	32	1.89
Flash Flooding / Flooding due to Poor Drainage	38	35	16	1.75
Severe Thunderstorms (including hail, lightning, or downbursts)	36	42	13	1.75
Wildfires and Brush Fires	52	27	10	1.53
Tornadoes	64	12	4	1.25
Earthquakes	77	5	3	1.13

The hazards with the highest perceived threat for the majority of respondents include hurricanes and tropical storms, other high wind events, winter storms, sea level rise, and coastal flooding. 47 respondents felt erosion posed a high threat, and 33 felt it posed a low threat; only 7 classified the threat from erosion as moderate, indicating that those for whom erosion is at all a concern feel that it is a high concern.

Respondents wrote-in additional or more specific hazards of concern, including:

- Groundwater pollution
- Urban interface [possibly referring to the urban-wildland interface that is correlated to wildfire occurrence]
- Ocean breaching beach and flooding Hither Creek opposite Millie's bridge
- Catastrophic events, such as tsunamis

The follow-up question asked which hazards have affected the participant's selves or businesses. Table 1-9 summarizes these results.

Table 1-9: Hazards that Have Impacted Respondents

Hazard	Number Selecting
Other High Wind	49
Winter Storms and Blizzards	44
Hurricanes and Tropical Storms	37
Erosion	28
Flooding from the Coast	26
None; I have not been impacted	22
Sea Level Rise	20
Flash Flooding / Flooding due to Poor Drainage	19
Direct Damage from Wave Action (coastal)	19
Severe Thunderstorms	10
Wildfires	3
Tornadoes	0
Earthquakes	0

Many respondents reported being affected by high winds from tropical and other storms. Winter storms have also impacted many respondents. One respondent noted that extreme heat and humidity has also had an effect.

68 participants entered answers when asked if any specific areas of Nantucket were vulnerable to any of the above hazards. Their responses are summarized in the table below.

Table 1-10: Specific Areas Vulnerable to Hazards

Location	Number of Mentions
Smith Point	17
Ames Ave & Madaket Rd	16
Millie's Bridge	16
Madaket South Shore	14
Hither Creek	9
Easy St	6
Madaket	6
North Cambridge St	6
Downtown	5
Maine Ave & New Jersey Ave	5
Ames Ave	4
Ferry Terminals	4
'Sconset	4
Sheep Pond Rd	4
Brant Point	3
Broad St & Easy St	3
Coskata-Coatue	3
Friendship Lane	3
Long Pond	3
Tom Nevers	3

Location	Number of Mentions
Washington St	3
Baxter Rd	2
California Ave	2
Madaket Marine	2
Main St	2
North Cambridge St Culvert	2
Starbuck Rd	2
32 Madaket Rd	1
Airport	1
Broad St & South Water St	1
Chicago Beach Rd	1
Cisco	1
Consue Springs	1
transmission towers at Stop & Shop	1
Jetties	1
Madaket Rd	1
Milestone Rd	1
Open Space Along Milestone Rd	1
Red Barn Rd Beach	1
Tuckernuck Coast	1
Polpis Rd	1
Raceway Drive & Somerset Rd	1
Orkorwaw Ave	1
Sea St Pumping Station	1
Sewer Plant	1
Easton & Beach St	1
Wauwinet	1
Chuck Hollow	1
Tristram's Beach	1
Winter St	1

Responders were asked about their thoughts on flood insurance, specifically with regards to increasing insurance premiums. The results are presented in Table 1-11.

Table 1-11: Opinions about Flood Insurance

Statement	Number Selecting
I do not have flood insurance & have no opinions about it	36
I currently have flood insurance & am not concerned about changes in the premiums	8
I currently have flood insurance & will be looking for ways to reduce my premiums	16
I would be supportive of looking for ways to reduce the cost of flood insurance policies for all policyholders	44

A number of interesting comments were made about this question:

- **Potential Misunderstanding:** one resident explained that they don't have flood insurance because they are not in a flood zone; similarly, another respondent claimed that they *cannot* buy flood insurance. *Flood insurance is available to every property owner, even if they are not in a 1% annual-chance flood zone.*
- **Apparent Lack of Support:** eight respondents expressed dissatisfaction with the relative *low* cost of flood insurance, and their perception that it encourages building and rebuilding in flood prone areas, and costs other taxpayers money.
- **Apparent Lack of Trust:** two respondents expressed distrust in the NFIP; one described FEMA declining payment after a loss they suffered, and the other was concerned that FEMA budget problems would make money unavailable after a disaster.

Survey-takers were also asked about their thoughts about planning for climate change and sea level change. Most responders (71) believed that it was appropriate to plan for sea level rise to accelerate, with more than one foot of rise experienced by 2100. Furthermore, most responders (65) believed that it is appropriate to plan for storm events to become more severe and more frequent in the future.

Table 1-12: Planning for Sea Level Change

Statement "It is appropriate to plan for sea level rise to…"	Number Selecting
Continue at the current rate, with less than a foot of rise by 2100	23
Accelerate, with more than one foot of rise by 2100	41
Accelerate dramatically, with several feet of rise by 2100	30

Table 1-13: Planning for Changing Storm Patterns

Statement "It is appropriate to plan for storm events to…"	Number Selecting
Occur more frequently	9
Become more severe	5
Become more severe and more frequent	65
Occur at a similar frequency and severity as in the past	13

Mitigation

The survey asked residents whether they were aware of any activities that had been performed by the Town of Nantucket to prepare for disasters. Table 1-14 summarizes the results.

Table 1-14: Mitigation Actions Performed by Nantucket

Statement	Number Selecting
Conducted drainage and flood control projects	31
Improved warning and response systems	31
Conducted erosion control projects	29
Provided outreach and education to help residents, businesses, and organizations	26
Conducted wildfire control and prevention projects	22
Enacted regulations, codes, and ordinances designed to protect from natural hazards	18
Hardened and improved utility infrastructure	12
Conducted general/other hazard preparedness and mitigation projects	11
Conducted winter storm mitigation projects	10
Improved disaster response capabilities	8
Provided technical assistance to help residents, businesses, and organizations	6
Conducted high wind mitigation projects	5
Made it easier for residents, businesses, and organizations to take their own mitigation actions	3
Conducted earthquake mitigation projects	0
I am not aware of any improvements to the town's hazard mitigation capabilities	29

Respondents noted that the Nantucket Conservation Foundation is cutting fire breaks and raising money and awareness for wildfire mitigation. Other respondents stated that the Town had begun some mitigation planning, but not followed through on project completion.

Survey takers were asked what actions they had taken to protect their own families, homes, or businesses. Table 1-15 presents their answers.

Table 1-15: Mitigation Actions Performed by Individuals

Statement	Number Selecting
Elevated home or business to reduce flood damage	4
Floodproofed business to reduce flood damage	1
Relocated home away from eroding shoreline	5
Installed storm shutters or braces to reduce wind damage	9
Took measures to reduce snow build-up on roofs	2
Cut back or removed vegetation from overhead utility lines or roof	7
Replaced overhead utility lines with underground lines	4
Managed vegetation to reduce risk of wildfire reaching home or business	14
Developed a disaster plan for family, home, or business	14
Maintain a disaster supply kit for family, home, or business	23
Participated in public meetings to discuss plans	24
Participated in public meetings to discuss regulations	15
I have not taken any of these actions	24

One respondent noted that they had elevated their utilities above the flood elevation.

When asked "What are the most important things that Nantucket's government and leaders can do to help residents and businesses be prepared for a disaster and become more resilient over time?" respondents answered as presented in Table 1-16.

Table 1-16: Most Important Municipal Mitigation Measures

Statement	Number Selecting
Provide outreach and education to help understand risks and be prepared	47
Provide technical assistance to help reduce losses from hazards & disasters	34
Conduct projects, such as drainage and flood control projects, to mitigate and minimize impacts from disasters	57
Make it easier for residents, businesses, and organizations to take their own actions to mitigate for hazards	34
Improve warning and response systems to improve disaster management	22
Enact municipal regulations, codes, and ordinances designed to protect residents and businesses from natural hazards and disasters	35

Specific suggestions included the following:

- Protect existing dunes
- Protect shorelines to reduce erosion
- Publish articles in the newspaper to educate the public
- Build offshore reefs to protect coast from waves
- Replace all overhead utility lines with underground lines

Survey-takers were asked to rank a set of activities, intended to restore daily life after a hazard event, from most important (1) to least important (10). The average rating of each action was taken to calculate the overall importance of each. These results are presented in Table 1-17.

Table 1-17: Most Important Recovery Actions

Action	Score
Address Injuries and Casualties	8.27
Restore Water Service	7.22
Restore Communication	7.06
Restore Wastewater Collection and Disposal	6.43
Re-open Roads	6.29
Make Home Livable	5.46
Repair Damaged Buildings	4.81
Reopen Businesses	4.40
Restore Parks, Beaches, and other Natural Resources	3.48
Resume Tourism Activities	2.73

This table shows that, after addressing injuries and casualties, restoring critical infrastructure is seen as the most important action after a hazard event.

Participants were asked what one action could be taken in their community to reduce risks of hazards and disasters. Responses are summarized in Table 1-18.

Table 1-18: Suggestions for Single Mitigation Actions

Action	Number Selecting
Limit erosion	13
Place utilities underground	6
Improve communication	5
Educate residents	3
Protect and replenish dunes	3
Install breakwaters	3
Protect beaches	2
Protect Hither Creek overwash area	2
Protect Smith Point roads	2
Mitigate climate change	2
Improve education about climate change	2
Improve warning systems	2
Improve drainage	2
Move buildings away from the coast	2
Protect ponds from hazardous waste	1
Stop discussing climate change	1
Redesign Millie's Bridge	1
Mitigate Madaket Rd & Ames Ave erosion	1
Provide reliable insurance	1
Enact codes & regulations to promote mitigation	1
Improve emergency response & readiness	1
Mitigate overwash of Coskata Pond barrier dune	1
Eliminate new construction in the 100-year flood zone	1
Develop a comprehensive coastal resiliency plan	1
Protect Brant Point and downtown	1
Ensure town has sufficient food supplies	1
Improve on-island debris disposal	1
Distribute battery-operated emergency radios	1
More interdepartmental collaboration on project review	1

Finally, participants were asked for additional comments, which included:

- Add beach grass at Hither Creek Beach
- Hazard mitigation is an unnecessary use of tax-payer money
- Establish a reverse-911 system
- Educate the public about the meaning of the public alert sirens, and where to get more information

- Explore micro-power units for homeowners
- Distribute emergency communication tools (such as radios) to homeowners
- Improve zoning and building regulations and codes to limit runoff
- Develop evacuation plan for Madaket
- Perform public education about hazards
- Ensure rapid power restoration following cold-weather hazard events
- Strengthen community involvement
- Install valves on storm water outflows to prevent surcharging
- Plan for significant sea level rise
- Increase homeowner responsibility if they build in at-risk areas
- Retreat from the waterfront
- Develop wildfire evacuation routes
- Ensure local food security in the event of isolation from the mainland
- Address erosion

A total of 42 participants provided contact information and expressed interest in following the progress of this plan update.

Summary and Key Takeaways

From the responses above, a number of key patterns and takeaways can be seen:

- **Engagement and Investment**: the relatively large number of respondents indicates that the community is engaged and informed. Respondents tended to have long-term connections to the Island, indicating investment in the Town's success.
- **Wind, Flooding, and Erosion**: primary concerns for respondents were high wind events (including Hurricanes and Tropical Storm), winter storms, coastal flooding, and erosion. Respondents indicated concern about climate change and sea level rise.
- **Madaket**: Many respondents reported that the Madaket area, including Smith Point, is at high risk.
- **Town-Driven Mitigation:** Respondents have noticed mitigation actions taken by the Town, and support further action. Individual mitigation activities are relatively minor, mostly limited to participation in public meetings and maintaining disaster supplies. Respondents feel that conducting structural hazard mitigation projects and providing outreach and education are the most important hazard mitigation measures for the Town to take.
- **Mitigating Erosion:** Addressing erosion was noted as a top priority.
- **Mitigate Utility Failure**: Protecting the services provided by utilities – whether by hardening or burial of utilities, rapid restoration after an event, or creation of microgrids – was repeatedly noted as important.

From this survey we conclude that Nantucket should strongly pursue hazard mitigation, with a focus on erosion mitigation and utility protection, and a particular focus on Madaket. It will be important to involve the community through education and outreach. It is important to note that, despite the relatively high response rate, this survey only represents a small segment of the Nantucket population, and the needs and interests of the rest of the Island's residents should be solicited and addressed.

Coordination with Neighboring Communities

Nantucket has coordinated with neighboring municipalities in the past relative to hazard mitigation and emergency preparedness and will continue to do so. Emergency evacuation plans direct populations from at-risk areas to safer portions of the Island, but do not include evacuation to the "mainland." While the fire department has mutual aid agreements with departments on Cape Cod, the time it would take to receive that aid requires Nantucket to be mostly self-reliant. At the same time, electricity, fuel, food, and other critical supplies and equipment must travel to Nantucket from the mainland; however, these services are provided by companies and organizations outside the jurisdiction of any specific municipality (such as the Steamship Authority), and Nantucket coordinates closely with those entities. For these reasons, coordination with neighboring communities on this Hazard Mitigation Plan was limited.

In order to give communities directly connected to Nantucket an opportunity for comment, copies of this document were provided to the Cape Cod Commission and to the Town of Barnstable in January 2019.

2 COMMUNITY PROFILE

2.1 Physical Setting

The Town of Nantucket is located off the coast of Massachusetts approximately 20 miles east of Martha's Vineyard and 25 miles south of Cape Cod. The Town of Nantucket is coincident with the County of Nantucket and includes the islands of Nantucket, Tuckernuck, and Muskeget. Refer to Figure 2-1 for a location plan of the Town, and Figure 2-2 for a more detailed map of the Town on a USGS topographic base.

Nantucket has an area of 48 square miles and approximately 88 miles of shoreline. Nantucket Sound is located north of the Town, and the open Atlantic Ocean is located to the east and south. Sheltered and semi-sheltered marine systems include Nantucket Harbor, connected to Nantucket Sound; Polpis Harbor, an embayment of Nantucket Harbor; and Madaket Harbor, at the west end of Nantucket Island toward Tuckernuck. Extensive sandy shoals are located east and west of Nantucket.

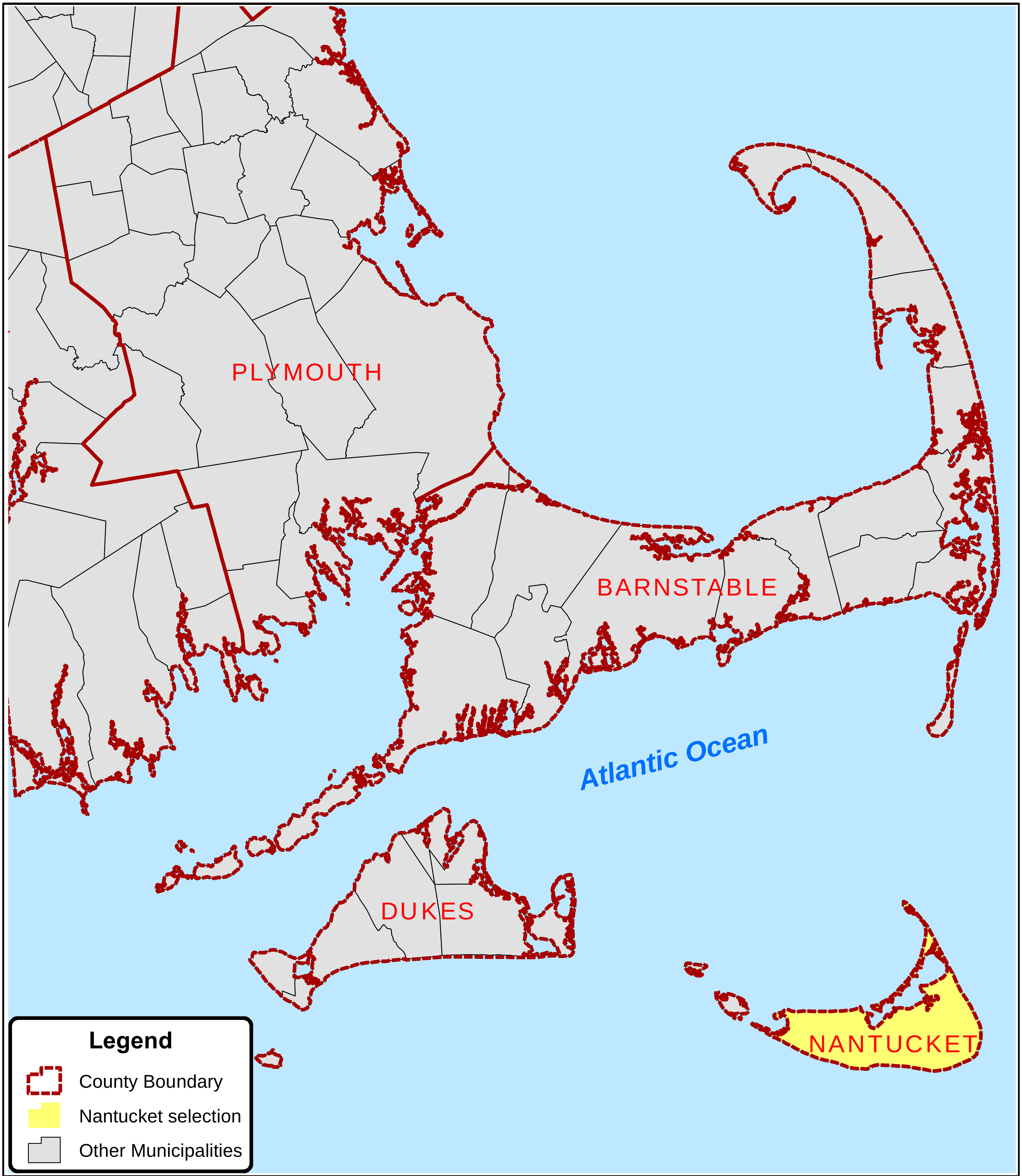
Key physical features of Nantucket Island include high bluffs at Sankaty Head and the Nantucket Cliffs, long systems of beaches and dunes (Great Point and Coatue) formed by longshore currents, several north-south trending elongated ponds that are typically cut off from the ocean by narrow beaches (such as Hummock Pond and Miacomet Pond), extensive moorlands, and numerous areas of tidal wetlands. Nantucket does not, however, have many non-tidal fresh watercourses, due to the sandy nature of the soil and the flat terrain. Exceptions include the stream known as Phillips Run and a tributary of Miacomet Pond.

2.2 Geology

Geology is important to the occurrence and relative effects of natural hazards such as shoreline change, erosion, earthquakes, and flooding. Thus, it is important to understand the geologic setting and variation of geologic formations in Nantucket.

Nantucket is located in the Atlantic Coastal Plain, a broad belt along the eastern seaboard of the United States and the Gulf of Mexico, extending from the mouth of the Rio Grande to Cape Cod. The region is generally characterized by sedimentary rock formations and thick unconsolidated sediment deposits that extend to the continental shelf.

Nantucket was formed by the Laurentide continental ice sheet associated with the last North American glaciation, less than 25,000 years ago. Cape Cod, Martha's Vineyard, Block Island, and Long Island have similar origins. Sometime after 23,000 years ago, the glacier reached its maximum advance at a position marked by the islands of Nantucket and Martha's Vineyard. The terminal moraine of this glacier consists of unsorted glacial till (ranging from clay, silt, and sand to boulders) and extends from Nantucket Harbor to Siasconset ("Sconset"), including the Shawkemo Hills, Sauls Hills, Folger Hill, and the cliffs at Sankaty Head. Refer to Figure 2-5 for a depiction of surficial geology.



SOURCE(S):
Mass GIS Division

Figure 2-1: Location Map

LOCATION:
Nantucket, MA

N

Town of Nantucket
Natural Hazard Mitigation Plan

MXD: Y:\2967-09\Maps\Fig2_1_location_map1.mxd

Map By: MER
MMI#: 2967-09
Original: 08/28/2017
Revision: 03/07/2018 NBS
Scale: 1:500,000

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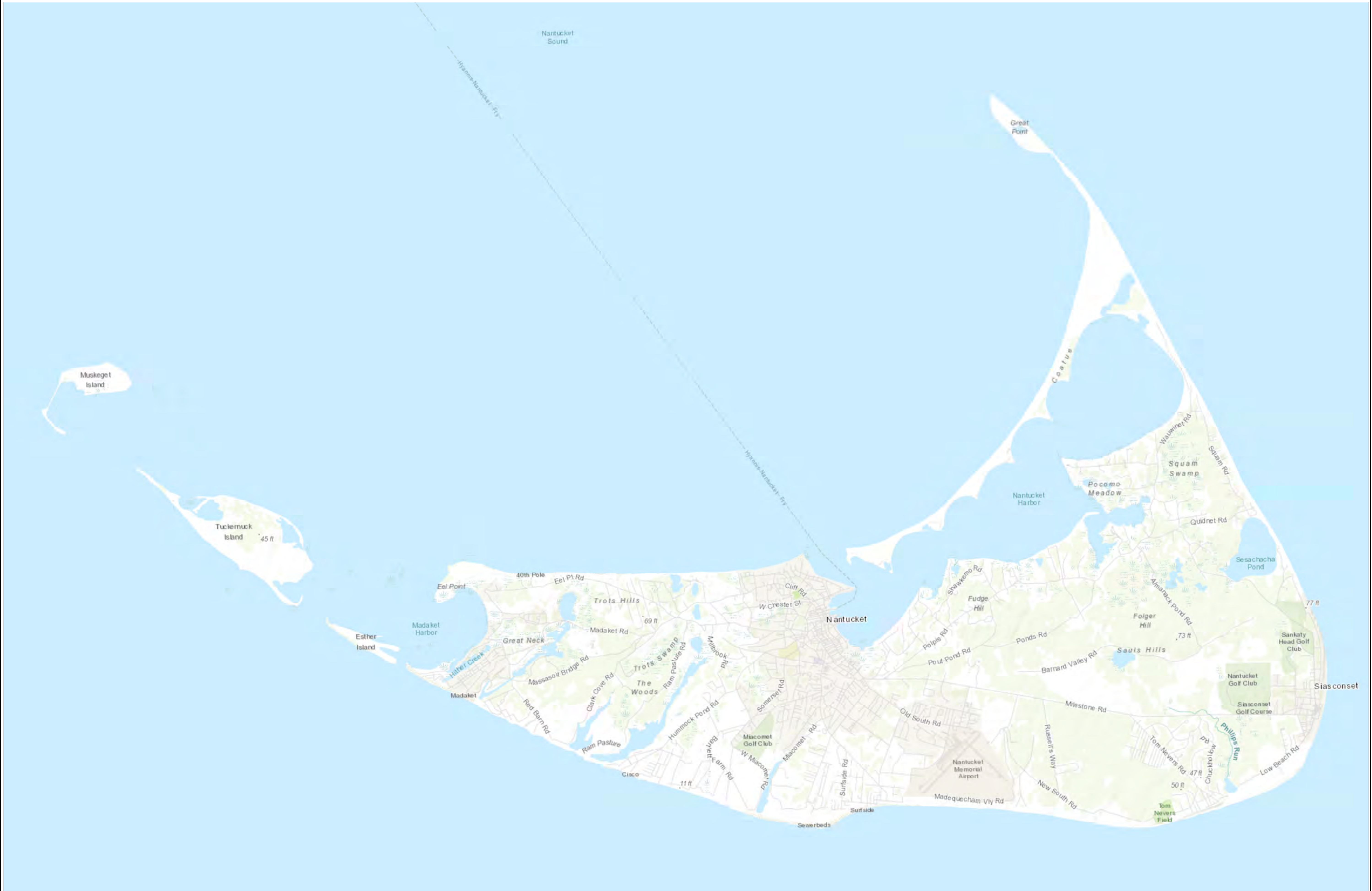

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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N S E W

SOURCE(S):
XXXXXX

TOWN MAP

TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN

NANTUCKET, MASSACHUSETTS

Map By: MER
MMI#: 2967-09
MXD: Y:\2967-09\Maps\Fig2_2_town_map1.mxd
1st Version: 08/28/2017
Revision: 03/07/2018
Scale: 1 in = 6,667 ft

FIGURE 2-2

Other parts of the island are smoother and flatter, as they were formed as the outwash plain of the glacier. Outwash plains are made up of silt, sand, and gravel deposited by meltwater streams that flowed across the plain in a braided pattern. This resulted in a flat depositional surface that slopes gently away from the ice front. Outwash deposits can form an irregular morphology called kame and kettle terrain. A kame is a hill composed of outwash deposits, which originally filled a hole in the ice. When ice melted away, the deposits formed a hill. Kettles formed where outwash was deposited around and over an ice block. When the ice block melted, the outwash collapsed to form a hole.

By 18,000 years ago, the Laurentide ice sheet had retreated northward into the Gulf of Maine. By roughly 15,000 years ago, the ice had retreated from the Gulf of Maine and the remainder of New England.

Not all of the surficial materials of Nantucket were deposited directly by the glaciers or by glacial meltwater. Beach and dune deposits were laid down by waves and wind, respectively. Of course, these deposits were derived from the tills and outwash.

2.4 Climate

Nantucket's island setting provides for moderate temperature variation characterized by distinct seasons. According to the county's 2014 FEMA Flood Insurance Study (FIS), average temperatures range from 32.5 degrees Fahrenheit in January to 67.5 in July. Extreme conditions can raise summer temperatures to near 100 degrees and winter temperatures to below zero, although these occurrences are very infrequent.

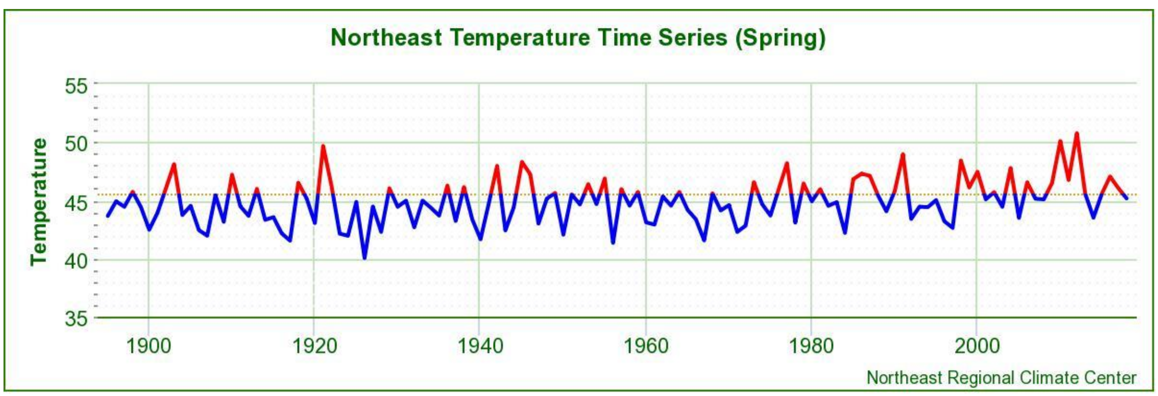


Figure 2-3: Three-Month-Average Temperatures (Fahrenheit) Spring (Mar-May) 1895 – 2018
Red-dotted line indicates 1981-2010 normal
www.nrcc.cornell.edu/regional/tables/tables.html

It is important to note that hazards from extreme temperatures include direct impacts to health (such as heat stroke or frostbite), exacerbation of existing health issues (such as respiratory disorders, impacts to infrastructure (softening of pavements, increased power demands, bursting pipes), and negative impacts to natural systems.

Mean precipitation is 43.66 inches (from the FEMA FIS), spread evenly over the course of a year with average precipitation of three to four inches per month. Snowfall ranges from 12 to 24 inches per year.

Average annual precipitation in Massachusetts has been increasing over the last century. The National Climatic Data Center (2017) reports that the trend within the Massachusetts coastal area from 1895 through 2017 is an increase of 0.55 inches of precipitation per decade; note that this upward trend is less significant than the trend of 1.18 inch per decade calculated through 2006 and cited in the previous plan; this decrease in the rate of increasing precipitation is due to a decrease in annual precipitation since 2012. According to the Massachusetts Hazard Mitigation Plan (2013) and the UMass Amherst Northeast Climate Science Center (NECSC), precipitation in Massachusetts is predicted to increase by 10% in spring and summer, 15% in autumn, and 20 to 60% in winter. The continued increase in precipitation only heightens the need for hazard mitigation planning, as the occurrence of floods and snow hazards may change as a result of greater precipitation.

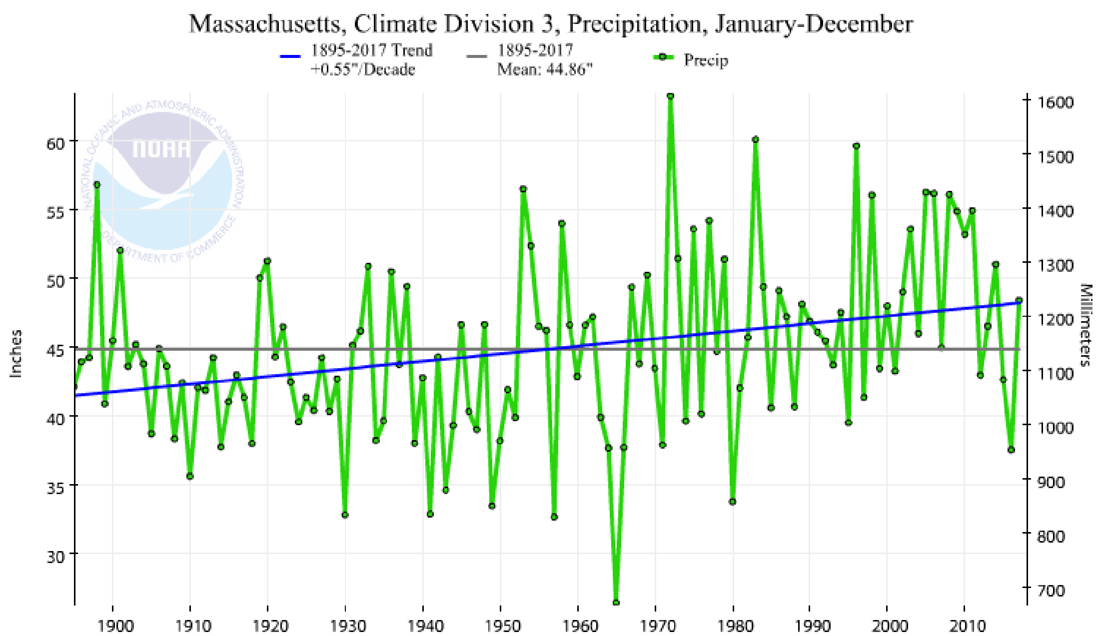
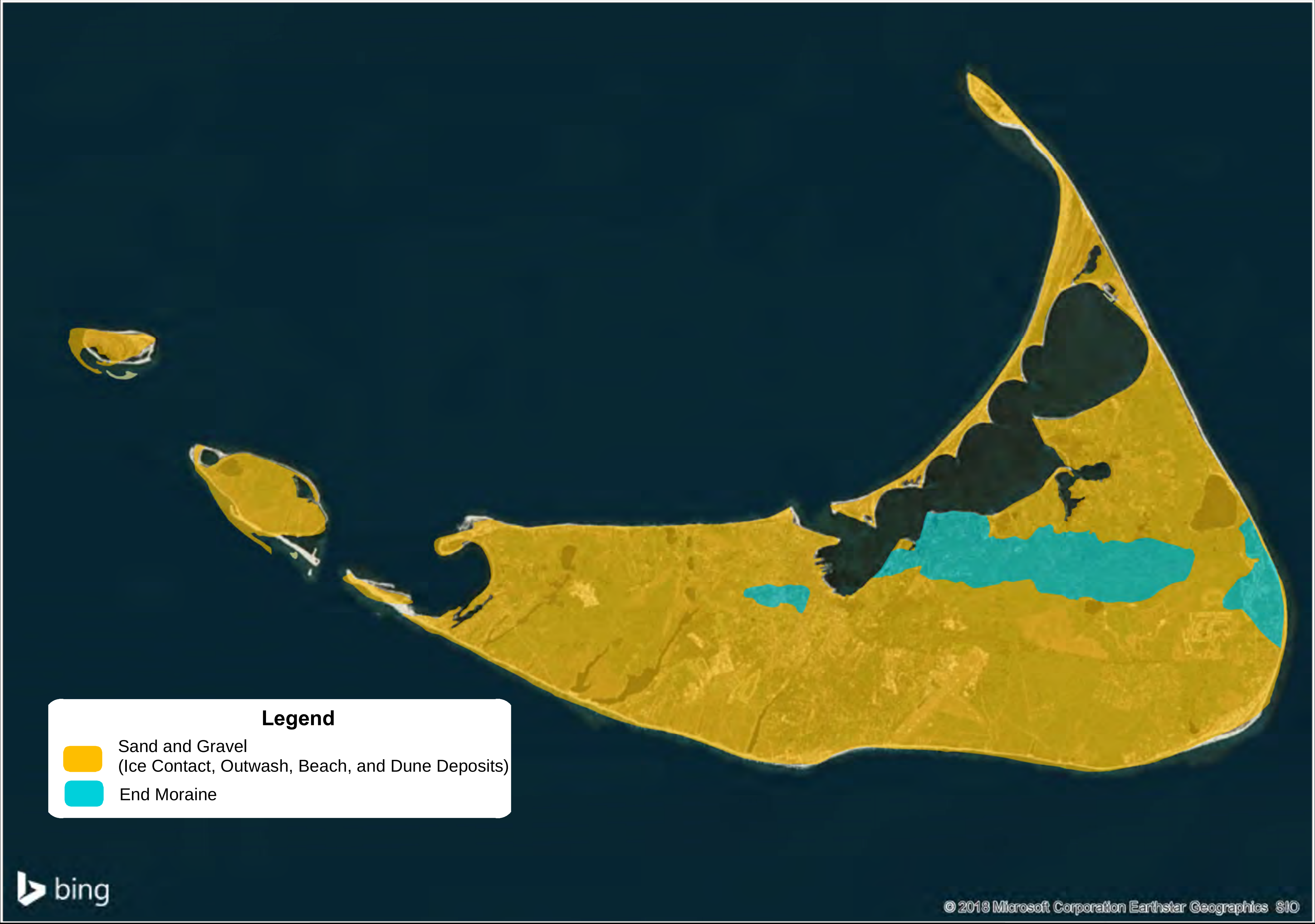


Figure 2-4: Historic Annual Precipitation Trend, Coastal Massachusetts



SOURCE(S): XXXXX	N **Figure 2-5: Surficial Geology** MXD: Y:\2967-09\Maps\Fig2_3surficial1.mxd	**Town of Nantucket** **Natural Hazard Mitigation Plan** **LOCATION:** **Nantucket, MA**	**Map By:** MER **MMI#:** 2967-09 **Original:** 3/7/2018 **Revision:** **Scale:** 1:120,000	MILONE & MACBROOM 99 Realty Drive Cheshire, Connecticut 06410 Phone: (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

2.5 History and Land Use

Nantucket was discovered by Bartholomew Gosnold in 1602, but the first Englishmen to settle Nantucket arrived in 1659 when the land was owned by ten men. By 1670, the island was owned by only 27 men. After they laid out land for homesteads, approximately 60% of the island was set aside for sheep pasture. Owners of these sheep commons were known as "Proprietors of the Common and Undivided Lands of Nantucket." The expanses of common lands persisted until the 19th century when private ownership increased. By 1970, 92% of the island was privately-owned, yet still largely undeveloped.

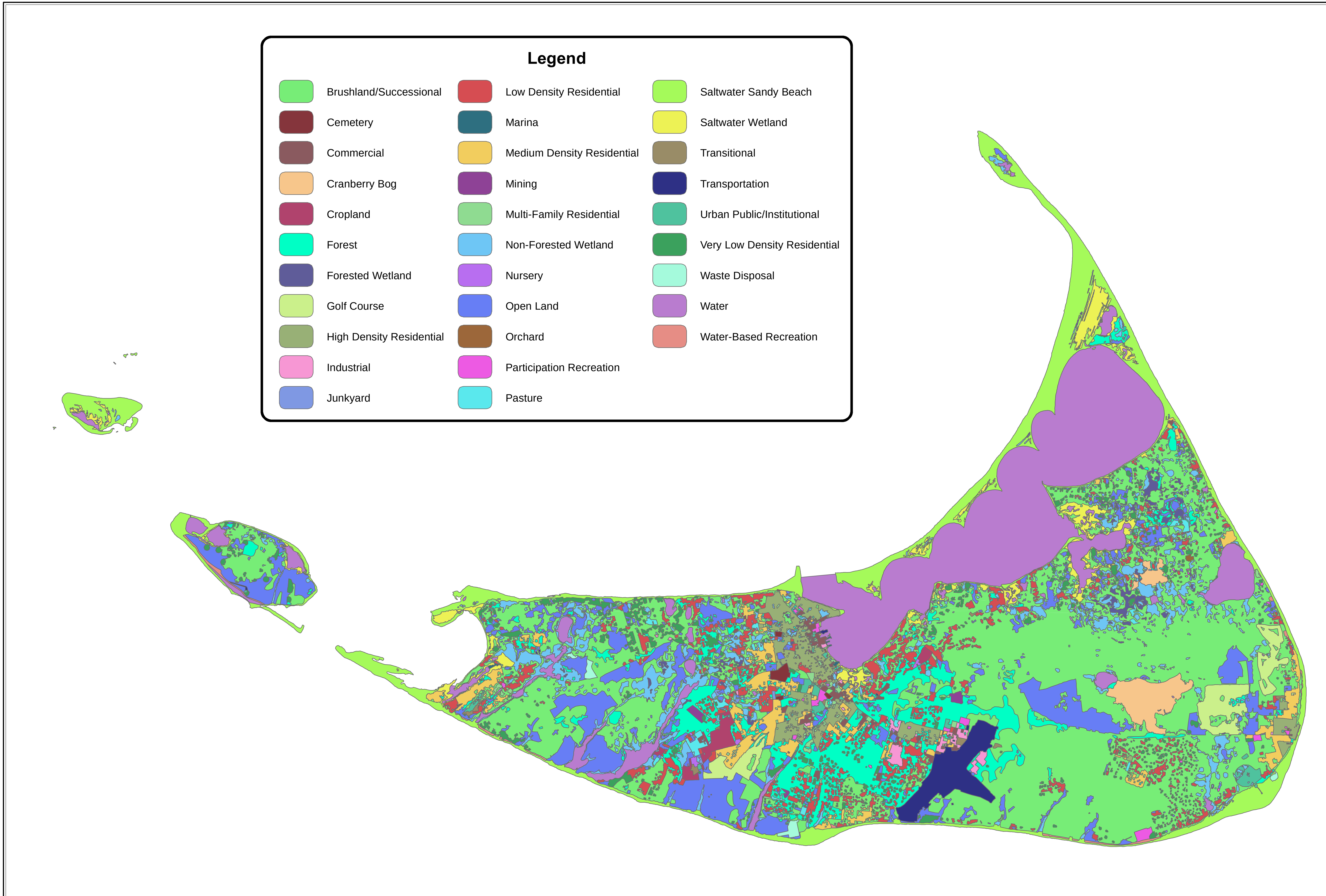
Although Nantucket has only a few formally-named villages such as Madaket and Siasconset ("Sconset"), numerous neighborhoods are located throughout the Town. These are depicted on Figure 1-1 along with a cross-reference table of hazard effects. Many of these localities date back to the original pattern of settlement and land ownership on Nantucket. Unlike many cities and towns, Nantucket does not delineate boundaries between neighborhoods and localities. Thus, the patterns on Figure 1-1 are meant to be approximate and are intended to aid the discussions herein, and do not imply any formal demarcations.

Whaling began in the late 1600s but first came to prominence in Nantucket in the early 1700s. By the 1820s, Nantucket had become a wealthy city and the whaling capital of the world. This prominence continued until the 1840s, but as whaling ships increased in size, Nantucket Harbor was too shallow to accommodate them. Whaling moved to New Bedford, and in 1846 a large part of downtown Nantucket was destroyed by a fire. By the end of the decade, many residents had departed for gold exploration in California. The last whaling ship operated from Nantucket until 1869.

At the same time as the decline in whaling and the passing of the sheep pastures, agriculture also declined in Nantucket. By the 1870s, tourism was beginning to be viewed as a viable means of economic growth, although it did not take off until the 1890s. As recently as 1893, a railroad ran from downtown Nantucket to Surfside, turned at a right angle to the east running along the south shore, ending in ‘Sconset. The railroad was abandoned in the 20th century in favor of other means of transportation.

Zoning ordinances did not exist on Nantucket for many years. The first historic districts were established in 1955, "Old and Historic Nantucket" and "Old and Historic Siasconset," to promote exterior design standards.

Current land use in Nantucket primarily consists of residential, commercial, institutional, and conservation lands. Some agricultural uses have remained as well. Refer to Figure 2-6 for a map of land use. Commercial uses are concentrated in the downtown and mid-island areas. Institutional uses such as schools, municipal buildings, and transportation centers are concentrated in the population centers of downtown, ‘Sconset, and Madaket; and at the airport.



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SOURCE(S):
MASS GIS

LAND USE MAP

TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN

NANTUCKET, MASSACHUSETTS

Map By: MER
MMI#: 2967-09
MXD: Y:\2967-09\Maps\Fig2_5LandUse1.mxd
1st Version: 08/28/2017
Revision: 3/7/2018
Scale: 1:80,000

FIGURE 2-6

Source:
Town of Nantucket

FIGURE 2-7

N

Conservation Lands

MXD: Y:\2967-09\Maps\Fig2_6ConservationLands.mxd

Town of Nantucket
Natural Hazard Mitigation Plan

LOCATION: **Nantucket, MA**

Map By: MER
MMI#: 2967-09
Original: 9/15/2017
Revision: 09/15/2017
Scale: 1:120,000

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Approximately 16,419 acres of land in Nantucket are classified as conservation lands, owned by the Nantucket Conservation Foundation (NCF), Massachusetts Audubon Society, Madaket Land Trust, 'Sconset Trust, Nantucket Land Bank, Nantucket Land Council, The Nature Conservancy, the Trustees of Reservations, the Town of Nantucket, State and Federal governmental agencies, and other conservation groups. Overall, the 16,419 acres make up 55% of the total land area of Nantucket. NCF owns 30% of Nantucket Island, and is the largest landowner in the Town. Refer to Figure 2-7 for a map of conservation lands.

Town wide land use has not changed significant in the last ten years. Specific projects that have been undertaken since the adoption of the initial hazard mitigation plan include redevelopments, rebuilds, and modifications to properties and buildings. These are described below.

2.6 Population and Demographic Setting

Nantucket was the third largest city in Massachusetts while its whaling economy was booming. At the end of its whaling heyday in the 1840s, Nantucket had a population of 9,712. By the 1870s, the town's population was only 4,000.

The suburbanization that characterized the U.S. from the late 1940s through the 1970s, with the construction of new roads and the enhanced availability of the automobile and federally funded housing programs, did not affect Nantucket. Instead, from the 1930s through the 1970s, the year-round population of Nantucket remained approximately 3,500. In the 1970s, the summer population was 16,000.

According to the 2000 U.S. Census, Nantucket had an enormous population increase of 58% between 1990 and 2000, growing from 6,025 to 9,520 permanent residents. This growth was due in large part to the attractive setting and high quality of life, as well as the influence of tourism and the need for workers to support the tourism industry. The population in 2010 was 10,164, a more stable 6.76% increase over the preceding five years, but still representing substantial growth and nearly twice the statewide trend for the Massachusetts. The projected estimated population in 2016 was 11,008, reflecting continued growth of about 8% percent over 2010.

The local nonprofit Nantucket Data Platform was formed in 2017 to collect and consolidate reliable data on the Island, including population. In July 2018 they estimated that the Island has a permanent population of 17,200, with an additional 11,000 seasonal residents, 6,590 seasonal workers, and 365 commuters. The nonprofit estimated peak summer population at 46,580 people, total. These figures were derived from assessor's records, voting records, transportation counts, and cell-phone records, and were reported in The Inquirer and Mirror on July 19, 2018. These estimates highlight both the difficulty in obtaining accurate population estimates, as well as the wide range in populations on Nantucket over the course of a year.

According to the 2010 Census, 21% of the population of Nantucket was younger than 18 years of age, 67% was between the ages of 18 and 64, and only 12% was 65 years and older.

Table 2-1: Nantucket Population Trends

AREA	POPULATION					2010 DENSITY (PER SQ MI)
	2000	2010	# Change	% Change	2016 Projection	
Nantucket	9,520	10,164	+644	6.76	11,008	226
Massachusetts	6,349,097	6,565,524	+216,427	3.41	6,811,779	838

The downtown, Madaket, and ‘Sconset neighborhoods are home to more residents than any other areas in the community; additionally, the Mid-Island area has become more developed over time and is expected to continue to grow as a residential and commercial center in the future. More than 1,000 commercial and residential buildings are located downtown.

According to the University of Massachusetts Donahue Institute (Renski & Strate, 2015), the projected Town population in 2025 will be 10,895, and in 2035 will be 12,004. These projections are based on the 2010 Census as a baseline; along with US Census Bureau projections, they estimate that continued population growth will occur at a moderate rate. The anticipated locations of this growth are discussed in the following section.

2.7 Development Trends

Unlike many coastal communities in the United States, residential development on Nantucket is not concentrated along the shoreline. This is mainly because many of these areas are substantially protected as conservation lands, and the remaining private land is already developed in accordance with previously accepted densities or more recent zoning.

Instead, residential development is projected to remain scattered among available parcels located in the central and eastern portions of the Town. The potential for large developments is believed to be low. Very little development is occurring in the northeast and western parts of the Town. A limited number of projects are underway:

- ❑ Construction of “Richmond Great Point” is underway off Old South Road between the downtown area and the airport. This includes 225 apartments and 52 house lots off Old South Road.
- ❑ Development is planned for 6 Fairgrounds Road along Waitt Drive.
- ❑ Development is being considered off South Shore Rd (“Surfside Crossing”).

The Town has participated in specific projects that provide benefit to the entire community. For example, the Town completed and opened a new Intermediate School to accommodate the growing population; and the Town is completing a major addition to the Nantucket Cottage Hospital.

Commercial development projects are more likely than residential projects to be located in mapped floodplains, though most of these nonresidential projects likewise involve renovations and redevelopment. The mid-island area, farther from the waterfront, had been identified by the Town as a node for future commercial development.

The Town is not aware of any specific projects that have increased development in areas of flood risk, erosion risk, or risks to other hazards discussed in this plan. In fact, numerous buildings have been lost to erosion since the adoption of the initial hazard mitigation plan, without rebuilding in the same location. When applicable, projects that have exceeded the thresholds for substantial improvement have resulted in floodproofing or building elevation.

2.8 Governmental Structure

The Town of Nantucket is managed by a Select Board. The Board oversees many of the municipal departments, commissions, and boards. According to the most recent report of the Nantucket Government Study Commission, local government has three broad components consisting of voters and the Town Meeting, elected officials and appointed committees, and administration.

Elected boards and officials include the Select Board, Town Clerk, Planning Board, Planning & Economic Development Commission, School Committee, Historic District Commission, and the Water Commission. Boards and Commissions appointed by the Selectmen include Airport, Conservation, Parks & Recreation, Zoning Board of Appeals, Finance, and Local Emergency Planning. The directors or chiefs of the Fire, Police, Public Works, Health, Building, and Marine Resources Departments report to the Town Administrator. In turn, the Town Administrator reports to the Select Board.

Many municipal departments, commissions, and boards are involved with natural hazard pre-disaster mitigation. The following subsections describe general departmental responsibilities, and duties related to natural hazard pre-disaster mitigation. Where applicable, one or more of the six types of hazard mitigation (*prevention, property protection, natural resource protection, structural projects, emergency services, and public education*) are identified as relevant for each department.

Emergency Management Agency

The Nantucket Emergency Management Agency (NEMA) is operated from the Nantucket Police Department. NEMA staff include the Police Chief as the Emergency Management Director (EMD), and a Police Sergeant as the Emergency Management Coordinator (EMC). The previous EMC retired during the update of the HMP.

The NEMA Emergency Operations Center (EOC) is located at the newly constructed Police Department and Emergency Operations Facility at 4 Fairgrounds Road. This change represents a significant increase in hazard mitigation capability relative to the Town's position when the original HMP was adopted.

The mission of the agency is stated on the Town website as follows:

> *The Nantucket Emergency Management Agency (NEMA) seeks to maximize survival of persons and preservation of property in the County and Town of Nantucket in the event of a natural or man-made disaster by effective planning and coordinated use of all personnel, equipment, available shelter, and any other resources during an actual emergency.*

NEMA is also responsible for mitigation and financial recovery from such incidents and also for formulating and exercising emergency plans for natural disasters and hazardous materials accidents, which may occur at facilities and transportation routes within the county and town.

According to the 2013 CEMP, the Emergency Management Director's responsibilities relative to mitigation and preparedness include:

- ❑ Coordinates and carries out all Emergency Management activities and ensures smooth operation of the department and the EOC.
- ❑ Coordinates public emergency education/awareness.
- ❑ Develops and maintains the local Comprehensive Emergency Management Plan. Refer to the Forms Section for suggested forms and lists to be used in the EOC.
- ❑ Develops EOC procedures to assure activation on short notice and adequate staffing
- ❑ and communications, including maintaining lists of resources and personnel to be notified when emergency situation occurs.
- ❑ Oversees the planning and development of basic warning/notification functions.
- ❑ Trains public officials and EOC personnel on EOC operations.
- ❑ Ensures stocking and/or tracks availability of food, water, administrative supplies, and other essential supplies and equipment needed for emergency operations.
- ❑ Designates facilities to be used as EOC and alternate EOC.
- ❑ Ensures that adequate resources are available at alternate EOC.
- ❑ Consults with coordinators of all individual emergency functions to ensure readiness for management of potential emergency/disasters.
- ❑ Activates EOC and initiates response procedures and activities.
- ❑ Coordinates all EOC activities and emergency response activities of other agencies, and interfaces with the on-site Incident Command. Refer to Part 3 for protective procedures such as evacuation and sheltering and to Part 4 for hazard specific response actions.
- ❑ Continues or phases out response operations as needed.
- ❑ Initiates recovery activities including damage assessment, compilation of damage assessment data, and applying for federal and state disaster relief funds. (In some cases, a separate individual may be appointed by the Chief Executive Official to be in charge of coordinating disaster relief applications). Refer to the Massachusetts Emergency Management Agency's Disaster Assistance Program Guide, a manual of information and instructions on damage assessment and applying for state and federal disaster relief assistance.
- ❑ De-activates EOC.

The Emergency Management Agency also runs emergency event training drills, including for natural hazard emergencies.

NEMA, through the Fire Department, coordinated and oversaw the development of the initial, 2007 Hazard Mitigation Plan; however, responsibility for ongoing maintenance of and updates to the plan has been given to the Planning and Land Use Services (PLUS) Department.

The types of mitigation that are directly administered by the Emergency Management Agency include mainly emergency services and public education. However, as the department responsible for emergency planning, all six types of natural hazard mitigation may be influenced by the actions of the department.

Fire Department

Day-to-day duties of the Fire Department include fire response, emergency medical response, fire prevention and safety education, ambulance response, and fire alarm plan review. Duties related to natural hazard mitigation include planning and coordination of personnel, equipment, shelters, and other resources necessary during an emergency. The types of mitigation that are directly administered by the Fire Department include mainly emergency services and public education, as well implementation of wildfire hazard mitigation efforts on Town owned land. Communication and coordination with conservation-land owners, such as the Nantucket Conservation Foundation, is essential to wildfire management on those lands. Coordination and communication with the Police Department (below) is critical before, during, and after natural hazard emergencies.

According to the 2013 CEMP, the Fire Department's other responsibilities relative to mitigation and preparedness include:

- ❑ Provides fire code enforcement and fire prevention services including inspections and public education.
- ❑ Maintains plans for providing resources and services needed during disaster/emergency periods.
- ❑ Maintains fire department resources. Refer to Resource Manual (Emergency Services) for fire service inventory.
- ❑ Provides emergency disaster training for primary and auxiliary fire personnel.
- ❑ Ensures hazardous materials safeguards are in place. Refer to Part 4.
- ❑ Maintains readiness of all fire service equipment, supplies, procedures, and mutual aid agreements needed for emergency disaster response activities.
- ❑ Provides fire response and control during disaster/emergency period.
- ❑ Provides communications and warning/notification support, including operation of fixed and mobile siren units.
- ❑ Provides search and rescue operations.
- ❑ Provides radiological monitoring and decontamination support.
- ❑ Provides hazardous material incident response, control, and operations support, including biochemical decontamination.
- ❑ Provides primary or secondary emergency medical services.

- ❑ Provides EOC support.
- ❑ Provides fire control in shelters.
- ❑ Performs incident command duties when appropriate.
- ❑ Conducts and/or supports damage assessment activities including fire inspection of damaged facilities.
- ❑ Continues to provide EOC support until no longer needed.

Police Department

Day-to-day duties of the Police Department include crime prevention, criminal investigations, traffic enforcement, motor vehicle accident investigations, beach patrol, and bicycle patrol. Duties related to natural hazard mitigation include planning and coordination of personnel, equipment, shelters, and other resources necessary during an emergency. The types of mitigation that are directly administered by the Police Department include mainly emergency services and public education. Communication and coordination with the Fire Department (above) is critical before, during, and after natural hazard emergencies.

According to the 2013 CEMP, the Police Department's other responsibilities relative to mitigation and preparedness include:

- ❑ Plans for maintaining law and order, traffic and crowd control during disasters emergencies.
- ❑ Maintains law enforcement resources. Refer to Resource Manual (Emergency Services) for law enforcement equipment inventory.
- ❑ Provides training for primary and auxiliary law enforcement personnel.
- ❑ Ensures that law enforcement mutual aid agreements are in place.
- ❑ Provides law enforcement during disaster emergency period
- ❑ Provides traffic control, crowd control, and restricted area control, including patrolling
- ❑ evacuated areas. Refer to Flood and Hurricane Traffic Control Points and Evacuation Routes the Maps and Tables annex.
- ❑ Provides security to Critical Infrastructure and Facilities, including Mass Care Shelters.
- ❑ Provides warning and notification support, which may include the use of mobile warning units.
- ❑ May provide back-up communications for shelter operations and other communications support.
- ❑ Conducts and/or supports search and rescue operations.
- ❑ May issue restricted area passes to appropriate personnel. Refer to the Forms Section for a sample emergency pass. The following vehicles and occupants are typically allowed access to controlled areas with valid ID: marked utility company vehicles, military and government vehicles, marked town/city vehicles, and relief agency vehicles.
- ❑ Provides liaison and coordination with other law enforcement groups and mutual aid.
- ❑ Provides EOC support.
- ❑ Directs and carries out evacuation and relocation of prisoners in jail/lock-up facility.

- ❑ Coordinates with State Police to provide traffic control on state highways, and additional support to local operations.
- ❑ Performs Incident Command duties if appropriate.

Department of Public Works

Day-to-day duties of the Department of Public Works (DPW) include engineering, solid waste disposal and recycling, storm water management, snow removal, tree maintenance, and roadway maintenance. The types of mitigation that may be administered by DPW include prevention, property protection, natural resource protection, and structural projects.

Specifically, with regard to disaster mitigation, roadway/infrastructure maintenance and complaint logging/tracking are the two primary duties of the DPW. For example, DPW tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure. DPW also conducts snow removal and deicing on roads; tree and tree limb removal in rights-of-way; and maintains and upgrades storm drainage systems to prevent flooding caused by rainfall. The DPW has improved its tree inspection and maintenance program over the last decade. The DPW is responsible for the deployment of sandbags to protect municipal facilities and barricades to inundated roadways; the operation of the Children's Beach storm water pump station as well as for opening and closing the flood gate at the Harbor View Way boat ramp.

According to the 2013 CEMP and the DPW, other responsibilities relative to mitigation and preparedness include:

- ❑ Maintains plans for providing equipment and services needed during emergency/disaster period.
- ❑ Provides training as needed to DPW and other response personnel for optimal utilization of resources during emergency/disaster periods.
- ❑ Maintains DPW resources. Refer to Resource Manual (Core Functions) for DPW inventory.
- ❑ Maintains roads, bridges, waterways, water and sewer systems and services
- ❑ Maintains flood control systems.
- ❑ Provides engineering services and consultation.
- ❑ Provides snow and debris removal.
- ❑ Maintains readiness of all DPW equipment, supplies, and personnel needed in connection with emergency/disaster response activities. Refer to Resource Manual (Core Functions) for location of regular DPW staging area, and designated additional staging area(s).
- ❑ Ensures written agreements are in place with emergency response organizations for use of equipment.
- ❑ Provides fuel storage.
- ❑ Provides distribution and management for emergency/disaster equipment and related resources for emergency use through EOC.
- ❑ Identifies and staffs resource distribution centers.

- Provides fuel for emergency generators.
- Provides for pre-positioning of traffic control devices. Refer to traffic control point list.
- Provides EOC support.
- Provides potable water.
- Provides debris clearance supporting emergency response activities and access to affected areas.
- Performs incident command duties at emergency scene, if appropriate.
- Provides damage assessment of public buildings, roads, bridges, and other facilities and infrastructure.
- Assesses impact of emergency on available equipment and resources.
- Provides estimates of costs to provide needed recovery resources.
- Coordinates record keeping related to damage assessment and recover resources.
- Provides debris clearance and disposal.
- Coordinates with public health on water testing.
- Provides road, bridge, and other public facility repair.
- Coordinates with utility companies to restore services.
- Deploys barriers to inundated areas for vehicular/pedestrian protection.
- Deploys sandbags to protect municipal facilities.
- Operates the Harbor View Way tide gate.

Because of the duties described above, DPW is often the de-facto first responder during emergencies. Disasters are extremely taxing on the resources of the Department, and the island setting of Nantucket prevents opportunities for mutual aid agreements with other municipalities, such as those enjoyed by mainland communities. On-call and emergency contracts are in place with local contractors, and these are used when necessary during large storms. Although DPW typically is supplied by the Town with needed equipment, staffing sometimes is not optimal to operate the equipment during emergencies. Even with these potential problems, DPW has succeeded in maintaining access for the Police and Fire Departments to respond to emergencies.

Specific issues related to the DPW hazard mitigation capabilities have been identified following recent storm events:

- The storm water pump station at Children's Beach can become overwhelmed by floodwaters when the Children's Beach tide gate (also known as the Harbor View Way tide gate) is closed, allowing flooding to occur in the neighborhood.
- Operation of the Children's Beach tide gate is not always consistent, in part due to interference by local residents; this results in the gate being left open during flood events.
- Due to the rapid succession of 2018 winter storms, the Town has run low on the construction materials needed for emergency roadway construction and repairs. The limitations on travel to the Island that go hand-in-hand with such storm events slowed replenishment of those resources.

Actions to address these issues are listed in sections 0 and 3.7.2.

Sewer Department

The Sewer Department operates and maintains Nantucket's wastewater systems, which consists of two Wastewater Treatment Facilities (Surfside and 'Sconset), 13 pumping station, and over 60-miles of sewer mains. Responsibilities include inspection and verification of proper operation of all facilities and bi-annual cleaning of the sewer main pipelines. The Sewer Department's stated mission is to protect public health and the environment for the community by providing high-quality wastewater-treatment services in an effective, efficient, and responsive manner.

With regard to pre-disaster mitigation the Sewer Department, plans, prepares for, and responds to flooding, inundation, and/or erosion of sewer infrastructure such as the sewer pumping stations and the wastewater treatment plants.

Planning and Land Use Services Department

The Planning and Land Use Services (PLUS) Department was established in 2012 by consolidating the former Code Enforcement Department with the offices of Planning and Zoning. PLUS consists of the Building Division (previously the Building Department), the Planning Division and Zoning Board of Appeals (previously the Department of Planning & Zoning) and the Historic District Commission. Within the Planning Division is the Energy Office, Planning & Economic Development Commission, and Planning Board.

Recall that two important types of natural hazard mitigation are prevention and natural resource protection. Because the subdivision regulations, zoning regulations, and several master and area plans directly and/or indirectly address hazard mitigation, PLUS staff have a unique opportunity to enforce and encourage pre-disaster mitigation.

Planning Board

The Planning Board regulates secondary and tertiary dwelling permits, residential subdivisions, and special permits for major commercial development, Moorlands Management District developments, major residential developments, multi-family developments, and second curb cuts. The Board is elected separately than other municipal commissions. Planning Board staff administer subdivision regulations, amend zoning regulations and zones as needed, and coordinate planning studies and documents.

Planning & Economic Development Commission

The mission of the Nantucket Planning & Economic Development Commission (NP&EDC) is to plan for the orderly and coordinated development and protection of the physical, social, and economic resources of Nantucket. The commission is responsible for preparation and implementation of development planning documents. Documents include studies, research reports, and maps of natural resources, land utilization, economic development, recreation and conservation, transportation and population characteristics.

Energy Office

The Energy Office was established in 2011 to assist the town in identifying and implementing energy efficiency, conservation, and renewable energy programs that are economically viable, environmentally responsible, and socially respectful for Nantucket. One goal of the office is to contribute to overall community sustainability. With respect to natural hazard planning, a number of mitigation actions intended to limit or quickly respond to power outages fall under the purview of the Energy Office.

The Energy Office is particularly interested in installation of solar panels on the roofs of critical facilities, as well as batteries for local energy storage, in order to provide both a local clean energy source, and a potential source of backup power following hazard-related outages.

Building Department

The Building Department issues permits for building, electrical, plumbing, gas, and siding; issues zoning violations; and issues certificates of occupancy and certificates of inspection. Although other departments and commissions may review development plans and develop or revise regulations, many important types of pre-disaster mitigation are funneled through, and enforced by, the Building Department. For example, the Building Department enforces A and V-zone standards for flood-proof construction and building elevations, maintains elevation certificates, and enforces building codes that protect against wind and fire damage. Thus, the types of mitigation that are administered by the Building Department include prevention and property protection.

Health Department

The Health Department was consolidated into PLUS in 2012, then made into a free-standing department in 2015. The department is responsible for licensing, inspections, regulation enforcement, water quality testing, and complaint investigations as related to sanitary issues.

The Health Department coordinates much of the education and outreach that is necessary for successful hazard mitigation. For example, the Health Department has educated of property owners, merchants, and residents in flood zones about moving critical equipment and property off the first floor, above flood elevations. Thus, the types of mitigation that are administered by the Health Department include prevention, property protection, and public education.

Conservation Commission

The Massachusetts Wetlands Protection Act requires that no person shall remove, dredge, or alter any bank, freshwater or coastal wetlands, beach, dunes, flat, marsh, meadow or swamp bordering on any resource area as defined in the Act without filing written notice of the intention to perform such work with the Conservation Commission of the Town in which the land is located and receiving a permit from the Commission to perform the work. This mandated authority was reinforced by the 1963 Annual Town Meeting which authorized the establishment of a Conservation Commission for the Town.

The Conservation Commission is comprised of seven members appointed by the Select Board. The Commission function is to review, condition and permit activities within 100 feet of inland and coastal wetlands. The Town has a separate Wetlands By-law, Chapter 136, that increases protection over the State Wetlands Protection Act.

In February 1988, the Conservation Commission passed local regulations which provide for more strict controls in and around both inland and coastal wetlands than are provided by the State's enabling legislation and ensuing regulations. The Commission's protected interests of public and private groundwater protection, prevention of pollution, erosion control and storm damage prevention provide great benefit to the Town's seasonal and year-round economy.

Nantucket Memorial Airport

The Nantucket Memorial Airport is one of the two important transportation hubs serving the community. The Nantucket Memorial Airport is governed by the Town's Airport Commission. According to the Town of Nantucket web site, the airport has operated for more than 60 years and is open seven days a week, year-round. The airport serves over 500,000 commercial passengers each year.

According to the airport web site, Nantucket Memorial Airport is responsible for operating and maintaining airport facilities; and ensuring that runways, taxiways and other facilities are in good working condition, meet FAA regulations, and are available for use. The FAA is responsible for managing Nantucket's airspace and for ensuring the safe and expeditious flow of traffic. This is accomplished through a coordinated effort between Nantucket Air Traffic Control Tower located at the Airport and Cape Terminal Radar Approach Control located at Otis Air Force Base on the Cape. Nantucket Air Traffic Control Tower is responsible for selecting the runway(s) in use at any particular time.

With regard to pre-disaster mitigation, the Nantucket Memorial Airport is mainly involved with the element of emergency services. The Town and the Airport staff coordinate sharing heavy equipment, such as loaders, firefighting equipment and snow removal equipment, when necessary.

Wannacomet Water Company

Wannacomet Water Company provides potable water and fire protection to the Island. The water company is a municipal department that is overseen by two separate elected commissions (the Siasconset service area, previously served by the Siasconset Water Department, continues to have its own commission).

The water company provides support roles as related to natural disaster preparation and response. Water company equipment and personnel is available to assist the Emergency Management Agency. Before storms, water tanks are filled, and equipment is secured. Through careful preparation, fire protection and potable supply are available during and after natural disasters. Natural disasters specifically addressed in the water system emergency plans include hurricanes, fires, and earthquakes.

Tanker leaks or hazardous material spillage within the groundwater wellhead source areas is a significant concern for the Town. Natural hazard events that may degrade or damage equipment are seen as potential catalysts of groundwater contamination. The Town will conduct a table-top exercise in 2019 for a simulated tanker leak adjacent to a Town well head. Findings will improve capabilities and identify additional needs for emergency response. Nantucket is also concerned about safety and runoff on the roadways adjacent to Town water supply wellfields.

Selectman's Office and the Town Administration Department

The mission of the Select Board is to "serve the community by providing clear, concise goals and policies that ensure quality in the delivery of town services and improved efficiencies in operating town government." The Office of the Selectmen oversees administration of Town government, licensing, personnel administration, and administration of policies and procedures.

The Town Manager oversees the Administration department, and has responsibilities ranging from supervision of town departments, coordinating major projects and preparation of the Town budget.

Although the selectmen and the Town Manager may not directly participate in hazard mitigation, they oversee most of the other departments described in this section, including Health, Building, Fire, Police, Public Works, and Marine and Coastal Resources; and appoint the Airport Commission, Conservation Commission, and Zoning Board of Appeals.

Former Marine and Coastal Resources Department

One major change since the adoption of the initial hazard mitigation plan is that the Marine and Coastal Resources Department was dissolved, and its duties transferred between 2007 and 2018. The former department had five primary areas of responsibility:

- Harbor Management – The department operates the Town's 100-slip marina, seasonal transient slips, and pump out facilities; permits and inspects 1,600 private moorings; negotiates and monitors the 125 rental mooring contracts; performs search and rescue missions, firefighting, and oil spill response throughout all waters of Nantucket; and deploys and maintains 78 navigational aids.
- Law Enforcement – Enforces state and local boating laws, safety regulations, boat registration, jet skis, and speeding; enforces fisheries (within the three-mile limit) and shellfishing state and local laws; issues 1,800 non-commercial shellfish permits; patrols and regulates 100 commercial bay scallop boats for a five-month season; and posts and patrols all areas open/closed to shellfishing.
- Water Quality – Maximizes the number of non-commercial and commercial shellfish beds open to the public; performs water sampling and analysis for all waters of Nantucket; maintains parameters outlined for the continuance of a Federal No-Discharge Zone with

emphasis on education and enforcement; coordinates Title V sampling with the Health Department to reduce the number of septic sources of pollution; and monitors single source and ground water run off pollution points.

- Beach-Pond Management – Rescues individuals endangered while swimming and boating and provides first aid; coordinates marine-related missing person searches with other agencies; continuously checks barrier beaches for marine mammal stranding events and monitors areas for endangered species prior to pond opening and dredging activities; and issues beach stickers and provides educational materials to individuals driving on the authorized beaches.
- Support and Maintenance – Provides technical assistance to state and local agencies upon request in the development of recommendations for environmental issues; maintains department buildings, piers, boats and equipment on a year-round basis; and develops bid specifications, coordinates grant awards, and monitors contract performance (for example, related to major repairs of department structures).

With regard to hazard mitigation, the Department had many roles, reflecting all six mitigation types (prevention, property protection, natural resource protection, structural projects, emergency services, and public education). Department staff posted weather and surf advisories and conduct informal education of boaters regarding the potential for storm damage. Before storms, the Department recommended that people leave Nantucket, and then assisted remaining boaters with removal of boats from the harbor and securing crafts that remain in the harbor. The Department was responsible for maintaining, repairing, and improving piers and boat ramps that are used to remove and secure boats. Finally, through its beach management duties, the Department helped protect natural resources that reduce hazard effects, such as dunes and barrier beaches. These duties are now accomplished by other departments. The Town's overall capabilities have not been hindered by the reorganization.

Summary of Department and Agency Roles in Hazard Mitigation

Table 2-2 summarizes the roles of the municipal departments, agencies, and groups described above.

Table 2-2: Municipal Roles in Hazard Mitigation

AGENCY	RELEVANT MITIGATION TYPE					
	Prevention	Property Protection	Natural Resource Protection	Structural Projects	Emergency Services	Public Education
Emergency Management					✓	✓
Fire Department					✓	✓
Police Department					✓	✓
Public Works	✓	✓	✓	✓		
Sewer Department	✓		✓			
Planning & Land Use Services	✓	✓	✓			
Health Department	✓	✓				✓
Conservation Commission			✓			
Nantucket Memorial Airport					✓	
Water Companies	✓				✓	
Town Administration	✓	✓	✓	✓	✓	✓

2.9 Review of Existing Plans and Regulations

It is important that the HMP be consistent with, build off of, and inform other municipal and regional plans, regulations, and other documents. This section summarizes relevant aspects of such documents and can be used as a tool to ensure continued integration.

Nantucket Zoning and Ordinances

The Town of Nantucket has a number of regulations on the books that fall within the categories of natural hazard mitigation formally known as "property protection," "natural resource protection," "emergency services," and "prevention." These regulations are incorporated into a number of locations within Nantucket's code and zoning regulations (zoning regulations are incorporated into the Town's code as chapter 139). Relevant sections are listed below.

Chapter 66: Protection of Coastal Areas and Open Spaces

- 66-1: Purpose
  - To protect the beaches, coastal areas and other open unimproved spaces of Nantucket by regulating activities deemed to have a significant effect on the environment, scenic views, or the natural, scenic, historic and aesthetic qualities of these spaces. Protection is extended to private as well as to public open space areas

- ❑ 66-3: Prohibited Activities
    - o Activities prohibited are short term disruptive activities (possession of alcohol, open burning, operation of generators)

<u>*Chapter 136: Wetlands*</u>

The Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) provide guidance to all local municipalities in the State relative to inland and coastal wetland and coastal resource protection. The Town has a Wetlands Bylaw, Chapter 136 of the Code of the Town of Nantucket, that increases protection above the State Wetlands Protection Act. Flood and erosion hazard mitigation are important considerations set forth in the bylaws.

Section 136-2 of the wetland regulations require that projects be reviewed in the context of not only impacts to wetlands, but *potential effects on flood control, erosion control, and storm damage prevention*. Section 136-3 of the wetland regulations prevents filling, altering, dredging, or construction on or within *100 feet of land subject to tidal action, coastal storm flowage, inland or coastal flooding or inundation, or within 100 feet of the 100-year storm line*, without a permit.

The Town of Nantucket Conservation Commission has published *Wetland Protection Regulations* (revised through May 18, 2005) to administer Bylaw Chapter 136. These regulations set forth certain performance standards for activities that are designed to protect the ability of resources to protect against flood damage and erosion, and prevent or limit construction near areas prone to flood damage and erosion. Examples of these performance standards include:

- ❑ For <u>"Land Under the Ocean"</u>
    - o "No new bulkheads or coastal engineering structures shall be permitted to protect structures constructed or substantially improved after 8/78. Bulkheads may be rebuilt if the Commission determines that there is no environmentally better way to control the erosion problem, including in appropriate cases the moving of the threatened building. Other coastal engineering structures may be permitted only upon a clear showing that no other alternative exists to protect a structure built prior to 9/78, but not substantially improved, from imminent danger."
    - o "Water dependent projects shall be designed and performed so as to cause no adverse effects on… erosion control… storm damage prevention, flood control…."
- ❑ For <u>"Coastal Beaches"</u>
    - o "No new bulkheads or coastal engineering structures shall be permitted to protect structures constructed or substantially improved after 8/78…[same as above]."
    - o "Clean fill of similar grain size may be used on a coastal beach nit not on a tidal flat, only if the Commissioner authorizes its use, and only if such fill is to be used for a beach or dune nourishment project."

- "In areas of eroding shoreline, the distance from all buildings to the coastal beach shall be at least 20 times the average annual shoreline erosion or 100 feet, whichever is the lesser."

- ❑ For "Coastal Dunes"
  - "Fill may be used only if the Commissioner authorizes its use and only if such fill is to be used for a beach or dune nourishment project."
  - "Any activity allowed on a coastal dune or within 100 feet of a dune shall be restricted to such activity that is determined by the Commissioner not to have any adverse effect on the dune… by causing any modification of the dune form or slope that would increase the potential for erosion, storm or flood damage…."
- ❑ For "Coastal Banks"
  - "No new bulkheads or coastal engineering structures shall be permitted to protect structures constructed or substantially improved after 8/78…[same as above]."
  - "In areas of eroding shoreline, the distance from all buildings to the coastal beach shall be at least 20 times the average annual shoreline erosion or 100 feet, whichever is the lesser."
  - "All permits issued for the construction of buildings under the Bylaw within 100 feet landward of the top of coastal bank shall contain the specific condition that no coastal engineering structure of any kind shall be permitted on an eroding bank in the future to protect the project allowed by this permit."
- ❑ For "Land Subject to Coastal Storm Flowage"
  - "The work shall not reduce the ability of the land to absorb and contain flood waters, or to buffer inland areas from flooding and wave damage."
  - "Building upon areas subject to coastal storm flowage in locations where such structure would be subject to storm damage may not be permitted. If permitted, all construction must be in compliance with state and local building code regulations for flood hazard areas."
- ❑ For "Vegetated Wetlands"
  - Proposed projects shall not use procedures that the Commission determines changes the flood protection function (leveling out of storm surges by storing and slowly releasing water) of vegetated wetlands by significantly changing the rate of water flow through the wetlands (by channelization or other means)."
- ❑ For "Land Subject to Flooding"
  - Projects on land subject to flooding shall be permitted only in connection with such procedures determined by the Commission as not having the effect of reducing the ability of the land to absorb and contain floodwaters."

- "The Commission may require compensating or greater flood storage capacity in the same watershed if it permits any filling of land subject to flooding, and all filling of areas subject to flooding shall be strictly minimized."
- Building upon areas subject to flooding shall be in compliance with appropriate state and local building code requirements."

Chapter 139: Zoning

Most of the Zoning regulations relevant to hazard mitigation specifically address flood hazard zones. Building height restrictions, in part designed to mitigate wind damage, are also included in these regulations. Relevant sections are listed below:

- 139-4: Location of Districts [approved 5/7/2014]
    - Defines the Flood Hazard Overlay District as coincident with Zones A, AE, and VE on the Nantucket County Flood Insurance Rate Map (FIRM) from June 9, 2014
- 139-12 (A): Flood Hazard Overlay District [approved 5/7/2014]
    - All development in the Flood Hazard Overlay District must comply with the following state regulations:
        - Massachusetts General Law c. 181, § 40
        - Massachusetts State Building Code addressing floodplain and coastal high hazard areas (780 CMR)
        - Wetlands Protection Regulations, DEP (310 CMR 10.00)
        - Inland Wetlands Restriction, DEP (310 CMR 13.00)
        - Coastal Wetlands Restriction, DEP (310 CMR 12.00)
        - Minimum requirements for subsurface disposal of sanitary sewage, DEP (310 CMR 15, Title 5)
    - Specific local requirements are:
        - VE Zones: All new construction, except water-related structures such as piers, groins, and similar structures shall be located landward of the reach of mean high tide. Man-made, alteration of sand dunes which would increase potential flood damage is prohibited.
        - In Zones A and AE, along watercourses that have not had a regulatory floodway designated, the best available federal, state, local or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.
        - Base flood elevation data is required for subdivision proposals or other developments greater than 50 lots or five acres, whichever is the lesser, within unnumbered A Zones.

- In a riverine situation, the Natural Resources Coordinator shall notify the following of any alteration or relocation of a watercourse:
  - Adjacent communities
  - NFIP State Coordinator
  - Massachusetts Department of Conservation and Recreation
  - NFIP Program Specialist
- All subdivision proposals must be designed to assure that:
  - Such proposals minimize flood damage;
  - All public utilities and facilities are located and constructed to minimize or eliminate flood damage; and
  - Adequate drainage is provided to reduce exposure to flood hazards.

- ❑ 139-13: Moorlands Management District [approved 5-31-2017]
  - A. Purpose: protect areas of the island known to be excellent examples of temperate zone health; often located along coastal areas.
  - B. Limits uses to conservation & recreation and single-family structures.
- ❑ 139-17 (C.7): Height Limitations [approved 12/29/2009]
  - Defines the maximum allowable heights of new construction, depending on which zone the building is in
  - In "one-hundred-year" flood zones, defines height limits based on the first floor elevation as required by floodplain management regulations [updated 7/12/2016]
- ❑ 139-22: Island Perimeter Restrictions [approved 8/18/2008]
  - Prohibits construction seaward of the primary coastal bank
  - Limits construction of new, or expansion of existing, docks, piers, wharfs or related structures
- ❑ 139-23: Site Plan Review [approved 8-5-2015]
  - Requires Base Flood Elevation and the existing or proposed Lowest Floor Elevation if the structure is within the Flood Hazard Overlay District

Previously, the purpose of the Zoning Regulations as noted in Chapter 139 was directly tied to flood damage mitigation. Since adoption of the previous HMP, however, the purpose has been rewritten, and now reads:

To promote the health, safety, convenience, morals and general welfare of its inhabitants, to lessen the danger from fire and congestion and to improve the Town…" (§139-1)

Additionally, the previous version of this HMP referenced an Open Space District proposed in 2006, and thought to be beneficial to hazard mitigation; this district appears to have been removed from the Nantucket code.

Subdivision Regulations

In Nantucket, the Planning Board is charged with administering subdivision regulations. Components of the regulations that address natural hazard mitigation are listed below:

- Section 2.0 of the subdivision regulations requires that a site analysis report answer the following questions relative to flood hazards: *"Has the layout of streets and lots fully reflected the need to protect life and property by properly locating building lots out of areas of Special Flood Hazard as delineated by the Federal Government? Will floodway easements be used to protect these areas from encroachment and advise lot purchasers of the nature of their prospective property? Has the proposed system of drainage taken severe storm damage into account?"*
- Section 3.04 of the subdivision regulations requires that subdivisions be designed to prevent loss of life and property due to flooding. Parts a, b, and c of Section 3.04 specify additional requirements for flood damage prevention as follows:
    - …new structures will be able to be safely sited within areas of each lot so that the lowest floor (including basement) is elevated to above the 100-year flood;
    - Designate flood hazard areas as common open space to be deeded fee simple to the Nantucket Conservation Commission, a homeowners association or a suitable conservation organization;
    - Include conservation easements in the plan to accommodate flood hazard areas.
- Section 3.04 further requires that all public utilities and facilities such as sewer, gas, electrical, and water systems shall be located, elevated, and constructed to minimize or eliminate flood damage. Special drainage measures shall be taken to reduce exposure of areas, both on and off-site, to flood damage.
- Section 3.08 of the subdivision regulations requires that "land subject to hazard to life, health, or property shall not be subdivided for residential purposes until such hazards have been eliminated or unless adequate safeguards against such hazards are provided."
- Section 4.07 of the subdivision regulations requires certain easements for providing underground electrical, cable, and telephone lines; and provision of easements along watercourses or channels to provide for the possibility of flood and protection of banks.
- Part (a) of Section 4.08 of the subdivision regulations requires that access be adequate to "ensure direct ingress and a rapid response time for emergency vehicles." Part (b) requires that electrical and telephone service be installed underground.

Nantucket Master Plan (Accepted April 6, 2009)

Massachusetts State law (MGL Chapter 41, Section 81D) requires every municipality to produce a Master Plan, "… a statement, through text, maps, illustrations or other forms of communication that is designed to provide a basis for decision making regarding the long-term physical development of the municipality" (M.G.L. Ch. 41-81D). Stated purposes of the 2009 Nantucket Master Plan (NMP) include:

- Fulfill the MGL 41-81D requirement
- Update the *Goals and Objectives for Balanced Growth: A Broad Policy for the Island's Future* document of 1990
- Advance and clarify aspects of the Comprehensive Community Plan of 2001
- Provide a legally defensible basis and consistency standard for zoning changes
- Enable the community to be in compliance with anticipated changes to the State's enabling laws, allowing greater local control

The 2009 NMP was intended to be relevant for a ten- to twenty-year period, with certain elements updated more frequently, such as:

- Annually: demographic information, implementation measures, and capital programming
- Four Year Cycle: transportation (circulation) goals)
- Five Year Cycle: housing and open space

Natural Hazard Mitigation Implications within the Master Plan

The Economic Development section of the 2009 NMP identifies the Downtown neighborhood (adjacent to Nantucket Harbor) as the "symbolic center" of the Island, with a high density of code-non-conforming buildings built prior to code adoption. The 2009 NMP also identifies the Mid-island area as a node for current and future growth and development.

Chapter 5 of the 2009 NMP addresses natural and cultural resources. Beaches, the harbor, the great ponds, and five scenic landscapes are noted as being Nantucket's natural resources. Renewable energy resources such as wind, solar, wave power, and tidal action are also noted. The Island-wide State-designation as a Historic District, the Federal designation of the Island as a Historic Landmark, and the plentiful individual historic buildings, sites, lighthouses, burial grounds and archaeological sites area specifically called out as critical cultural resources for the Island community.

Chapter 6 of the 2009 NMP discusses open space and recreation, and has a section on water resources. One action listed in this section is relevant to natural hazard mitigation:

- Strengthen regulations governing development, and prioritization of the acquisitions of land, within the 100-year coastal flood plain and in buffers to other wetland resource areas

This section also calls for the implementation of the Harbor Management Plan and a Coastal Management Plan (once created on 2012). Both of these plans, and their relevance to hazard mitigation, are discussed elsewhere in this HMP.

Chapter 7 covers municipal services and facilities. This section noted that the Nantucket Fire Department and the Nantucket Police Department are both deficient for current use and will need to be upgraded to meet future demand. The plan suggests construction of new facilities, or of a new shared facility, in a centralized location. Both will be the new location in 2019.

Table 2-3: 2009 Nantucket Master Plan Policies with Hazard Mitigation Implications As identified in the 2009 Plan

Policy #	Policy	Relevance
4.1.2	Encourage expansion in the mid island area	Risk Profile
5.1.2	Encourage environmentally responsible technologies (including septic technologies) to protect beaches, dunes, and coastal banks	Shoreline Change & Erosion
5.1.3	Protect the shorelines from encroachment by development	Coastal Flooding
6.1.1	Aggressively acquire land & conservation restrictions to protect natural ecosystems	Inland Flooding
7.3.1	Provide adequate public-safety facilities for rapid response to emergencies throughout the Island	Critical Facilities
7.4.1	Ensure public water-supply system provides adequate fire protection (upgrade piping, extend service, increase pressure, install additional towers)	Wildfire
7.7.1	Continue program of placing utility lines underground in all new development	All Hazards

Area Plans

To supplement the Island-wide Master Plan, Nantucket has developed six area plans to guide development and planning in the relatively dense neighborhoods of Madaket, the Mid-Island Area, Siasconset ('Sconset), Tom Nevers, Surfside, and Naushop Crossing. These Area Plans are considered part of the Nantucket Master Plan and conform with the State MGL Ch. 41-81D requirements. Recommendations put forth in these plans that are relevant to natural hazard mitigation are summarized below. Note that many of these plans are over a decade old, and recommended actions may have been completed or may no longer be relevant at this point.

Table 2-4: Nantucket Area Plan Policies with Hazard Mitigation Implications

Area	#	Recommendation	Relevance
Madaket (2006)	1	Limit growth, maintain low density	Risk Profile
Madaket (2006)	5.2	Maintain open space & waterfront access	Risk Profile
Madaket (2006)	5.3	Purchase development rights to 270-acre Loring property	Open Space/ Risk Profile
Madaket (2006)	6.2	Study establishment of an Open Space Zoning district	Open Space/ Risk Profile
Madaket (2006)	6.4	Encourage Town to purchase FAA property & keep it as open space	Open Space/ Risk Profile
Madaket (2006)	7.5	Do not install town water service.	Wildfire / Critical Facilities / Coastal Flood
Madaket (2006)	7.6	Avoid replacing septic systems with a central sewage treatment plant	Critical Facilities/ Coastal Flooding
Madaket (2006)	8.1	Develop alternative access route via Eel Point Rd & Warren's Landing	All Hazards
Mid-Island (2003)	LU1	Promote growth (through infill)	Risk Profile
Mid-Island (2003)	Inf1	Relocate & upgrade Fire Department at new Mid-Island site	All Hazards
Mid-Island (2003)	Inf4	Improve storm drainage system on Pleasant Street	Inland Flooding
Mid-Island (2003)	Inf6	Place utilities underground along Pleasant Street in connection with streetscape improvements. If cost is prohibitive, at least install conduit, in anticipation of placing utilities underground in the future.	All Hazards
'Sconset (2007)	4	Limit growth, no additional commercial development	Risk Profile
'Sconset (2007)	3.1	Develop architectural guidelines for five "architectural neighborhoods"	Potential code conflicts
'Sconset (2007)	5.6	Support research to abate erosion of easternmost coastline	Shoreline Change
'Sconset (2007)	6	Support open space preservation	Open Space
'Sconset (2007)	7.2	Construct new water tower at the old ball field.	Wildfires
'Sconset (2007)	7.2	Continue to enhance water pressure for public safety	Wildfires
'Sconset (2007)	7.5	Support continuing presence of a fire department substation within village	All Hazards
Surfside (2008)	2.2	Develop "Perimeter Beachfront Zoning District," implement 25 ft height limit	Potential code conflicts
Surfside (2008)	2.7	Maintain & improve "paper roads" with public or emergency access benefits, dispose others.	All Hazards
Surfside (2008)	3.3	Implement design standards for 3 distinct neighborhoods	Potential code conflicts
Surfside (2008)	6	Preserve Open Space	All Hazards
Surfside (2008)	6.1	Establish perimeter beachfront zoning district	Shoreline Change
Surfside (2008)	6.4	Acknowledge critical importance of dunes and beach areas	Shoreline Change
Surfside (2008)	7.3 7.4	Create reservoirs to provide sufficient water for suppression in areas not serviced by municipal water. If not feasible, extend municipal water lines to surfside for fire suppression.	Wildfires
Surfside (2008)	7.13	Bury remaining utility lines to protect from elements and lessen visual impact	All Hazards
Surfside (2008)	8.1	Develop alternate town road from Boulevarde to Monohansett Rd	All Hazards
Surfside (2008)	8.7	Develop alternate access to South Shore Road to increase emergency access	All Hazards
Surfside (2008)	8.9	Develop clear policy statement for improving & maintaining dirt roads for providing emergency vehicular access	All Hazards

Area	#	Recommendation	Relevance
Tom Nevers (2008)	5.B	Clear brush and reopen road from Milestone Road to Tom Nevers Pond to provide additional water for firefighting	Wildfire
	6.C	Address erosion (average loss of 15-feet per year in some places)	Shoreline Change
	6.3	Install removable steps from Tom Nevers Field to beach to protect bluff from erosion caused by pedestrian traffic	Shoreline Change
	7.B	Drill more shallow wells that can provide firefighting water	Wildfire
	7.6	Bury large water tanks around the area to store firefighting water	Wildfire
	7.B	Clear brush in conservation areas, especially Nantucket Conservation Foundation land, near Tom Nevers West, & near Wigwam Road	Wildfire
	7.B	Create fire-lines in conservation areas	Wildfire
	7.B	Prevent dumping of brush	Wildfire
	7.4	Bury Tom Nevers Road utility lines under bike path, to be constructed	All Hazards
Naushop Crossing (2014)	6.1	Promote open space preservation in development	All Hazards
	6.2	Convert undeveloped portion of Hinsdale Road to open space.	All Hazards
	7.2	Extend municipal water lines to Naushop Crossing to provide adequate system of hydrants to aid in fire suppression	Wildfire
	7.3	Extend sewer line to areas currently not served	Critical Facilities
	7.7	Bury remaining utility service lines to protect from the elements	All Hazards
	7.9	Improve and regularly maintain drainage on Old South Road to eliminate pooling and freezing in the wintertime.	Flooding, Winter Storms
	8.7	Pave Lovers Lane to provide alternative access.	All Hazards

Comprehensive Emergency Management Plan (CEMP)

The Nantucket CEMP underwent a significant rewrite and restructuring in 2013 in order to be consistent with new guidelines from the Massachusetts Emergency Management Agency (MEMA). The Hazard Identification section lists the natural hazards that impact Massachusetts in order of frequency as follows:

- Floods
- Heavy rainstorms
- "Nor'easter" storms
- Coastal erosion
- Hurricanes
- Tornadoes
- Urban fires and wildfires
- Drought
- Earthquakes

The hazards addressed in this HMP, as listed in section 1.3, align with the CEMP priorities. The effects of climate change on those hazards are not specifically addressed in the CEMP, as they are in this HMP.

The CEMP includes a suite of maps that useful for both emergency planning and hazard mitigation. These include maps depicting:

- ❑ **Emergency Operations Centers**: a primary (Public Safety Facility), secondary (Mobile Emergency Operations Center), and tertiary (Fire Department) EOC is shown.
- ❑ **Health & Medical Facilities**: six facilities are shown
- ❑ **Traffic Control Points**: Fifteen control points are shown, along with two alternate pickup points. Flood and Hurricane evacuation routes are mapped.
- ❑ **Mass Care Shelters**: Three shelters are shown.
- ❑ **Flood & Hurricane Evacuation Routes**: Evacuation routes are mapped, along with fifteen special institutions.
- ❑ **Fixed Hazardous Facilities**: This map depicts fixed-location hazardous facilities as well as critical infrastructure, health and medical facilities, public venues, and special institutions.
- ❑ **Critical Infrastructure**: Critical infrastructure, health and medical facilities, and transportation facilities are shown.
- ❑ **Special Institutions**: Special institutions are shown with cultural resources and public venues.
- ❑ **Hazardous Material Transportation**: Fixed hazardous facilities are mapped with hazardous transportation routes.

The CEMP should be referenced for maps and more information.

<u>Nantucket and Madaket Harbors Action Plan (2009)</u>

The Nantucket and Madaket Harbors Action Plan (HAP) presents the Town's planning vision for use and development within the harbor planning areas. The plan was developed in accordance with Massachusetts State Law (MGL 21A Sections 2 and 4A), giving authority to the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) to review and approve municipal harbor plans (301 CMR 23). MGL 21A also gives the EOEEA the agency to implement the Massachusetts Coastal Zone Management (CZM) Act (16 USC 1451). The HAP was found to be consistent with CZM program policies and management principles, as well as with the state tidelands policy objectives (301 CMR 9).

General goals and associated objectives listed in the 2009 HAP include:

- ❑ **Natural Resources:** Protect and restore the valuable natural resources of the harbors.
  - Maintain existing systems for natural resource protection
  - Provide technical & scientific support for planning & decision-making on coastal natural resource issues
- ❑ **Commercial Waterfront:** Preserve, promote, & support water-dependent uses
  - Discourage displacement of existing water-dependent uses & activities
  - Prioritize uses & activities requiring access to coastal waters when making land-use decisions on waterfront redevelopment
- ❑ **Harbor Operations, Safety, Navigation and Moorings:** Promote safety and balanced uses while maintaining the character & protecting the natural resources of the harbors

These goals are consistent with hazard mitigation objectives by encouraging protection of coastal natural resources, limiting the types of development that will occur along the shoreline in areas at risk of coastal flooding, and maximizing the navigation capacity of the harbor (essential for access following a hazard event).

Specific recommendation put forward in the 2009 HAP that are relevant to hazard mitigation are summarized in the table below.

Table 2-5: Nantucket & Madaket Harbors Action Plan Policies with Hazard Mitigation Implications

Recommendation	#	Relevance
Repair and raise jetties at the entrance to Nantucket Harbor	V.1	All Hazards / Access
Study relocation of the fuel off-loading and storage facilities away from downtown	V.2	Critical Facilities
Study feasibility of developing a second commercial dock capable of handling large vessels carrying passengers, goods, and vehicles in an emergency	VI.1	All Hazards / Access
Evaluate alternatives for addressing loss of vessel access to harbor, including improving icebreaking capabilities and establishing immediate temporary off-loading facilities	VI.1	All Hazards / Access
Maintain haul-out capacity at levels that will allow for the safe and timely removal of boats from the water in an emergency situation	VII.1	Hurricane / Coastal Flood
Investigate options for developing a new boat ramp at the south end of town	VII.2	All Hazards / Access
Formalize in writing coordination of hauling of boats before an imminent storm between the Department of Marine and Coastal Resources and local businesses	VII.3	Hurricane / Coastal Flood

Coastal Management Plan, 2014

The Nantucket Coastal Management Plan (CMP) was created for two purposes:

- To enable the Town to impose local control over activities occurring in local waters
- To comply with a 2008 Annual Town Meeting vote that created Chapter 67-1 of the local code, placing "a moratorium on the use of Town properties located along the eastern coastline… for new coastal engineering structures, bluff armoring projects, hard or soft erosion control devices, bulkheads and the like…" until a Coastal Management Plan was written.

The CMP establishes priorities and procedures for protecting and managing town-owned infrastructure, public access points, and roads adjacent to the coastline.

The 2014 CMP lists many Coastal Management principles, a number of which are relevant to coastal hazards and erosion:

- Should any Town-owned coastal-infrastructure become damaged in a storm, the Department of Public Works (or other appropriate parties) should remove debris and take action to prevent it from becoming a hazard

- Any license granted for the use of Town land for coastal management or erosion control projects shall include a requirement to establish insurance that will provide funding for any action necessary to stabilize the site or remove any debris that becomes hazardous
- The Town should use an established system to identify and mark all structures or debris that pose a hazard
- Erosion control projects on Town property will minimize adverse impacts to the extent that they can. The long-term viability or sustainability of projects must be carefully considered.
- The Town should be notified when a coastal erosion control project is proposed on property adjacent to a "one big beach[7]" easement or other property in which the Town has interest.

The 2014 CMP breaks the Island's coastline into a series of sectors and presents a suite of recommended actions for each sector. Many actions are repeated as recommendations in multiple sectors. A summary of these recommendations is provided below. All of these recommendations are relevant to coastal flooding and shoreline change, unless otherwise specified.

- Repair return [wingwall] on Quaise Road bulkhead
- Use dredge spoils to nourish Quaise Road beach area
- Replace and upgrade Easy Street bulkhead
    - Raise to reduce splash over at high tides
    - Incorporate storm drain valves
- Permit maintenance dredging for existing boat channels in Madaket Harbor (relevant to emergency access)
- Establish emergency access plan with the Tuckernuck Island Landowners Association (relevant to emergency access)
- Monitor Ames Street & Madaket Road intersection
- Monitor distance from top of bank at the head of Hither Creek to nearby home
- Deposit dredge spoils at the head of Hither Creek to increase protection to that site, Millie's Bridge, and Smith Point
- Maintain new access road to neighborhood around Sheep Pond road (relevant to emergency access)
- Establish actionable "trigger points" between the town's sewer beds and the eroding shoreline bank, and monitor erosion; when trigger points are reached, draw up plans to either address the erosion or relocate the sewer beds.
- Install sand fencing and implement beach grass replanting in front of the airport runway
- Develop options for soft engineering, hard armoring, and relocation of infrastructure, at the airport to prepare for continued erosion

[7] Nantucket's "One Big Beach" program is a municipal effort to obtain public access to private beaches in exchange for tax breaks, liability insurance, and Town maintenance and clean-up.

- ❑ Remove sand after Codfish Park storm inundation, and return that sand to the barrier beach for nourishment (do not remove for other uses)
- ❑ Plan native, salt-tolerant vegetation to stabilize bank slope (multiple locations)
- ❑ Provide beach nourishment (multiple locations)
- ❑ Slope road or parking-lot drainage away from eroding bank, redirecting runoff into vegetative swale (multiple locations)
- ❑ Ensure storm drains are maintained and functioning properly (multiple locations; relevant to inland flooding)
- ❑ Continually monitor coastline, inspect following storms, and maintain a photo record (all locations)

The 2014 CMP condenses all of its sector-specific recommendations into a set of action items, including:

- ❑ Monitor implications of continued erosion in front of Dionis Beach infrastructure
- ❑ Establish emergency access plan with Tuckernuck Island Landowners Association
- ❑ Prioritize monitoring of erosion in front of sewer beds
- ❑ Establish actionable trigger points in front of sewer beds - when point is reached, plans must be drawn up to address erosion or relocate
- ❑ Establish trigger points in front of Airport and monitor erosion
- ❑ Develop a maintenance and alternate access plan for Codfish Park Road, including management of sand and coastal dune and its natural migration
- ❑ Maintain Jetties
- ❑ Require insurance of all parties that construct or maintain coastal management or erosion control projects on Town owned property
- ❑ Produce a Vulnerability Study to identify properties and infrastructure in danger of being damaged or compromised by erosion or coastal storms. These assets should be prioritized and a Committee or Work Group should be established to plan for and implement emergency response (including maintenance, protection, relocation, or removal) when necessary.
- ❑ Identify areas that are experiencing accelerated erosion from adjacent land use conditions or infrastructure; begin implementing mitigation measures wherever possible
- ❑ Address restricted building height in areas where it is in conflict with state requirements for flood zone compliance
- ❑ Update Hazard Mitigation Plan

<u>Coastal Resilience Plan/Climate Resiliency Plan (underway)</u>

Nantucket retained a consulting firm in December 2017 to begin development of a Coastal Resilience Plan/Climate Resiliency Plan for the Town. This plan will focus on policy and regulatory tools that can be implemented to ensure the continued resilience of the Island in the face of rising seas and increasingly severe and frequent coastal storms. The document will include and implementation plan for integration of recommendations into the municipal code the town's

Master Plan, and other town plans (including this HMP). The plan will also be a first step in a more comprehensive climate resilience plan process that will follow the Massachusetts Municipal Vulnerability Planning (MVP) program framework, follow the state's workshop process, and will lead to a report and recommended actions for designation as a state-certified MVP community.

Capital Improvement Plan

The Town of Nantucket, Massachusetts Capital Improvement Plan (CIP) lists all of Town projects planned over the next ten years that will increase the overall value of the Town's assets. The most recently available CIP for the Town was completed in February 2018 and includes projects expected to be initiated during the 2019 fiscal year (FY19) through the 2028 fiscal year (FY18). Projects span all municipal departments.

Types of projects relevant to natural hazard mitigation include:

- **Airport:**
    - Maintenance, infrastructure, and environmental projects planned over multiple years
- **Facilities**
    - Facility roof repairs planned on an annual basis
- **Fire Department**
    - Equipment and vehicle replacements planned on a rolling basis.
- **Geographical Information Systems**
    - Updates to digital mapping capabilities.
- **Police Department**
    - Improvements to harbormaster building planned in FY19
    - Public safety radio replacement planned in FY22
- **Public Works**
    - Maintenance, repair, and replacement of vehicles and machinery planned on an annual basis
    - Storm water projects planned for most years (over $12 million to be spent by 2028)
- **School Department**
    - Improvements to building and roofs – relevant to emergency shelter
- **Sewer**
    - Evaluation and repairs to wastewater treatment plants (WWTP) and pump stations
    - Assessment and inspections of force mains
- **Water Utilities**
    - Maintenance and replacement of water tanks
    - Water Main replacements
- **Transportation**
    - Road maintenance, improvements, and reconstruction planned annually

Wastewater Capacity, Management Operations and Maintenance (CMOM) Program

The Town's sanitary sewer infrastructure has been built over the last 100 years or more using a variety of materials, design standards, installation techniques, and maintenance practices. As this valuable infrastructure ages, the importance of preventive and predictive maintenance increases.

Nantucket is complying with the requirements of the EPA and performing a complete evaluation of the Town-owned sanitary sewage collection systems to prevent sanitary sewer overflows and basement back-ups. It includes framework to identify and incorporate widely-accepted wastewater industry practices to:

- ❑ Better manage, operate, and maintain collection systems
- ❑ Investigate capacity constrained areas of the collection system
- ❑ Respond to sanitary sewer overflow (SSO) events

The Sewer Department is actively performing an inventory, closed-circuit-television (CCTV) inspection, and condition assessment of its infrastructure. Data collected through these efforts will shape the Town's Capital Program and will be incorporated into the Town's Geographical Information System (GIS) to facilitate planning and coordinating projects with Sewer, DPW, Water Company, Transportation Planning and Coastal Resilience activities.

Storm Water Management Plan (SWMP)

Similar to the sanitary sewer system, Nantucket's storm drainage infrastructure has been built over the last 100 years or more using a variety of materials, design standards, installation techniques, and maintenance practices. Managing storm water on Nantucket has used a variety of solutions ranging from "doing nothing" to having a convenient connection to the sanitary sewer system. The CMOM program is helping to identify these connections. Handling storm water, increased runoff from development, climate change (increasingly more intense and more frequent storms) as well as an increased addition of basement sump pumps has exacerbated capacity issues within our drainage systems.

Building off the CMOM Program, DPW is actively performing an inventory, CCTV inspection and condition assessment of the storm water and drainage systems.

2.10 Available Information to inform Planning and Taking Action

Massachusetts Shoreline Change Project, published by CZM, (current)
Provides information about changes to Nantucket's coastal areas
https://www.mass.gov/service-details/massachusetts-shoreline-change-project

CZM's Online Mapping Tool (current)
GIS based mapping tool to examine specific property locations
http://maps.massgis.state.ma.us/map_ol/moris.php

Nantucket Storm Tide Pathways (2016)
Report provides insight to rising sea levels and location susceptible to inundation.

http://www.nantucket-ma.gov/DocumentCenter/View/19053/Storm-Surge-and-Inundation-Pathways---2016

Worcester Polytech Institute, Storm Surge & Critical Infrastructure on Nantucket (2015)
Identifies locations of critical infrastructure in Town and recommended mitigation actions.
http://www.nantucket-ma.gov/DocumentCenter/View/19052/Storm-Surge-and-Critical-Infrastructure-on-Nantucket---2015

Town of Nantucket GIS (current)
Provides information for parcels, land use and planning, topography, aerial imagery and emergency management
https://nantucketma.mapgeo.io

2.11 Critical Facilities and Sheltering Capacity

The Town of Nantucket considers that several categories of facilities are critical, for these are needed to ensure that emergencies are addressed while day-to-day management of the community continues:

- Emergency Services – Police, Fire, Coast Guard
- Municipal Facilities – Town Hall, Municipal Buildings, DPW
- Schools – Primarily for use as a Shelter
- Health Care – Hospital, Assisted Living
- Water Utilities – Tanks, Pumping Stations
- Wastewater Utilities – Pumping Stations, Treatment Plants
- Transportation – Steamship Dock, Airport, Transit Authority, Boat Ramps
- Fuel Storage and Power Generation – Tank Farms, Alternate Generating Facilities
- Communications – Telephone Stations, Mobile Phone Towers
- Power Supply from Mainland – National Grid and Power Transmission/Switching Infrastructure
- Supply Chain for the transportation of people, supplies, materials, equipment, etc., between the Island mainland (via sea or air)

Upon comparison to other Massachusetts communities, Nantucket has a larger proportion of facilities that are considered critical. This is partly a reflection of the Town's character as an island and 30 miles off the coast of Cape Cod. For example, docks, boat ramps, and an airport may not be critical facilities for a community adjacent to another municipality with the same facilities, because one community could offer mutual aid services to another during a disaster. This arrangement is not possible for Nantucket. The inclusion of communications towers as critical facilities is another example. Due to its isolation in the Atlantic Ocean, Nantucket must be able to rely on many of its own facilities.

A list of critical facilities is provided in Table 2-6 on the next page. Figure 2-8 depicts locations of critical facilities. A few notable categories of critical facilities are discussed below.

Table 2-6: Critical Facilities

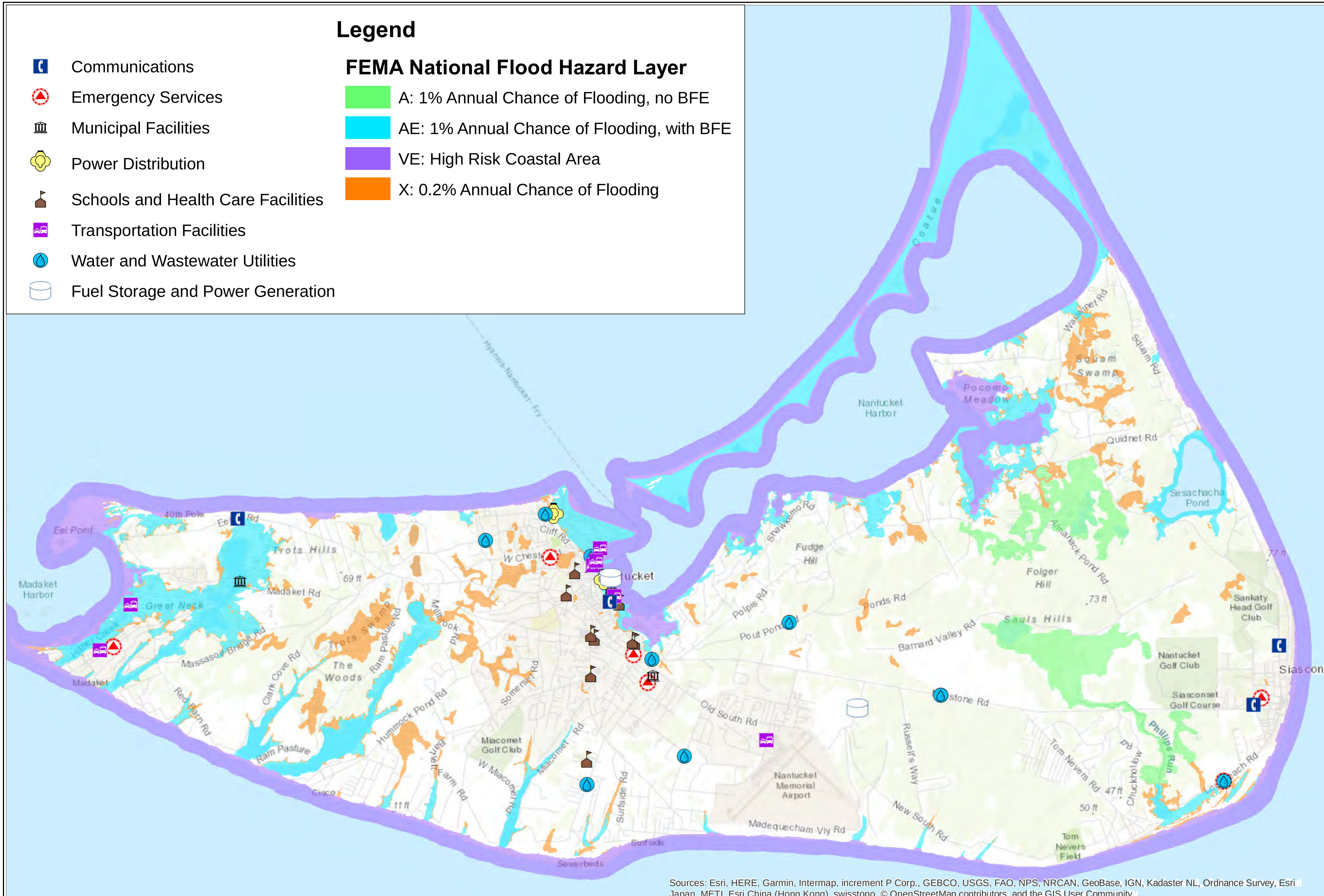
Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	Near Erosion Zone?
Emergency Services					
Police Station (Emergency Operations)	4 Fairgrounds Road	Yes	Secondary	No	No
Main Fire Station: *new station under construction*	131 Pleasant St	Yes	No	No	No
Madaket Fire Station (unstaffed satellite)	292 Madaket Rd	No	No	No[1]	No
'Sconset Fire Station (unstaffed satellite)	10 W. Sankaty Rd	No	No	No[1]	No
Police & Coast Guard Barracks	Low Beach Rd	No	No	No[1]	Yes
Massachusetts State Police Barracks	North Liberty St	Unknown	No	No	No
Municipal Facilities					
Town Hall	16 Broad St	No	No	Yes (AE9)	No
Town Building	22 Federal Rd	No	No	No	No
Town Building	2 Fairgrounds Rd	Yes	Yes	No	No
Town Building	37 Washington St	No	No	Yes (AE9)	No
Marine Department	34 Washington St	No	No	Yes (VE9)	No
DPW Facility	188 Madaket Rd	Yes (garage only)	No	No	No
Schools and Health Care Facilities					
High School	10 Surfside Rd	Yes	Yes	No	No
Intermediate School	30 Surfside Rd	Yes	No	No	No
Elementary School	30 Surfside Rd	No	No	No	No
Nantucket Cottage Hospital	57 Prospect St	Yes	No	No	No
Academy Hill Apartments	4 Westminster St	No	No	No	No
Our Island Home	9 East Creek Rd	No	No	Margin[2]	No
Saltmarsh Senior Center	81 Washington St	No	No	Yes (AE9, LimWA)	No
Landmark House	144 Orange St	No	No	Margin	No
Sherburne Commons	40 Sherburne Commons	No	No	No	No
The Homestead	115 Main St	No	No	No	No
Power Distribution					
Undersea Cable Entry Point	Jefferson Ave	NA	NA	Yes (submerged)	Yes
Candle Street Substation	Candle Street	NA	NA	Yes (AE9)[3]	No

1. *Not located in floodplain or coastal flood hazard area, but potentially isolated during a 1% annual-chance flood event*
2. *Located in a hurricane storm surge area*
3. *Flood barriers have been installed at this site*

Table 2-6 Critical Facilities (Continued)

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	Near Erosion Zone?
Water and Wastewater Utilities					
Wannacomet Water Company Facility	1 Milestone Rd	Yes	NA	No	No
Wannacomet Water Wyer's Valley Wellfield	Milestone Rd	Yes	NA	No	No
Wannacomet Water State Forest Wellfield	Lovers Lane	Yes	NA	No	No
Wannacomet Water Pout Pond Wellfield	Pout Pond Rd	Yes	NA	No	No
'Sconset Water Siasconset Wellfield	Milestone Rd	Yes	NA	No	No
Main Water Tank	Cliff Rd	NA	NA	No	No
'Sconset Water Tank	Lincoln Ave	NA	NA	No[1]	No
Sewer Pumping Sta.	Sea Street	Yes	NA	Yes (AE8)	No
'Sconset WWTP	Low Beach Rd	Yes	NA	No[1]	Yes
Surfside WWTP	South Shore Rd	Yes	NA	No	Yes
Transportation Facilities					
Steamship Dock	Broad St	No	No	Yes (AE9)	No
Nantucket Airport	Airport Rd	Yes	No	No	No
Airport Maintenance Building	New South Rd	Yes	No	No	No
Transit Authority Office	New South Rd	No	No	No	No
Transit Authority Garage	New South Rd	No	No	No	No
Town Pier	Washington St	NA	NA	Yes (VE11)	No
Children's Beach Boat Ramp	Harbor View Way	NA	NA	Yes (VE10)	No
Madaket Boat Ramp	F Street	NA	NA	Yes (AE8)	No
Madaket Marine Boat Ramp	20 N. Cambridge St	NA	NA	Yes (AE8)	No
Great Harbor Yacht Club Boat Ramp	1 S. Beach Street	NA	NA	Yes (AE8)	No
Fuel Storage and Power Generation					
Fuel Tank Farm	New Whale St	NA	NA	Yes (AE10)	No
Propane Tank Farm	New South Rd	NA	NA	No	No
Alternate Generation Facilities	New South Rd	NA	NA	No	No
Communications					
Telephone/Microwave	Eel Point Rd	Yes	NA	No	No
Telephone Switching	Union St	Yes	NA	Margin	No
Telephone Switching	Bunker Hill Rd	Yes	NA	No[1]	No
Mobile Phone Tower	Eel Point Way	Yes	NA	No	No
Mobile Phone Tower	Sankaty Ave	Yes	NA	No	No

1. *Not located in floodplain or coastal flood hazard area, but potentially isolated during a 1% annual-chance flood event*



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www.miloneandmacbroom.com

SOURCE(S):
FEMA DFIRM
Town of Nantucket

CRITICAL FACILITIES
TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN
NANTUCKET, MASSACHUSETTS

Map By: NBS
MMI#: 2967-09
MXD: U:\Y\2967-09\Maps\Fig2_9_CriticalFacilities.mxd
1st Version: 08/28/2017
Revision: 11/06/2018
Scale: 1 in = 4,638 ft

FIGURE 2-8

Nantucket Cottage Hospital

Nantucket Cottage Hospital is a full-service emergency health center, and the only hospital on the Island. The Hospital is currently constructing a new, larger building to replace the current facility; the new building will include an emergency command center to direct the Hospital's existing incident response plan. The Hospital has the capacity to operate for 96 hours on its backup generators.

Docks and Boat Ramps

Steamboat Wharf

The Steamship Authority Dock is the point of entry for almost all of the food, supplies, equipment, and resources that are used in Nantucket. It is also one of only two major passenger ferry terminals. An increase in truck traffic via the terminal has been realized over the past two decades as population has increased. This has been accommodated, in part, by improving operational efficiencies. Two freight boats were also increased in capacity.

Many Nantucket residents consider Steamboat Wharf to be the most important of all critical facilities. Keeping the dock open and operable before and after any natural disaster is paramount to the Town's ability to handle a disaster.

Steamboat Wharf is located in a 1-percent annual-chance coastal flood zone with wave velocity hazards (VE Zone). Although the dock is relatively elevated and could remain dry during certain storm surges, ships would not be expected to operate at such times. After subsidence of storm surges, rapid recovery of the dock area would be imperative.

Several 10,000-gallon fuel tanker trucks arrive via the Steamboat Wharf each week during the summer. It is important to maintain safe conditions for their arrival to avoid an accident or a fire, as a fuel-related incident could cut off the Steamship Dock (and hence, all of Nantucket) from the mainland. Similar to storm events, rapid recovery of the dock area after an accident or fire would be imperative.

Straight Wharf

The other high-capacity ferry service to Nantucket is operated by Hy-Line Cruises off of Straight Wharf. This facility is located in a 1-percent annual-chance coastal flood zone with wave velocity hazards, just south of Steamboat Wharf. While Hy-Line Cruises does not transport freight, supplies, or equipment in the way the Steamship Authority does, its ability to transport hundreds of passengers to and from the Island make it a critical lifeline to the mainland.

Town Pier

The Town Pier and Harbormaster house are located on Washington Street, and are open to all recreational boaters. The pier is vulnerable to storm surge and easterly wind conditions and was damaged by the nor'easter storms of 2018. Additionally, the section of the pier built on floats had been decaying under ocean conditions. A project to replace the floating docks began in the fall of 2018, with a project budget of over $500,000. It is estimated that complete repair of the pier will cost over $1.3 million. Over the long term, the Town is considering upgrading the structure to one that is more robust or installing a barrier wall. The Emergency Management Agency considers this facility to be one of the most at-risk.

Public Boat Ramps

- Children's Beach: The Children's Beach Boat Ramp is located at the end of Harbor View Way and provides access to Nantucket Harbor north of Children's Beach. Work to deepen the boat launching ramp and to repair the piers and decking were completed in February 2018. Previous repairs in fall of 2006 increased the width, pitch and depth of the ramp, making it easier to remove two boats simultaneously. A storm water pump station and flood gate are located on this site and present challenges relevant to coastal flood hazards; these are discussed in Section 4.5.1.
- Washington Street Extension: A second boat ramp servicing the downtown area is located near the end of Washington Street Extension. This facility is unpaved.
- Polpis: A boat ramp servicing the eastern end of Nantucket Harbor is located in the Polpis neighborhood at the end of Wauwinet Road. This facility is unpaved.
- Madaket Boat Ramps: Two public boat ramps service the western part of Nantucket; the F-Street Boat Ramp and the Massachusetts Avenue Boat Ramp (on Smiths Point).
- Several private docks serve Tuckernuck Island, and municipal officials report a single Town-owned dock is available for Town use. Access to Tuckernuck Island before, during, or after emergency events is a concern of the Town.
- Muskeget Island does not have any docking facilities.
- Other locations providing boat access to the waters around Nantucket are located around the Island but are not maintained by the Town.

Gray Lady Marine provides large lift services on Nantucket Harbor. Great Harbor Yacht Club (96 Washington St. Ext.) now owns the property and maintains the facility and a boat ramp. Although there has been some question from residents that the facility will no longer be available to lift before storms or store boats with fixed masts/towers over 25 feet, Nantucket Planning Board permit conditions require that the facility remain available.

Madaket Marine operates a large lift facility servicing the Madaket area.

All boat ramps, docks, and lift facilities, due to their water-dependent natures, are located in coastal 1-percent annual-chance flood zones. The ramps would need to be used in advance of storms with any possibility of storm surge.

The Nantucket Harbor Channel and Jetties

All ferry and freight traffic to and from Nantucket, as well as a majority of small boat traffic, occurs via terminals and docks located within Nantucket Harbor. The Harbor is accessed through the Nantucket Harbor Channel ("the Channel"), a relatively narrow dug channel protected by two

U.S. Army Corps of Engineers jetties and maintained through regular dredging activities. The eastern jetty has an opening toward the southern end with a small, also dredged, channel to allow emergency access for small boats.

Significant concern has been expressed by Town personnel, and is reflected in other municipal documents, about the risk of the channel being blocked by damaged ships or debris. This is of particular concern following debris-generating storm events, which could conceivably carry debris or damaged vessels and deposit them in a location that would prevent travel through the channel.

In the winter of 2018, the Nantucket Harbor and Hyannis Harbor both experienced extreme cold temperatures causing ice to block passage of the freight and passenger ferries. The US Coast Guard was contacted and reopened the channel when weather conditions allowed. As a result, and like other coastal weather conditions, the ferries and supplies were delayed for several days. Some trips required the ferry to run from Wood Hole due to the amount of ice in Hyannis Harbor. Navigational buoys in Nantucket Harbor were dragged out of position by the ice and that impacted the operation of the ferries until the situation was corrected.

<u>Nantucket Airport</u>

Nantucket Airport as a whole is considered the most critical transit facility after the Steamship dock. The airport has its own emergency response personnel and they serve as the First Responders during emergency incidents, until the Nantucket Fire Department arrives. The airport has its own snow removal equipment. As with other areas in Nantucket, snow drifts are a problem and they need to be cleared frequently. Before wind storms of any kind, airplanes are moved to hangars and loose items are secured. They also maintain some emergency supplies for employees (cots, etc.) in order to remain operable. Fuel storage at the airport includes 50,000 gallons of aviation gasoline and 100,000 gallons jet fuel. The airport has its own generating facility. In summary, the airport can operate relatively autonomously, although it has a good relationship with the Town.

Although the airport is not located in a flood zone, erosion rates directly south of the airport are a concern. As explained in Section 6.0, the south shore of Nantucket is eroding at an average long-term rate of nine feet per year south of the airport. Eventually, significant portions of the airport will need to be relocated, including a runway, to retreat from the eroding coast. However, this will not occur for another 50 to 100 years.

The critical nature of the airport was exhibited in January of 2018, after a sewer main burst under the stresses of major temperature swings and precipitation. Nantucket Harbor was about 70-percent iced over at the time, making supplies and workers from Cape Cod unable to access the Island by Ferry. High winds prohibited typical air travel. In the end, an Air National Guard Blackhawk helicopter delivered nine workers to the Nantucket airport from Joint Base Cape Cod. Having the airport as an additional method of ingress and egress is critical in emergency situations.

Fuel Tank Farm

The fuel tank farm is considered a critical facility because fuels are stored at the site and distributed from the site. According to the Nantucket Pipeline and Bulk Fuel Storage assessment (VHB, 2005), the facility stores gasoline, heating oil, diesel fuel, and kerosene in 11 above-ground storage tanks ranging in capacity from 10,000 gallons to 200,000 gallons, for a total storage of one million gallons. The ages of the tanks range from the 1940s to the 1960s. Fuels are delivered to the tanks by tanker trucks arriving at the Steamship Dock and by barges that dock at the Nantucket Boat Basin Marina.

While the fuel tank farm is currently located on New Whale Street in the harbor area, it is slated to be relocated to a site near Nantucket Memorial Airport in 2019. This relocation will remove a potential fire, explosion, and hazardous spill condition from the densely developed downtown area to a less-developed location. More specifically related to *natural* hazard mitigation, the primary benefits of a relocation will be to remove the tank farm from the harbor's coastal flood zone and site the facility in a location that is not only outside of a floodplain, but more accessible during natural hazard events such as floods and winter storms.

All fuel will be shipped from the mainland by full-size tanker trucks via the Steamship Ferry. The route from the Steamship Dock to the Tank Farm will transport the fuel through the water supply wellfields that feed the Town's water system. At closest proximity, well heads are within 500 feet of the roadway. The increased truck traffic and volumes of fuel along the corridor present a new vulnerability that the Town must consider. The HMP includes this technological hazard and human-caused threat (i.e. human error, not terrorism) due to its possible impact to the community water supply.

Water Facilities

Nantucket residents get drinking water either from the Wannacomet Water Company (WWC) or from private wells. The WWC sources its water from five wellfields, four in the central part of the Island and one in the 'Sconset area. Wellhead protection districts have been established around these wellfields and regulations (such as limits on septic system size) applied to limit the risk of contamination of the water sources.

Wastewater Facilities

The Town of Nantucket Sewer Department operates two wastewater collection systems and treatment facilities. The larger system collects wastewater from the downtown and central areas. The Surfside treatment plant serves the larger system. The smaller system collects wastewater from the village of 'Sconset. The 'Sconset treatment plant serves the smaller system. The effluent beds at each wastewater treatment facility are located near the edges of the coastal dune/bluff, outside of mapped coastal flood zones but near eroding shorelines. It is understood that the beds will need to be relocated when the shoreline has eroded to within certain distances of each facility.

The Sea Street sewer pumping station is a critical facility because it is the heart of the larger sewer system that serves downtown and the central island. The pumping station sends up to nine million gallons per day (mgd) to the treatment plant using three 3-mgd pumps. Failure of the station would cause backups to most of the downtown customers and a major public health threat. The pumping station is located within the 1% annual-chance coastal flood zone adjacent to Nantucket Harbor. The site of the station was last flooded during the 1992 "No Name" storm. Sandbags were used to prevent water from entering the masonry pumping station building at doorways and other openings. Because sandbags work well to prevent flood damage, the Town has not moved forward with other means of flood control, such as dikes or flashboard gates.

Another hazard and problem that occurs during storms is infiltration of storm water to the wastewater system. It is believed that floodwaters can increase the demand to 14 mgd. During the 1992 No Name storm, the pumping station could barely keep up with the increased flow. In January 2018, the combined effects of high storm water volume and sub-zero temperatures caused a sewer main to burst. The DPW believes that ongoing infrastructure improvements will reduce the risk of floodwater infiltration, while simultaneously increasing the capacity of the system.

The Sea Street sewer pumping station has a 230 KW diesel fueled generator, the Surfside Treatment Plant is equipped with two diesel generators (1.3 MW and 75 KW), and the 'Sconset Plant has a 400 KW diesel generator protected with backup power. The pump stations at South Valley and Surfside both have diesel generators installed for emergency operation and the Sewer Department deploys trailer mounted generators for all other Town wastewater pump stations. These locations include the Surfside, Kato Lane, Mizzenmast, Sherburne Commons, and Naushop pumping stations; and the two lift stations on Monomoy Road.

The Sewer Department is currently working on a six-million-dollar project to update the Island's main pumping station in the downtown neighborhood at the edge of the harbor; one aspect of this project is floodproofing the station to the 1% annual-chance flood elevation.

The Sewer Department has multiple generators, including four portable generators, that can be used to maintain pumping station operation during power outages. The Nantucket Energy Office recently applied for a grant to install solar panels at the wastewater treatment facilities and intends to pursue installation of batteries for local energy storage if possible.

<u>Shelters</u>

Emergency shelters are considered to be an important subset of critical facilities, as they are needed most in emergency situations. According to the 2013 Nantucket CEMP, "selection of mass care shelter should consider potential vulnerability to hazards such as flooding, and exposure to hurricane winds, and handicap accessibility, for example."

As such, Town officials have designated the **Nantucket High School** and the Police Station/Emergency Operations Center at 4 Fairgrounds Road as the primary and secondary shelters, respectively. The high school shelter has a capacity of 500 people and is operated by the American Red Cross through a memorandum of understanding signed with Nantucket Public Schools. The shelter has a backup generator that is "pre-staged" through the US Army Corps of Engineers; this means that if the generator were to fail, the USACE can bring in a replacement that is pre-staged and would be able to be hooked up and used immediately.

The shelters are reserved mainly for residents. During minor emergencies when people cannot leave Nantucket, the shelters will not be opened to tourists until every hotel is full. During major emergencies, the shelters would be opened to everyone.

The Nantucket Intermediate School has been constructed recently and includes a backup generator. While the school has not been designated as a shelter, the Town is interested in reviewing the property and determining its ability to serve as such. The Town is also interested in identifying buildings (such as the Police or Fire Department branches) in Madaket and 'Sconset that can serve as emergency shelters in case those areas are isolated following a storm event.

While Nantucket feels its sheltering capacity is sufficient for its residents (its shelters can hold approximately 1,500 individuals), it does not currently have sufficient equipment, and is working to acquire additional cots and sleeping gear.

Municipal officials have also expressed interest in providing temporary shelter or housing for emergency personnel that come to the Island to assist with disaster response. For example, National Grid has sent down workers to restore power after storms, and it was difficult to house both those workers and displaced residents in shelters. The Town will explore options moving forward as part of a general effort to expand and improve shelter capacity and quality.

Our Island Home

Our Island Home is a 45-bed Skilled Nursing Facility dually licensed in Medicaid and Medicare owned by the Town of Nantucket. The facility is currently located at the edge of a 1% annual-chance flood zone and is at-risk of isolation during flooding. The Town is exploring relocation to a new facility. It is the Town's priority to ensure any new facility, or the existing facility if it does not relocate, is accessible during flooding, or has sufficient backup power and equipment to operate in isolation.

2.12 Communication, Warning, and Evacuation

Public Communication and Warnings

Nantucket communicates with residents and visitors, and warns of impending disasters, in a number of ways:

- Mobile Devices: The Town has implemented the *Ping4alerts!* system, enabling it to send warnings, information concerning public health incidents, or general advisories to residents and visitors through their smart-devices. The system allows for alerts to be sent to selected geographic areas. Residents and visitors must install the application and have cellular reception to receive the warnings. A link to sign-up is on the Town website, informational signs and pamphlets are located at transportation terminals, and the system is promoted on the towns social media platforms. Ping4, Inc., is partnered with The Massachusetts Emergency Management Agency (MEMA).

- <u>Emergency Sirens</u>: Nantucket has three emergency sirens located across the Island, which can be heard in all the Island's population centers. The sirens can be used to emit a general alert signal prior to emergency events. Residents and visitors must then use other means to discover the reason for the alert.
- <u>Social Media</u>: The Town posts emergency alerts on an official Twitter account, on the Town website (www.nantucket-ma.gov), and through email distribution lists (including both a municipal employee list and a public subscription announcement list). Some Town departments have a Facebook presence, and the Town Administration is considering the benefits and resources needed to establish and operate a Facebook presence of its own.
- <u>Radio</u>: Nantucket broadcasts emergency information as needed via its low-power FM-radio station (105.5 FM).
- <u>Local Media Outlets:</u> Nantucket disseminates information through local FM radio, television and news outlets.

Nantucket officials note that finding a way to inform visitors, especially during the high-volume tourist season during the summer, is a challenge.

<u>Internal Emergency Communication</u>

As of July 2018, Nantucket Police completed an upgrade to the most current version of its radio communication system. The system has Police, Fire/EMS and county government agencies divided into "talk groups" on a single digital voice system that supports communication interoperability when necessary. This system includes direct radio contact with Barnstable County Control and the ability to communicate with state, federal or other local resources that may come to Nantucket in a mutual-aid or emergency support scenario. All of the Town owned communication applications and systems are supported by emergency power.

Winter storm events in January 2018 put several of the Town's internal communication tools to use; the Town found their internal emergency communications capabilities to be sufficient during those events.

<u>Evacuation</u>

According to the 2013 CEMP, an emergency situation

> *…may require the evacuation of part of or all of the community. The characteristics and scope of the emergency will determine where evacuation occurs, the number of people affected, and the measures needed to ensure safety. The public will be advised to evacuate by public safety officials. The primary means of transportation during an evacuation is private automobile. Providing transportation to those without access to a vehicle or who require medical or other assistance is an important factor in the evacuation process.*

The discussion in the 2013 CEMP pertains mainly to evacuation within portions of Nantucket. Evacuation of the community is not practical or feasible, and it is understood by Town officials that it could not be attempted. The population is too large, and transportation issues are too complex. For example, ferry service and/or airline service would be suspended during storms. Even if people could be brought to Hyannis, the Cape Cod Canal bridges are closed during major disasters. This underscores the importance of emergency preparedness, hazard mitigation planning, and ensuring adequate sheltering capacity.

Informal evacuation routes are depicted on Figure 2-9. It is anticipated that evacuations from outlying areas would be directed toward the High School and the 2 Fairgrounds Road facility for those instances where evacuation from the island is not possible; and toward the airport and Steamship Dock in cases where sufficient time is available for leaving Nantucket. The Town intends to pursue a memorandum of understanding with tour bus companies to provide transport during emergencies.

Table 2-7 summarizes floodplain crossings for major roads such as arterials and collectors, and minor roads that serve a number of residents. For the downtown and Brant Point areas, numerous street segments are in floodplains, so not all streets are listed. Although the table shows that numerous crossings are present, most of these are 0.2% annual-chance flood zones. A small number of collector and arterial roadways do, however, cross 1% annual-chance floodplains. These include Polpis Road, Wauwinet Road, Milestone Road, Madaket Road, and Cambridge Road. Additional streets in the downtown and Brant Point areas are fully or partially within 1% annual-chance flood zones. Floodplains are described in more detail in Sections 3.0 and 4.0, covering inland and coastal flooding, respectively.

Table 2-7: Floodplain Road Crossings

Road	Locality	Water Body or Watershed	Flood Zone	Base Flood Elevation
Wauwinet Rd	Wauwinet	Tidal creek	100-yr AE	8 feet
Wauwinet Rd	Pocomo	Near Polpis Harbor	100-yr AE	8 feet
Wauwinet Rd	Pocomo	Near Polpis Harbor	500-yr X	Not mapped
Polpis Rd	Near Quidnet	Sesachacha Pond	100 & 500-yr (road on line)	8 feet
Polpis Rd	Polpis	Near Polpis Harbor	500-yr X	Not mapped
Polpis Rd	Polpis	Near Polpis Harbor	500-yr X	Not mapped
Polpis Rd	Quaise	Near Polpis Harbor	500-yr X	Not mapped
Polpis Rd	Quaise	Fulling Mill Brook	100-yr A5	8 feet
Milestone Rd	Milestone Rd	Phillips Run	100-yr A	Not mapped
New South Rd	Airport	Coastal pond valley	500-yr X	Not mapped
New South Rd	Airport	Coastal pond valley	500-yr X	Not mapped
New South Rd	Airport	Coastal pond valley	500-yr X	Not mapped
Orange St at Union Street	Downtown	Nantucket Harbor	500-yr X	Not mapped
N. Beach St	Brant Point	Nantucket Harbor	100-yr A	8 feet
S. Beach St	Downtown	Nantucket Harbor	100-yr A	8 feet
Easton St	Brant Point	Nantucket Harbor	100-yr A	8 feet

Road	Locality	Water Body or Watershed	Flood Zone	Base Flood Elevation
Easy St	Downtown	Nantucket Harbor	100-yr A	8 feet
Washington St	Downtown	Nantucket Harbor	100-yr A	8-9 feet
Union St (southern part)	Downtown	Nantucket Harbor	100-yr A	8 feet
Atlantic Ave	Mid-Island	Miacomet valley	500-yr X	Not mapped
W. Miacomet Rd	Miacomet	Miacomet Pond	100 & 500-yr (road on line)	8 feet
Eel Point Rd	Maddequet	Head of Long Pond	500-yr X, B	Not mapped
Eel Point Rd	Maddequet	Head of Long Pond	500-yr X, B	Not mapped
Eel Point Rd	Maddequet	Creek	500-yr X, B	Not mapped
Madaket Rd	Madaket	Head of Long Pond	100-yr AE	8 feet
Madaket Rd	Madaket	Madaket Ditch	100-yr AE	8 feet
Madaket Rd	Madaket	Long Pond	500-yr X	Not mapped
Cambridge Rd	Madaket	Hither Creek	100-yr AE	8 feet
Cambridge Rd	Madaket	Long Pond	500-yr X	Not mapped
Cambridge Rd	Madaket	Long Pond	100-yr AE	7 feet
Tennessee Ave	Madaket	Hither Creek	100 & 500-yr zones	8 feet
Ames Street	Madaket	Hither Creek	100-yr AE	8 feet

2.13 Historic and Cultural Resources

The Town of Nantucket has an abundance of historic sites and resources that are a defining characteristic of the Island's culture. The entire Island as a National Historic Landmark, the Town contains two Local Historic Districts (The Downtown and Siasconset neighborhoods), and many individual sites are listed on the State and National Historic Registers. Historic resource inventories are included in Appendix F.

The Town recognizes that historic and cultural resources are increasingly at risk to natural hazards and climate change. For example, at least 46 of the repetitive loss structures in Nantucket are listed as historic structures. It is difficult to implement structural hazard mitigation measures, such as wind-resistant retrofits, floodproofing and elevation, or relocation, on historic resources without potential loss of their historicity. Therefore, a thorough understanding of the site-specific options for each set of historic resources is necessary prior to disasters that could damage these resources, in order to avoid damage during recovery.

States that received significant financial resources from the Hurricane Sandy appropriations have been fortunate to fund historic resources resiliency planning. One example is Connecticut, which funded a two-year planning effort to advance resiliency of historic resources. A set of reports were produced for the Connecticut State Historic Preservation Office through this planning effort in August 2017. These reports outline eight strategies that can be employed to make historic and cultural resources more resilient to natural disasters. Those strategies are:

- Identify Historic Resources
- Revisit Historic District Zoning Regulations

- Strengthen Recovery Planning
- Incorporate Historic Preservation into Planning Documents
- Revisit Floodplain Regulations and Ordinances
- Coordinate Regionally and with the State
- Structural Adaptation Measures
- Educate

Because of Nantucket's historic character, the specific vulnerabilities and mitigation constraints of historic resources are considered when addressing each of the specific hazards included in this Plan. The Town wishes to focus on a specific area of historic structures during the five-year lifespan of this hazard mitigation plan and conduct a targeted vulnerability assessment with technical assistance offered at the end of the study.

Additional resources to reference when pursuing hazard mitigation for historic properties include:

- Federal Emergency Management Agency, 2005, *FEMA 386-6: Integrating Historic Property and cultural resource considerations into hazard mitigation planning*. May 2005
- US Department of the Interior National Park Service, *The Secretary of the Interior's Standards for the Treatment of Historic Properties, with Guidelines for Preserving, Rehabilitation, Restoring & Reconstructing Historic Buildings.*

2.14 Potential Community Strategies and Actions

Through discussion of the current state, and changes since the previous HMP, of Nantucket's plans, regulations, critical facilities, and other community features, the following potential hazard mitigation and emergency management actions were developed:

- Review the NMP, and associated Area Plans, for consistency with this HMP, and revise as needed
- Add a five-year review of natural hazard mitigation priorities, to coincide with updates of the HMP, to the NMP implementation schedule
- Review the Nantucket Intermediate School and the Elementary School and determining their abilities to serve as emergency shelters.
- Develop a comprehensive checklist that cross-references bylaws, regulations, and codes related to natural hazard damage prevention that may be applicable to proposed development project.
- Identify potential locations for development of an alternative shipping terminal capable of accepting high-capacity ferries and/or freight boats to maintain critical access to the mainland in case of blockage of the main channel. Outline steps to follow to develop such a terminal.
- Conduct a targeted hazard vulnerability assessment of historic structures and offer technical assistance to property owners.

- ❑ Conduct a table-top exercise for a simulated tanker leak adjacent to a Town well head to improve emergency response capabilities and identify additional needs. Specifically consider how a natural hazard event may impact response capabilities.
- ❑ Complete a study and develop recommendations to improve safety and control runoff on the roadways adjacent to Town water-supply wellheads.
- ❑ Design and construct roadway improvements that reduce the risk of contamination of the Town's water supply due to new fuel transport.

Additionally, the Town is looking at developing microgrids for the core mid-island critical facilities, including the Police Station, Fire Station, Hospital, Water and Sewer facilities, High School (and Emergency Shelter), and possibly a grocery store. An action is being added to this plan:

- ❑ Explore development of one or more microgrid systems for core mid-island critical facilities to determine potential costs and benefits.

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N W E S

SOURCE(S):
XXXXXXX

MAJOR ROADS AND EVACUATION ROUTES

TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN

NANTUCKET, MASSACHUSETTS

Map By: MER
MMI#: 2967-09
MXD: U:\Y\2967-09\Maps\Figure2-10Major_Roads_Evac2.mxd
1st Version: 08/28/2017
Revision: 3/7/2018
Scale: 1 in = 4,975 ft

FIGURE 2-9

3 NON-COASTAL FLOODING

3.1 Setting

Nantucket is an island and flooding is all too common an event. Flooding hazards can be divided into two overarching categories: coastal flooding (sea water rising above normal tide action) and non-coastal flooding (caused by rain and runoff). On Nantucket the two types often occur together in major storms. Listed in this section are the flooding hazards for non-coastal events; coastal flooding associated with very high tides and storm surges is discussed in Section 4.0.

According to the 2013 Massachusetts Hazard Mitigation Plan, flooding in the State is often the direct result of weather events in Massachusetts including coastal storms such as nor'easters, heavy frontal rainstorms, tropical storms, and hurricanes. As a result of these events, Nantucket is at risk of the following types of inland flooding:

- **Riverine Flooding:** Also known as overbank flooding, it occurs when channels receive more rain or snowmelt from their watershed than normal, or the channel becomes blocked by debris. Excess water spills out of the channel and into the channel's floodplain area. Spring snowmelt or frozen ground conditions (which limits rainfall infiltration) can exacerbate riverine flooding caused by heavy precipitation.
    - **Ice Jams** occur when ice accumulates in a channel and acts as a dam, restricting flow and causing flooding
    - **Flash Flooding** is rapid rise of water along a water channel or low-lying urban area that is usually a result of an unusually large amount of rain and/or high velocity of water flow (particularly in hilly areas) within a very short period of time. Flash floods can occur with limited warning.
- **Shallow Flooding:** Occurs in flat areas where a lack of a water channel results in water being unable to drain away easily. The three types of shallow flooding include:
    - **Sheet Flow:** Water spreads over a large area at uniform depth.
    - **Ponding:** Runoff collects in depressions with no drainage ability.
    - **Urban Flooding:** Occurs when human-made drainage systems are overloaded by a larger amount of water than the system was designed to accommodate. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to outfall areas or infiltration systems. Nantucket has a unique setting in that much of the native ground is a sandy soil and usually very permeable, however the sand is a loose material easily carried by water into the drainage systems that require regular cleaning to maintain capacity.

This section addresses these categories of non-coastal flooding.

Figure 3-1 depicts mapped coastal and non-coastal floodplains of Nantucket. It is clear from the map that most of the flood zones are associated with coastal areas. As an island community with only a very few non-tidal watercourses, non-coastal flooding is a relatively minor natural hazard that threatens Nantucket. Riverine or overbank flooding almost never occurs as a result of heavy rainfall and runoff. Instead, most riverine flooding actually occurs along tidal estuaries and ditches. Therefore, some of these areas are discussed in Section 4.0 as coastal flooding.

Nevertheless, non-tidal watercourses and floodplains that may experience minor, infrequent inland flooding include the following:

- Phillips Run, the stream connecting the cranberry bogs located north of Milestone Road to the ponds between Tom Nevers Road and Low Beach (1% annual-chance flood zone without mapped elevations)
- Area west of Sesachacha Pond (1% annual-chance flood zone without mapped elevations)
- Polpis Road along the southwest edge of at Sesachacha Pond (a 1% annual-chance floodplain with a velocity zone)
- Floodplain extending from mid-island south (downstream) to Miacomet Pond, the only freshwater pond on Nantucket (0.2% annual-chance and 1% annual-chance flood zones)
- Other 0.2% annual-chance floodplains draining in southerly directions to coastal ponds

Urban flooding (flooding caused by poor drainage) is a more common type of inland flooding faced by Nantucket residents, specifically in the following areas:

- Bathing Beach Road in Brant Point
- The Downtown / Harbor-front area, including Washington Street, Easy Street, Straight Wharf, Broad Street, and Harbor View Way (1% annual-chance coastal flood zone)
- Orange Street
- Pleasant Street at Daves Street near the Post Office
- Lovers Lane
- Old South Road near Airport
- Between Madaket Road & Hummock Pond Road (including 0.2% annual-chance flood zones)

Of course, urban flooding can occur in almost any developed area, even in communities such as Nantucket that are characterized by well-drained sandy soils. This is because most of the Town's drainage systems rely on infiltration and subsurface leaching. These types of systems can be easily overwhelmed if undersized for any given storm.

Table 1-5 identifies the relationships between various Nantucket localities and the natural hazards addressed in this plan. Note that the localities identified above are checked in the "inland flooding" and "flooding from poor drainage" columns. Table 1-5 will be referenced again in subsequent chapters of this plan.

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SOURCE(S):
FEMA DFIRM

FEMA FLOOD ZONES

TOWN OF NANTUCKET NATURAL HAZARD MITIGATION PLAN

NANTUCKET, MASSACHUSETTS

Map By: NBS
MMI#: 2967-09
MXD: U:\Y\2967-09\Maps\Figure3_1FloodZones.mxd
1st Version: 08/28/2017
Revision: 3/7/2018
Scale: 1 in = 5,792 ft

FIGURE 3-1

3.2 Hazard Assessment

Nantucket lies in the zone of westerly prevailing winds and often experiences cyclonic disturbances that have crossed the country from the west or southwest. It is also exposed to coastal storms, some of tropical origin, that move up the Atlantic coast with heavy rainfall. In late summer and autumn these storms may attain hurricane intensity. Most inland flooding in Nantucket is caused by storms with heavy rainfall.

Flooding presents several safety hazards to people and property and can cause extensive damage and potential injury or loss of life. Floodwaters cause massive damage to the lower levels of buildings, destroying business records, furniture, and other sentimental papers and artifacts. In addition, floodwaters can prevent emergency and commercial egress by blocking streets, deteriorating municipal drainage systems, and diverting municipal staff and resources.

Furthermore, damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Snakes and rodents are forced out of their natural habitat and into closer contact with people, and ponded water following a flood presents a breeding ground for mosquitoes. Gasoline, pesticides, poorly treated sewage, and other aqueous pollutants can be carried into areas and buildings by floodwaters and soak into soil, building components, and furniture.

In order to provide a national standard without regional discrimination, the 1% annual-chance flood (previously called the "100-year flood") has been adopted by FEMA as the **base flood** for purposes of floodplain management. **The FEMA Special Flood Hazard Area (SFHA, described below) is coincident with the base flood.** This flood has a 1% chance of being equaled or exceeded each year. Similarly, a 0.2% annual-chance flood (previously called the "500-year flood") has a 0.2% chance of being equaled or exceeded in a given year. The 0.2% annual-chance floodplain indicates areas of moderate flood hazard. The risk of having a flood of this magnitude or greater increases when periods longer than one year are considered. For example, FEMA notes that a structure located within a 1% annual chance flood hazard area has a 26% change of suffering flood damage during the term of a 30-year mortgage.

Community flood hazards are described by FEMA in Flood Insurance Studies (FIS) that lay out flood sources, areas, and elevations where available. Flood hazard areas are mapped on Flood Insurance Rate Map (FIRM) panels and in digital format on Digital Flood Insurance Rate Maps (DFIRM).

> *Floodplains are lands along watercourses subject to periodic flooding.*
> *Floodways are the areas within floodplains that convey the majority of flood discharge; they are subject to water being conveyed at relatively high velocity and force.*
> *The floodway fringe is the area of the 1% annual-chance floodplain that is outside the floodway and subject to inundation but does not convey floodwaters at a high velocity.*
>
> *Given its relative lack of non-tidal inland watercourses,* ***floodways are not mapped on Nantucket.***

The most recent FIRM and FIS for Nantucket was made effective August 5, 2014, replacing the previous FIRM and FIS of 1996.

The Nantucket EMD notes that five letters of map amendment (LOMA) placing specific properties mapped as being located within flood zones on the FIRM outside those flood zones, were submitted to FEMA following adoption of the 2014 FIRM; all five have been approved.

This update reflects some notable changes from the flood-hazard profile described in the previous HMP.

The most recent Nantucket FIRM & FIS was made effective August 5, 2014

FEMA uses a variety of flood zones to delineate areas of annual chance flood hazard. Table 3-1 describes the various zones depicted on the FIRM panels for Nantucket.

Table 3-1 : Firm Zone Descriptions

Zone	Description
A	An area inundated by 1% annual-chance flooding, for which no base flood elevations (BFEs) have been determined.
AE	An area inundated by 1% annual-chance flooding, for which BFEs have been determined.
AH	An area inundated by 1% annual-chance flooding (usually an area of ponding), for which BFEs have been determined; flood depths range from 1 to 3 feet.
VE	An area inundated by 1% annual-chance flooding with velocity hazard (wave action); BFEs have been determined.
X	An area inundated by 0.2% annual-chance flooding (shaded X zone); an area inundated by 1% annual-chance flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 1% annual-chance flooding.
Area Not Included (ANI)	An area that is located within a community or county that is not mapped on any published FIRM.

Urban flooding occurs from heavy rains with a much higher frequency than 1% annual-chance and 0.2% annual-chance events, and often in different areas than those depicted on the FIRM panels. These frequent flooding events occur in areas with insufficient drainage; where conditions may cause flashy, localized flooding; and where tidal influences may exacerbate drainage problems.

3.2.1 Climate Change

Flood risk is typically determined through a review of historic events (as will be done in section 3.3). However, research increasingly points to "non-stationarity" in hydrologic patterns. For example, a 2016 paper (Barrett and Salis, 2016) finds that flow rates during peak annual floods, as well as floods with recurrence intervals of 5, 10- and 20- years, have been increasing between 1962 and 2012. Average observed rates of increasing magnitude are from 0.9 to 1.8 percent per year. Therefore, when planning for inland flood hazards, it is essential to consider not just the past and present, but also potential future conditions.

3.3 Historic Record

As identified earlier, Nantucket often experiences storms that cause both coastal flooding and inland or non-coastal flooding; therefore, many specific events will be found included in both this section and the coastal flooding historic record in Section 4. Since the adoption of the previous edition of this Plan in 2007, the following inland flood events have occurred on Nantucket (according to the National Centers for Environmental Information (NCEI) Storm Events Database):

- **November 17, 2014**: Heavy rain caused flooding that closed Union Street at Francis Street and Orange Street, Washington Street at Coffin Street, and portions of Easy Street.
- **December 9, 2014**: A strong coastal storm brought heavy rain to Nantucket, resulting in several sections of Orange Street, Bartlett Road, and Sparks Avenue being flooded with up to one foot of water. The rain was exacerbated by a simultaneous high tide that inhibited drainage.
- **May 7, 2016**: A low pressure system to the southeast brought 3-4 inches of rain across Nantucket within a couple of hours. Flooding was reported in the parking lot of the airport, with cars stalled due to the depth of the water. Eight inches of water was reported flooding Sparks Avenue. There was significant flooding in the main airport loop.

Prior to the adoption of the previous edition of the plan, other inland flood events impacted the Town, although records are limited. On example is as follows (from the NCEI Storm Events Database):

- **June 7, 2006**: A late season coastal storm brought heavy rainfall to much of eastern Massachusetts. As many as 7 inches of rain fell in Bristol County and on Cape Cod. Flooding affected Nantucket, where Orange Street was closed and an estimated $5,000 in damages were incurred.

3.4 Existing Capabilities

The Town of Nantucket has a number of measures in place to prevent inland and urban flood damage. These include regulations, codes, and ordinances; and a process for installing and maintaining storm drainage systems.

According to the 2013 Nantucket CEMP, the municipal responsibilities relative to flood mitigation and preparedness include:

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Community leaders should ensure that Nantucket is enrolled in the National Flood Insurance Program.
- Strict adherence should be paid to land use and building codes (e.g. Wetlands Protection Act), and new construction should not be built in flood prone areas.

- ☐ Ensure that flood control works are in good operating condition at all times.
- ☐ Natural water storage areas should be preserved.
- ☐ Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.
- ☐ Place EOC personnel on standby during stage of flood watch and monitor NWS/New England River Forecast Center reports.
- ☐ Ensure that public warning systems are working properly and broadcast any information that is needed.
- ☐ Review mutual aid agreements.
- ☐ Monitor levels of local bodies of water.
- ☐ Arrange for all evacuation and sheltering procedures to be ready for activation when needed.
- ☐ Carry out, or assist in carrying out, needed flood-proofing measures such as sand bag placement, etc.
- ☐ Regulate operation of flood control works such as flood gates.
- ☐ Notify all Emergency Management related groups that will assist with flood response activities to be ready in case of flood warning.

Participation in the NFIP

Nantucket has participated in the National Flood Insurance Program (NFIP) since September 13, 1974 (initial Flood Hazard Boundary Map identified), and plans to continue to participate in, and comply with the requirements of, the program. It has incorporated the NFIP regulations into its municipal codes and regulations (see next section).

Special Flood Hazard Areas (SFHA) in Nantucket County are delineated on a Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) published June 9, 2014. Nantucket utilizes the current effective FIRM to delineate flood prone areas under the NFIP.

As of August 31, 2017, there were 1,010 flood insurance policies within Nantucket, providing a total of $330 million in protection

Regulations, Codes, and Ordinances

Regulations, codes and ordinances that apply to flood hazard mitigation include Chapter 136 of the Nantucket Code and the accompanying Wetland Regulations; Chapter 139 of the Nantucket Code and the provisions of the Flood Hazard Overlay Zone; and the Subdivision Regulations. The components of these regulations, codes, and ordinances that apply to floodplain development and flood damage prevention were listed in Section 2.9. The Conservation Commission, Planning Board, and Building Department are all charged with administering portions of these regulations.

Nantucket enforces the Massachusetts State Building Code (MSBC). The ninth edition of the MSBC was made effective statewide on October 20, 2017. The MSBC lays out Design Flood Elevation (DFE) requirements or required elevations for new and substantially improved structures relative to flood surface elevations in FEMA-mapped flood zones. MSBC DFE requirements (R322.1.4) are as follows:

- AO Zone: 3 feet above highest adjacent grade (or FIRM flood depth plus 1 foot)
- AE Zone: 1 foot above Base Flood Elevation (BFE)
- VE Zone: 2 feet above BFE

The additional elevation above the BFE is known as "freeboard."

Outreach and Education

Nantucket strives to create an educated and engaged community that considers, plans for and takes action to most effectively reduce dangers and losses when experiencing a natural disaster. It is also important to the Town that property owners, the business community, decision makers, educators and developers understand that their actions can affect other people or the environment in a disaster.

Nantucket maintains and shares publicly available data and information about resources, references, and contacts related to:

- Planning, zoning and building codes
- Insurance industry guidance
- Local Hazard mapping
- Preparedness guides
- Emergency response capabilities
- Sheltering information
- Public recovery assistance sources
- Grants, loans and other applicable programs

Methods of outreach the Town undertakes includes:

- Making brochures available in common public places (town buildings, public transportation)
- Engaging the public through local civic or business groups
- Engaging neighborhood associations
- Disseminating information through local media outlets (radio, television, print)
- Disseminating information through internet-based media outlets
- Posting information on municipal agency or community organization websites and social media
- Having a presence at community events, fairs, and festivals
- Mailing information or references to property owners along with tax or utility bills

Infrastructure and Road Protection

The DPW tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. With regard to roads, bridges, and culverts at creeks, the DPW regularly maintains Town-owned roads and facilities and upgrades/improves them as needed. However, DPW does not have sufficient equipment to barricade all roadways that could potentially flood.

Drainage Systems

With regard to installation and maintenance of drainage systems, the DPW tries to regularly maintain Town-owned culverts, catch basins, leaching systems, and other drainage facilities. DPW also maintains a database of drainage and flooding complaints, and addresses problems as they arise. This helps pinpoint potential locations of hazard effects.

In 2013, the DPW is completed a major, 23-million-dollar Storm Water Improvement Program with intended water quality and drainage improvement benefits. The program has involved upgrading the storm drainage system by increasing outfall capacities, combining outfalls, installing riprap and flap gates, installing structures to catch sediment, and calling for increased street sweeping and catch basin sump cleaning. Drainage systems upgraded are those at Children's Beach, Orange Street, Consue Springs, Easy Street, Marine Fisheries, Broad Street, the Francis Street Beach, New Whale Street, Commercial Street, and Commercial Wharf. The existence of this Storm water Improvement Program, and the completed projects, are considered to be capabilities. The areas served by this project will continue to be listed (in the next section) as vulnerable areas until improvements are observed.

Natural Resource Protection

A long-term project to restore the Consue Springs Site has recently been rebooted. This project involves a number of drainage upgrades (including the storm drain upgrade as part of the Storm water Improvement Program, noted above) and Phragmites removal. The project is expected to improve drainage and overlap with conservation and open space preservation goals.

Private Efforts

In addition to existing mitigation at the municipal level, private mitigation measures have been implemented as needed over the last two decades in Nantucket. In the early 2000s, two residents on Lovers Lane constructed low dikes along their property lines to prevent flooding from poor drainage on the roadway.

3.4.1 Capabilities Summary

In summary, the Town of Nantucket primarily mitigates inland flood hazards by restricting building activities in areas with flood risk and improving drainage systems across the Island. The Conservation Commission, Planning Board, and Building Department administer flood-protection regulations, the Health Department performs outreach and education activities, and the Department of Public Works constructs drainage improvement projects.

Nantucket's capabilities to mitigate for inland flooding have remained strong since the initial HMP was adopted, largely through implementation of the downtown Storm water Improvement Program and continued enforcement of floodplain regulations. The publishing and local adoption of the updated FEMA FIS and FIRM have also improved flood mitigation capabilities by improving the local understanding of flood risks and by making NFIP insurance ratings more accurately reflect those risks.

3.5 Vulnerabilities and Risk Assessment

There are nearly 17,000 structures on Nantucket. Of these, 1,578 are located within FEMA-mapped flood hazard zones, though only 1,168 are within 1-percent-annual-chance flood zones (A, AE, and VE zones).

Differentiating between inland and coastal flood areas is challenging in a small island like Nantucket. For the purposes of this document, inland flood hazard areas are defined as those extending inland of the flood zones with defined base-flood-elevations based on FEMA coastal transect analysis. Based on this definition, 32 structures are located within inland 1-percent-annual-chance flood zones (A zones), and 498 are located within all inland flood hazard areas (including 0.2-percent-annual-chance flood zones). This information is summarized in Table 3-2, which, for reference, also includes the number of buildings in all FEMA-mapped flood zones and in coastal FEMA-mapped flood zones.

Table 3-2: Building Flood Risk Analysis

Title	Zone	Number of Buildings	Parcels	Value Of Parcels
All FEMA flood zones	A, AE, VE, X	1,578	3160	$10,357,302,600
All 1%-annual chance flood zones	A, AE, VE	1,168	2385	$8,667,337,000
Only coastal 1%-annual chance flood zones	AE, VE	1,136	2327	$8,498,480,100
Only inland flood zones	A, X (no inland AE)	498	1433	$4,161,904,400
Only inland 1%-annual chance	A (no inland AE)	32	59	$182,568,600

3.5.1 Vulnerable Areas

This section discusses specific areas at risk to inland flooding and urban flooding within Nantucket. Critical facilities and evacuation routes are identified as applicable.

Downtown, Brant Point, and Mid-Island

The most populous area of urban flooding vulnerability is the region extending from Brant Point through downtown to the mid-island area, including adjacent areas to the west. According to DPW, the storm water system includes a network of approximately 8.5 miles of pipes, 340 catch basins, infiltrators, grit chambers, and 21 outfall pipes. Many of the outfalls to Nantucket Harbor are undersized and impacted by backwater from tides, causing upstream flows to surcharge and deposit sediment in the systems, leading to urban flooding.

In short, minor flooding can occur each month along the harbor during the astronomical high tide when the base level of the drainage system rises. More significantly, if Nantucket is experiencing rainfall at the same time as the high tide, storm water cannot drain, and the area will flood. Lower Broad Street, Easy Street, Washington Street, and Brant Point reportedly flood at shallow depths a few times each year. The Town's ongoing Storm water Improvement Program may impact some of these issues. Critical facilities in this area include the Steamship Dock, the fuel tank farm, municipal buildings on Washington Street, the sewer pumping station, and a telephone switching station.

Also near downtown, flooding occurs at Orange Street where a drainage pipe is overwhelmed during storms, sometimes requiring the road to be closed. This pipe was enlarged as part of Phase I of the Storm water Improvement Project, addressing some of the flooding issues. Slightly west of downtown where Pleasant Street intersects with Daves Street, the low area at the post office floods during many storms, as the drainage system was designed for a 20-year storm, but additional development has occurred since that time. Flooding on Orange Street and Pleasant Street does not directly affect critical facilities, but these are important roadways that would be used during storms or storm surge events if evacuation was necessary.

At the intersection of Prospect Street, Atlantic Avenue, Sparks Avenue, and Surfside Road, next to Cottage Hospital, the road often becomes inundated and water sometimes flows onto adjacent properties. Residents report flooding has worsened at this site.

A broad region between Madaket Road and Hummock Pond Road includes some 0.2% annual-chance flood zones, but the problem in this area is mainly related to poor drainage. Drainage from much of the Town was previously directed west and south from this area to the coastal ponds. As development has occurred where drainage ditches were located, the Town has attempted to maintain drainage in the same direction. Critical facilities and roads are not affected. The flooding mainly causes problems for private property owners.

Although urban flooding in the Brant Point/downtown/mid-island area is relatively frequent and reduces the quality of life for residents in these areas, this type of flooding is not life-threatening and does not result in significant flood damage to property. This is primarily because the flood depths are typically nominal. Streets often remain passable to vehicles with more clearance, and floodwaters drain within hours of their appearance.

'Sconset

Sconset is not at great risk to urban flooding but is at risk of inland flooding because flooding can reduce access to and from 'Sconset via Milestone Road and Polpis Road. The Phillips Run corridor crosses Milestone Road as a 1% annual-chance flood zone, although occurrences of flooding are very rare. Risk to residents is minimal due to the rural nature of the area and its near-entire occupation by designated conservation lands. The risk from flooding of this corridor is the potential isolation of the eastern part of Milestone Road and the village of 'Sconset. Likewise, a vast area west of Sesachacha Pond is a 1% annual-chance flood zone, but occurrences of flooding are very rare and risk to residents is minimal due to the rural nature of the area and the presence of designated conservation lands. Where Polpis Road runs along the southwest edge of

Sesachacha Pond within a 1% annual-chance flood zone, high northeast winds can cause water to flood the road, cutting off ‘Sconset from this direction. If the pond is not drawn down in the spring as it normally is, the road floods during more moderate northeast winds. If Milestone Road and Polpis Road were flooded simultaneously, ‘Sconset residents would be isolated.

Critical facilities in ‘Sconset include the ‘Sconset Fire Station, the Police & Coast Guard Barracks, a water tank, and the ‘Sconset sewage treatment plant. However, most of these facilities support ‘Sconset residents and are not needed by the remainder of Nantucket, such that their isolation would not necessarily be a hardship.

Outlying Areas

At the southern end of the floodplain extending from the mid-island area to the south consisting of 0.2% annual-chance and 1% annual-chance flood zones, Miacomet Pond can rise due to heavy rainfall and comes very close to flooding the roads that are located on either side (Miacomet East and Miacomet West). This occurs at least once each year. Urban flooding of residential properties occurs at least once every five years along the "valley" where the 0.2% annual-chance floodplain is mapped. Much of this flooding is due to encroachment into and within the floodplain. Critical facilities are not located in this area, and only the residents of Miacomet would be affected by the loss of access. Other 0.2% annual-chance floodplains draining in southerly directions to coastal ponds are rarely believed to flood.

At Lovers Lane, Old South Road, and in many other parts of Nantucket, urban flooding along roadways will occur during many storms, but is typically only severe in a five-year storm and upward. The north side of Old South Road is lower than the south side near the Airport, and water drains down to residential properties during most heavy rainstorms. Critical facilities are generally not located in these areas, and mainly the residents on the subject streets are affected by temporary poor access. In cases where storm water may flow onto individual properties, property owners have utilized solutions such as building low dikes and walls. Two residents of Lovers Lane have built dikes along their properties to mitigate for the flooding. Overall, although Nantucket is at risk to this type of urban flooding, the problem areas are disparate and probably more effectively addressed on a case-by-case basis.

Historic Resources

Historic resources may be particularly at risk from inland flooding, relative to other assets, for the following reasons:

- **Location:** Historic properties built before modern zoning regulations may be located in higher risk areas than what would be allowed under current laws.
- **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand flooding as those built more recently.
- **Age:** Buildings and materials degrade over time, and a historic property may not be able to stand up to flooding as well as it could when first constructed.

Additionally, hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character.

3.5.2 *Loss Estimates*

The economic losses faced by the community from natural hazards can be estimated by reviewing historic, and modeling future, loss figures. It is difficult to accurately quantify losses, even after an event; therefore, a number of different sources are provided in this section. Taken together, they provide a range of possible loss estimates.

HAZUS-MH Vulnerability Analysis

HAZUS-MH is FEMA's loss estimation methodology software for flood, wind, and earthquake hazards. The software utilizes year 2010 U.S. Census data and a variety of engineering information to calculate potential damages (specified in year 2010 United States Dollars or USD) to a user-defined region.

Hydrology and hydraulics for the streams and rivers are typically generated for *HAZUS-MH* through the Flood Information Tool (FIT). The FIT utilizes FEMA cross sections for each watercourse and Digital Elevation Model (DEM) data to calculate potential flood depths in the user-specified areas. Due to the very limited extent of inland riverine 1%-annual chance flood zones in Nantucket, the absence of FEMA cross sections for those zones, and a lack of at-risk private property within those zones (only 32 properties are located within non-coastal A zones; see Table 3-2), running *HAZUS-MH* for inland flooding would not have produced compelling results; therefore the tool was not run. *HAZUS-MH* results for coastal flooding can be reviewed in section 4.5.

Public Assistance Reimbursements

Loss estimates for flooding can also be generated from the value of Public Assistance grants received by Nantucket and other entities within the Town. According to information from the FEMA Public Assistance Funded Projects Summary (Open Government Initiative), there has been one federal disaster declaration in Nantucket since 1999 that resulted from flooding events.

Table 3-3: Public Assistance Reimbursements for Nantucket

Disaster Number	Declaration Date	Incident Type	Incident Dates	Number of Projects	Federal Share	Total Cost
3315	09/02/2010	Hurricane Earl	9/1/10 to 9/4/10	1	$4,656.82	$6,209.09

Given the ratio of structures located in inland flood zones to those in coastal flood zones (1:36.5, see Table 3-2), it is estimated that $172.47 of the $6,209.09 of Public-Assistance-supported projects have been due to inland flooding. Dividing that figure by the number of years over which PA grant data has been tracked (1999 to 2017) provides an estimate of annualized losses due to inland flooding.

Annualized Loss Estimate: Inland Flooding (PA-based): ***$9.58***

NFIP Payments

As of August 31, 2017, there were 1,010 flood insurance policies within Nantucket paying a total annual premium of $1,73 million, or an average of $1,716 per policy per year. The total number of paid losses (claims paid) since 1978 is 435 totaling $16.74 million, though an addition 107 claims have been made but not paid. This information is summarized in Table 3-4, below.

Table 3-4: NFIP Policy and Loss Statistics (as of 8/31/2017)

Total Losses **(since 1978)**	Closed Losses **(since 1978)**	Total Payments **(since 1978)**	Policies In Force	Insurance In-Force	Premium In-Force
542	435	$16,741,745	1,010	$330,430,200	1,733,3100

Given the ratio of structures located in inland flood zones to those in coastal flood zones, it is estimated that $458,678 of the $16,741,745 of paid flood-loss claims have been due to inland flooding. Diving that figure by the number of years over which loss data has been tracked (January 1, 1978 to August 31, 2017) provides an estimate of annualized losses due to inland flooding.

*Annualized Loss Estimate: Inland Flooding (NFIP-based): **$11,539***

Several severe flood events occurred in Nantucket in winter 2017-2018 as discussed in later sections. NFIP claim data is still pending for these events, and they are not included in the above calculations. However, even if available, these claims would have been decidedly related to coastal flood events.

NCEI Storm Events Database

The National Centers for Environmental Information (NCEI, previously the National Climatic Data Center or NCDC) maintains a database of historic storm events across the country. Inland flood events (identified in the database as “Flood” or “Flash Flood” events, and differentiated from “Coastal Flood” events) have been recorded since 1996.

According to this dataset, there have been six significant inland flood events on Nantucket since 1996, two of which caused measurable damage.

Table 3-5: NCEI Storm Events Database – Inland Flood Events

Date	Type	Estimated Property Damage
3/5/2001	Flood	$0
10/25/2005	Flood	$10,000
6/7/2006	Flood	$5,000
11/17/2014	Flood	$0
12/9/2014	Flood	$0
7/5/2016	Flood	$0
	Total	**$15,000**

Dividing the total property damage from the NCEI figure by the number of years over which that data has been tracked (1996 to 2017) provides an estimate of annualized losses due to inland flooding.

*Annualized Loss Estimate: Inland Flooding (NCEI-based): **$714***

Loss Estimates Summary

Based on the loss estimates summarized above, an average expected annualized estimated loss can be calculated. Note that Public Assistance funding is only granted for public projects, while NFIP claims are only granted for private property; therefore, the two are considered as a single unit ("PA & NFIP" in the table below).

Table 3-6: Annualized Loss Estimates for Inland Flooding

Source	Annualized Estimated Loss
HAZUS-MH	N/A
Public Assistance	$9.58
NFIP Claims	$11,539
PA & NFIP	$11,597
NCEI	$714

These annualized figures may be low estimates of actual annualized losses, as PA funding, NFIP reimbursements, and NCEI loss records only account for damages reported through those programs; Nantucket has likely experienced additional losses that did not result in damage claims to FEMA or reported losses to NCEI.

3.6 Mitigation Strategies and Action

A number of measures can be taken to reduce the impact of an inland or urban flood event. These include measures that prevent increases in flood losses by managing new development, measures that reduce the exposure of existing development to flood risk, and measures to preserve and restore natural resources. These are listed below under the categories of *prevention*, *property protection*, *structural projects*, *public education and awareness*, *natural resource protection*, and *emergency services*.

3.6.1 Prevention

Prevention of damage from flood losses often takes the form of floodplain regulations and redevelopment policies. In most communities, these are administered by building, zoning, planning, and/or wetland bylaw and regulation enforcement. The following general guidelines are preventive tools that municipalities may have available:

Open Space Preservation:

Municipal departments should identify areas for acquisition to remove the potential for flood damage. Acquisition of heavily damaged structures (particularly RLPs) after a flood may be an economical and practical means to accomplish this.

Planning and Zoning:

Zoning and subdivision ordinances should regulate development in flood hazard areas. Flood hazard areas should reflect a balance of development and natural areas. Policies can also require the design and location of utilities to areas outside of flood hazard areas and the placement of utilities underground.

Floodplain Development Regulations:

Development regulations encompass subdivision regulations, building codes, and floodplain ordinances. Site plan and new subdivision regulations should include the following:

- ✓ Requirements that every lot have a buildable area above the flood level;
- ✓ Construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, and drainage ways; and
- ✓ A requirement that developers dedicate open space and flood flow, drainage, and maintenance easements.

Building codes should ensure that the foundation of structures will withstand flood forces and that all portions of the building subject to damage are above or otherwise protected from flooding. Floodplain ordinances should at minimum follow the requirements of the National Flood Insurance Program for subdivision and building codes. These could be included in the ordinances for zoning and building codes or could be addressed in a separate ordinance.

Storm water Management Policies:

Development and redevelopment policies to address the prevention of flood losses should include effective storm water management policies. Developers should be required to build detention and retention facilities where appropriate. Infiltration can be enhanced to reduce runoff volume, including the use of swales, infiltration trenches, vegetative filter strips, and permeable paving blocks. Generally, post-development storm water should not leave a site at a rate higher than under pre-development conditions.

In many communities, standard engineering practice is to avoid the use of detention measures if the project site is located in the lower one-third of a watershed. The effects of detention are least effective and even detrimental if used at such locations because of the delaying effect of the peak discharge from the site that typically results when detention measures are used. By detaining storm water in close proximity to the stream in the lower reaches of the overall watershed, the peak discharge from the site will occur later in the storm event, which will more closely coincide with the peak discharge of the stream, thus adding more flow during the peak discharge during any given storm event. However, in Nantucket, the distinction is not considered to be important because of the lack of inland watercourses.

Drainage System Maintenance:

An effective drainage system should be continually maintained to ensure efficiency and functionality. Maintenance should include programs to clean out blockages caused by overgrowth and debris. Culverts should be monitored and repaired and improved when necessary.

Education and Awareness:

Other prevention techniques include the promotion of awareness of natural hazards among citizens, property owners, developers, and local officials. Technical assistance for local officials, including workshops, can be helpful in preparation for dealing with the massive upheaval that can accompany a severe flooding event. Research efforts to improve knowledge, develop standards, and identify and map hazard areas will better prepare a community to identify relevant hazard mitigation efforts.

Wetlands:

Inland Wetlands and Watercourses Commissions (or their tribal equivalent) typically administer Wetland Regulations. The regulations simultaneously restrict development in floodplains, wetlands, and other flood prone areas. Many mitigation projects take place in wetland areas or the upland review zone and therefore are under the jurisdiction of the Wetland Commission. Thus, close coordination with this agency is required.

Coordination:

The Nantucket Conservation Commission administers the wetland regulations and the Nantucket Planning Board administers the subdivision regulations. The Nantucket Building Department is charged with ensuring that development meets the flood damage prevention codes. The Health Department provides the education and outreach that is often needed to reach owners of properties that are not subject to regulatory programs administered by the zoning, wetland, and subdivision regulations.

It is important to promote coordination among the various departments that are responsible for different aspects of flood mitigation. Coordination and cooperation among departments should be reviewed every few years as specific responsibilities and staff change.

Regulations related to flood damage prevention often lie within several different regulations and ordinances, and are the responsibility of several different departments. Development of a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to a proposed project can help streamline the permitting process and ensure maximum education of a developer or applicant.

3.6.2 Property Protection

Steps should be taken to protect existing public and private properties. Measures for public property protection include acquisition and relocation of properties at risk for flooding; purchase of flood insurance; and relocating valuable belongings above flood levels to reduce the amount of damage caused during a flood event.

All of the following *property protection* mitigation measures may be useful for Nantucket residents to prevent damage from inland and urban flooding. Note that many of the buildings on Nantucket are historic, posing additional complications with regards to elevating or performing other flood mitigation activities. See Section 2.13.

Standard Flood Protection Techniques

Techniques applicable to property protection include elevating buildings, constructing barriers, dry floodproofing, and wet floodproofing.

- Home elevation involves the removal of the building structure from the basement and elevating it on fill, foundation, or piers to a height such that the first floor is located above the 1% annual-chance flood level. The basement area is abandoned and filled. All utilities and appliances located within the basement must be relocated to the first-floor level. Building elevation in VE zones have additional requirements intended to mitigate the effects of waves on the elevated building (see section 4.6). Elevation is the only structural property protection technique permitted for residential buildings.
- Dry floodproofing refers to the act of making areas below the flood level water-tight. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents should be either permanently closed or covered with removable shields. Flood protection should only be two to three feet above the top of the foundation because building walls and floors cannot withstand the pressure of deeper water. Dry floodproofing is only permitted for non-residential structures.
- Wet floodproofing should only be used as a last resort. Wet floodproofing refers to intentionally letting floodwater into a building to minimize pressures. Furniture and electrical appliances should be moved away from advancing floodwaters. Dry floodproofing is only permitted for non-residential structures.
- Barriers include levees, floodwalls, and berms, and are useful in areas subject to shallow flooding.

General Improvements

FEMA offers a variety of suggestions regarding general improvements that can mitigate flooding:

- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the high-water mark (if the ceiling permits).
- Anchor the fuel tank to the wall or floor with noncorrosive metal strapping and lag bolts.
- Install a septic backflow valve to prevent sewer backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor and elevate electric outlets to at least 12 inches above the high-water mark.

Insurance

Although flood insurance does not prevent damage from occurring or remove structures from harm's way, it does provide an excellent means of recovering from losses. Changes to the NFIP insurance products in the 1990s added mitigation insurance coverage ("increased cost of compliance") at a very low cost. This coverage can provide people a portion of the additional financial resources needed to rebuild their repetitively flooded or substantially damaged homes and businesses to comply with local floodplain management regulations and building standards, therefore reducing the cost and amount of future flood damages.

3.6.3 Emergency Services

A natural hazard mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for inland flooding include:

- forecasting systems to provide information on the time of occurrence and magnitude of flooding;
- a system to issue flood warnings to the community and responsible officials; and
- emergency protective measures, such as evacuation and emergency flood-water control.

Based on the above guidelines, a number of specific proposals for improved *emergency services* are recommended to prevent damage from inland and urban flooding. These are common to all hazards in this plan and are listed in Section 11.1.

3.6.4 Public Education and Awareness

The objective of public education is to provide an understanding of the nature of flood risk, and the means by which that risk can be mitigated on an individual basis. Public information materials should encourage individuals to be aware of flood mitigation techniques, including discouraging the public from modifying channels and/or detention basins in their yards, and dumping in or otherwise altering watercourses and storage basins. Individuals should be made aware of drainage system maintenance programs and other methods of mitigation. The public should also be told what to expect when a hazard event occurs, and the procedures and time frames necessary for evacuation.

3.6.5 Natural Resource Protection

Floodplains can provide a number of natural resources and benefits, including storage of flood waters, open space and recreation, water quality protection, erosion control, and preservation of natural habitats. Retaining the natural resources and functions of floodplains can not only reduce the frequency and consequences of flooding, but also minimize storm water management and nonpoint pollution problems. Through natural resource planning, these objectives can be achieved at substantially reduced overall costs.

Measures for preserving floodplain functions and resources typically include:

- ❑ adoption of floodplain regulations to control or prohibit development that will alter natural resources
- ❑ development and redevelopment policies focused on resource protection
- ❑ information and education for both community and individual decision-makers
- ❑ review of community programs to identify opportunities for floodplain preservation

Measures for restoring diminished or destroyed natural resources and functions provide for re-establishment of an environment in which these functions can again operate. Such measures include development of land reuse policies focused on resource restoration and review of community programs to identify opportunities for floodplain restoration.

3.6.6 Structural Projects

Structural projects include the construction of new structures or modification of existing structures to lessen the impact of a flood event. Storm water controls such as drainage systems, detention controls such as dams and reservoirs, and conveyance structures such as culverts and bridges can be employed to lessen the impact of floodwater runoff. On-site detention can provide temporary storage of storm water runoff. Levees, floodwalls, and dikes physically control the hazard to protect certain areas from floodwaters. Channel alterations can be made to confine more water to the channel and accelerate flood flows. Care should be taken when using this technique to ensure that problems are not exacerbated in other areas of the watershed. Individuals can protect private property by constructing walls and levees around structures.

3.7 Recommended Actions

Based on the general mitigation strategies and actions discussed in the previous section, recommendations specific to Nantucket have been developed and are presented in this section. The status of actions recommended in the previous edition of the HMP is noted first, followed by a list of actions to be pursued in the current planning period.

3.7.1 Status of Previous Actions

Each mitigation action addressing inland and urban flooding that was proposed in the previous edition of this HMP is listed in the table below, along with its status and additional notes.

ACTION	STATUS	NOTES
Increase cooperation between the Nantucket Conservation Commission, Planning Board, Building Department, and Health Department with regard to controlling growth and development in inland flood zones.	Complete	The reorganization of Town departments as described in Section 0 has resulted in strong communication between these departments.

ACTION	STATUS	NOTES
Streamline the permitting process and ensure maximum education of a developer or applicant. Develop a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to the proposed project.	Carry Forward	Due to the improved communication described above, and no reports of permitting issues, this action was previously not deemed necessary; however, due to increasing development pressure, the Town wishes to carry this action forward. This action is revised to refer to all hazards and is carried forward in section 2.
Urge or petition FEMA to more critically evaluate LOMA applications that are received such that redevelopments do not potentially cause increased flooding or wave velocities to other properties.	Complete	Following issuance of the current (2014) FEMA FIRM, the Town spent considerable time working with property owners to review questions related to potential LOMAs. Five LOMA applications were submitted and all five were granted. The Town does not believe that many LOMAs are pending at the time of this Plan development, and feels its current capabilities are appropriate to handle future LOMA requests.
Continue to draw down Sesachacha Pond twice each year to prevent high water levels as long as it protects Polpis Road from flooding.	Capability	This is part of the DPW's standard operating procedures.
Increase the elevation of Polpis Road at Sesachacha Pond to the base flood (8') plus one-foot freeboard.	Carry Forward	This has not yet been accomplished due to budget constraints
Selectively pursue conservation objectives listed in the Madaket Area Plan.	Drop	Some Madaket Area Plan conservation objectives have been completed; however, this action is considered to be too general for the purposes of this Plan. It will be replaced with specific objectives as deemed appropriate.
Purchase the development rights to the 270-acre Loring Property in Madaket.	Complete	Completed by the Nantucket Land Bank
Selectively pursue conservation objectives listed in the 'Sconset Area Plan.	Drop	Some 'Sconset Area Plan conservation objectives have been completed; however, this action is considered to be too general for the purposes of this Plan. It will be replaced with specific objectives as deemed appropriate.
Adopt open space zoning.	Carry Forward with Revisions	Planning & Land Use Services is in the process of developing an Open Space Plan, which will determine whether adoption of open space zoning is necessary (given the Island's strong private land conservation organizations, existing municipal open space, and the value placed on open space by residents and developers.) Carry forward a revised action to complete the Open Space Plan.

ACTION	STATUS	NOTES
Conduct master drainage studies for problem areas, such as the broad area between Madaket Road and Hummock Pond Road, to ensure that individual repairs and upgrades fit seamlessly with upstream and downstream drainage systems.	Carry Forward	Town has been focused on implementing downtown Storm water Improvement Program. Carry forward as "Conduct Master Drainage Study for the Downtown area and its watershed."
Improve the storm drainage system on Pleasant Street to reduce flooding.	Complete	This has been completed as part of the downtown Storm water Improvement Program.
Complete the Orange Street drainage system upgrade to reduce flooding and allow better drainage of upstream areas.	Complete	This has been completed as part of the downtown Storm water Improvement Program.
Ensure that the Milestone Road crossing of Phillips Run can convey the 1% annual-chance flood and make repairs if necessary to convey the 1% annual-chance flood.	Drop	Conveyance of flood flows has not been a problem at this site; action is deemed unnecessary.

3.7.2 New Actions and Actions to Carry Forward

New actions were developed over the course of this Plan update; along with the actions being carried forward from the previous HMP, recommended inland flood mitigation actions to implement are listed below.

Carried Forward Actions:

- ❑ Increase the elevation of Polpis Road at Sesachacha Pond and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.
- ❑ Complete development of an Open Space Plan
- ❑ Conduct Master Drainage Study for the Downtown area and its watershed. Identify needs for storm water drainage improvement, including backflow devices at outfalls at the harbor. Develop an operations & maintenance policy for retention/detention and water quality treatment (Stormceptors) systems for Town and privately-owned facilities

New Actions

- ❑ In the Downtown area (including Brant Point to Orange St.), complete CCTV inspection and Storm Water Management Program. Prioritize improvements to reduce flooding.
- ❑ Complete Consue Springs project (including Orange St. and Pleasant St. systems) to improve drainage and outfall discharge in that area. The outfall serves a drainage area of 36 acres with several retention/detention systems. The project scope has been revised to address the restoration of the pond and creek to improve water quality.
- ❑ Conduct master drainage studies for problematic inland areas, such as that between Madaket Road and Hummock Pond Road, to ensure that individual repairs and upgrades fit seamlessly with upstream and downstream drainage systems.

- Adopt a set of design guidelines to encourage flood proofing and elevation of structures while maintaining their historic characters. The NFIP Floodplain Management Bulletin FEMA P-467-2, "Historic Structures," may be referenced.
- Develop a comprehensive storm water management plan that addresses needs and priorities to reduce flooding and improve drainage. Include a funding model and possible revenue sources to sustain ongoing maintenance and capital improvements. The Plan should review policy and regulations that govern the discharge of water into the Town's ROW and those that have direct connection to the Town's storm drainage system. The rising sea level and water table is leading to more sump pumps discharging into the drains or on the roadway.
- Document that the Milestone Road crossing of Phillips Run can convey the appropriate flood event. Identify the flood event that will overtop the road.
- Perform a network-level inventory and condition assessment of storm water infrastructure to drive development of a dedicated cleaning and maintenance program for the drainage systems. Current approach lacks the equipment and staffing in DPW. Use the same information to identify and plan for capital and improvement projects. Integrate the information with the Town's GIS and Work Order systems.
- Install water tight sewer manholes in areas that experience regular street flooding.

Important recommendations that apply to all hazards are listed in Sections 2-14 and 11-1.

4 COASTAL FLOODING

4.1 Setting

One of the greatest threats from a coastal storm is coastal flooding due to storm surge. This is the inundation of land along the coast and estuarine shoreline by sea water and wind-driven waves above normal tidal action. Coastal flooding is a well-documented natural hazard that threatens the Town of Nantucket far more frequently, and in many more locations, than inland flooding. A review of the flood zone map (Figure 3-1) reveals that the perimeter of Nantucket consists of AE-zones (1-percent annual chance flood zones with base-flood-elevations identified) and VE-zones (1% annual-chance flood zones with wave velocity hazards and base-flood-elevations identified). The FEMA mapping implies complete inundation for areas such as Brant Point, Smith Point, Muskeget Island, and Coatue/Great Point, during 1% annual-chance coastal flood events; and partial inundation of the population centers in Madaket Village and downtown Nantucket. Many of Nantucket's localities are checked in the "coastal flooding" column of Table 1-5.

In addition to the areas described above, flooding at tidal creeks and ponds can occur in the 1% annual-chance coastal flood zones that extend inland from the shoreline, not necessarily affecting structures but potentially cutting off access via roadways. The most notable examples include Polpis Road at Fulling Mill Brook, Wauwinet Road at Polpis Harbor, Madaket Road at the Head of Long Pond, and Madaket Road at Madaket Ditch.

4.2 Hazard Assessment

Refer to Figure 3-1 for the areas of Nantucket at risk of coastal flooding based on FEMA flood zones. These flood zones are based on the 1% annual-chance and 0.2% annual-chance flood events. coastal flooding is typically due to hurricanes, nor'easters, or other events that are discussed in subsequent sections of this plan.

Smaller magnitude flood events occur on a more frequent basis. For example, coastal areas and low-lying areas proximal to waters under tidal influence may be susceptible to frequent flooding.

Coastal flooding can occur as a result of astronomical high tides acting alone or concurrent with storms; as a result of nor'easters, hurricanes and tropical storms; or simply as a result of persistent strong winds. These causes will be discussed in Sections 5.0 and 8.0. In additional, it is believed that coastal flooding will increase in frequency as sea level rises, as discussed in Section 6.0.

4.3 Historic Record

Most non-nuisance, widespread flooding in Nantucket is caused by coastal storms such as nor'easters and tropical storms and hurricanes, which are frequently accompanied by low pressures and strong winds that cause tidal flooding. Detailed discussions of hurricanes and nor'easters are provided in Sections 5.0 and 8.0, respectively. A general record of significant coastal flooding in southeastern Massachusetts is presented below. This information was taken from USGS Water-Supply Paper 2375, *Massachusetts Flood and Droughts* (1989) and the NCEI storm event database. Other references are cited in Sections 5.3 and 8.3.

- **September 1938** – The Great New England Hurricane of 1938 caused strong hurricane storm surge flooding of 18 to 25 feet in southeastern Massachusetts including the Cape Cod area.
- **September 1944** – The Great Atlantic Hurricane of 1944 caused strong hurricane storm surge flooding in Cape Cod, Nantucket, and Martha's Vineyard.
- **August 1954** – Hurricane Carol caused strong hurricane storm surge flooding of 10 to 15 feet in the Cape Cod area.
- **September 1954** – Hurricane Edna caused hurricane storm surge flooding of six feet in southeastern Massachusetts, including the Cape Cod area.
- **February 1978** – Record tidal flooding occurred in the Cape Cod area.
- **August 1991** – Hurricane Bob caused strong hurricane storm surge flooding of 12 to 15 feet in Southeastern Massachusetts and the Cape Cod area.
- **December 1992** – The "No-Name Storm" of 1992 is the most recent record of *severe* and *widespread* coastal flooding on Nantucket. This nor'easter caused significant coastal flooding along Nantucket Harbor in the downtown (with inundation up to Sea Street) and Brant Point areas, and caused significant erosion along many ocean-facing beaches such as Codfish Park in 'Sconset. During this storm, the Fire Department had trouble reaching some homes in Madaket to rescue residents.
- **December 1995** – A strong nor'easter caused coastal flooding in Nantucket and other southeastern Massachusetts communities.
- **April 1997** – A strong storm with 50 to 90 mph winds on Nantucket caused flooding and erosion in Codfish Park.
- **February 1998** – A strong nor'easter caused coastal flooding in Nantucket and other southeastern Massachusetts communities. In addition, 12 to 20 feet of erosion occurred in eastern Nantucket.
- **October 2005** – A strong fall nor'easter entrained with remnants of tropical storm Wilma caused coastal flooding in Nantucket and other southeastern Massachusetts communities.
- **February 2006** – A strong nor'easter caused coastal flooding in Nantucket and other southeastern Massachusetts communities.
- **April 16-17, 2007** – A very strong nor'easter caused coastal flooding and severe erosion in Nantucket and other southeastern Massachusetts communities. A home on Sheep Pond Road fell into the ocean after waves eroded the bluff underneath.
- **November 3, 2007** – The remnants of Tropical Storm Noel brought high winds and coastal flooding to the Massachusetts coast. Several boats were beached on Nantucket, and five roads in Brant Point were closed.
- **October 18, 2009** – A strong low pressure system passing to the southeast of Nantucket brought rain, snow, and wind. Washington and Lafayette Streets were flooded with 6 inches

of water, the parking lots at Jetty Beach and Children's Beach were flooded, and several Brant Point streets were flooded.

- **September 3, 2010** – Tropical Storm Earl passed 98 miles southeast of Nantucket, bringing tropical storm force winds and high surf to Nantucket. Madaket Beach was submerged, and seawater overtopped the beach and entered Long Pond.
- **October 29, 2012 –** Hurricane Sandy brought high winds and coastal flooding to southern New England. In general, moderate flooding occurred along the Massachusetts coastline, with storm surges from 2.5 to 4.5 feet peaking between high tide cycles. On Nantucket, Broadway and streets east of Broadway were impassable due to flooding. Stairs, ramps, piers, docks, and a bulkhead were damaged at the harbor marina. Straight Wharf was flooded.
- **February 9, 2013 –** The Blizzard of 2013 brought very strong winds and snow to the Massachusetts coast, and a storm surge of 3 to 4 feet on top of an astronomically high tide. Easy Street and Washington Street were flooded up to three feet deep. Water up to two feet deep flooded Beach Street. Wauwinet Road near Eat Fire Springs Road flooded. Water was as far up as the Nantucket Hotel on Easton Street in the Brant Point area. Main Street was flooded up to the Club Car Restaurant. Significant beach erosion occurred, damaging sand fencing.
- **March 7, 2013 –** Hulbert Avenue, Washington, Broad, Easton, and Easy Streets, were flooded and impassable. Sheep Pond Road was flooded.
- **January 3, 2014 –** A significant, rapidly developing coastal storm flooded several roads along Nantucket Harbor, including Easy, Broad, and Washington Street. Those roads were impassable.
- **March 26, 2014 –** Coastal flooding occurred at Straight Wharf, on Easy Street, and in Brant Point.
- **November 2, 2014 –** Easy Street was closed to due minor coastal flooding.
- **January 27, 2015 –** The January 2015 Blizzard produced very strong winds and significant coastal flooding. A federal disaster declaration was issued. Moderate to major coastal flooding occurred on Nantucket, particularly on north and northeastern facing beaches. Francis Street at Union Street, Washington Street from Commercial Street and Easy Street, Broad Street from Easy Street to South Water Street, and South Beach Street were closed due to flooding. Parts of Brant Point were also flooded with ocean water. Three and a half feet of ocean water flooded the downtown section of Nantucket. The town pier, weakened by storms during the previous two years, was severely damaged.
- **February 15, 2015 –** Another heavy snow storm brought minor coastal flooding to the Children's Beach boat ramp. The barrier beach at Folger's Marsh was breached. Francis Street was closed at Union Street and Washington Street was closed from Commercial Street to Francis Street.
- **January 24, 2016 –** Boat ramps in Madaket were flooded. Easy Street was flooded with 4 to 12 inches of water.

- **February 8, 2016** – Front yards on Washington Street were flooded. Easy Street, lower Broad Street, and Commercial Street were flooded. Several roads in the Brant Point section were closed due to flooding. The traffic circle at Easton Street and Hulbert Avenue was flooded and impassable.
- **January 3-5, 2018** – A powerful nor'easter called Winter Storm Grayson brought rain, wind, and coastal flooding to Nantucket. Many low-lying areas of Downtown were flooded. Easton Street was flooded by four feet of water, and a car was seen floating down the street. A couple of homes on Washington Street were shifted on their foundations by floodwaters. More than 20 people had to be rescued, and at least two families were displaced. The Town opened the emergency shelter.
- **January 30, 2018** – A coastal storm passed offshore of Nantucket and brought a storm surge and several inches of snow to eastern Massachusetts. Easy Street, Easton Street, and Washington were all reported flooded.
- M**arch 2-4 2018** – A powerful nor'easter called Winter Storm Riley brought a storm surge that lasted multiple tide cycles. Multiple buildings sustained flood damage, and high winds created waves that caused erosion and directly impacted some buildings. Many roads were impassible due to flooding. Brant Point was cut off from both Easton Street and Cobblestone Hill, making it completely inaccessible. Sesachacha Pond was breached by the Atlantic Ocean, causing inundation to extend inland and overtop Polpis Road.

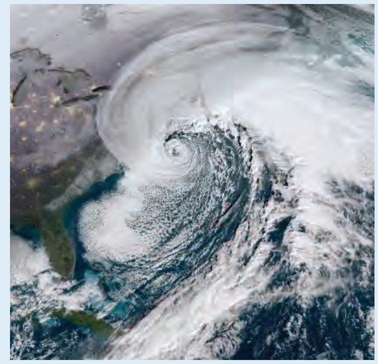
Even during lesser storm events, coastal flooding has the potential to occur. Consider the following locations that have been identified by Nantucket town officials:

- Polpis Road at Fulling Mill Brook – The road has come within six inches of flooding as water levels in the tidal brook increase landward as a result of high winds;
- Wauwinet Road at Polpis Harbor – The road has flooded in the past when water levels in the harbor increase as a result of high winds;
- Madaket Road at the Head of Long Pond and Madaket Road at Madaket Ditch – Although these road crossings did not flood during the No Name storm in 1992, they have come close to flooding. In March 2018, Winter Storm Riley and sustained wind from the north led to wave-driven flooding that reached this site and caused scouring on the north side of the roadway. DPW placed large concrete blocks to dissipate wave energy and mitigate erosion of the roadway and culvert.

Early 2018 Storm Events

2018 had a stormy start, with two major nor'easters in the first three months of the year. These storms highlight some of the risks that Nantucket faces from natural disasters, and its capacity to mitigate and recover from those hazards.

Winter Storm Grayson



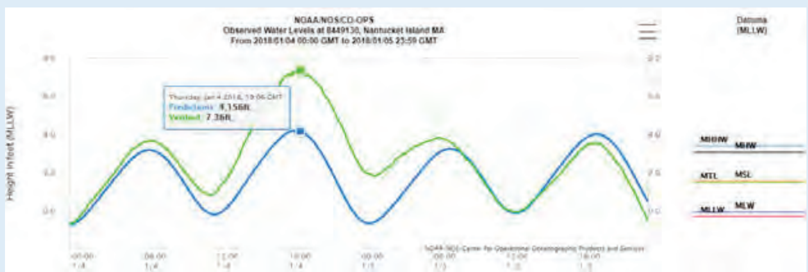
GOES-16 ABI GeoColor image Grayson. - NOAA

January 3rd, 2018, Winter Storm Grayson rapidly intensified (bombogenesis) off the East Coast, earning it the nickname of "Bomb Cyclone."

The main impacts in New England were felt on January 4th, with high winds, wintry precipitation, and storm surge. On Nantucket, some homes were evacuated and the High School emergency shelter was opened.

Water in Nantucket harbor surged 3.48 feet; maximum flooding reached 5.27 feet NAVD88.

Winds were sustained at 45 mph, with a peak gust of 76 mph. Many burglar-alarms were set off by the wind, but few tree limbs or power lines were downed. No outages were reported through Thursday.



Nantucket Harbor tide data, NOAA Gauge: Winter Storm Grayson

Wave heights of 6.6 feet were reported, but mitigated within Nantucket harbor by a layer of ice that had formed during the preceding deep freeze weather.

All ferry services were suspended Thursday and Friday. Ferry service had already been interrupted due to icing in Hyannis Harbor. Cape Air flights were suspended on Thursday.

Streets downtown were closed to traffic starting before noon on Thursday.

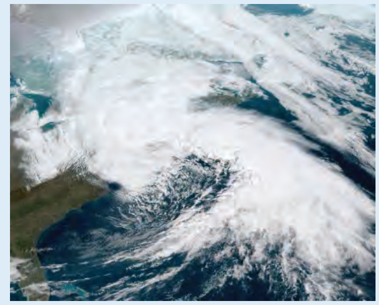
Unusually cold temperatures led to concern about icing. High stormwater volumes and cold weather combined to cause the failure of a sewer main, and the discharge of sewage directly into the harbor.

Ice dampens wave effects.
Photo: Nicole Harnishfeger/I&M Photo

High Tide on Easy Street.
Photo: Nicole Harnishfeger/I&M Photo

Early 2018 Storm Events

Winter Storm Riley



GOES-16 image of Riley. - NASA

On March 2, 2018, Winter Storm Riley formed rapidly (bombogenesis) off the East Coast, bringing a surge that lasted multiple tide cycles.

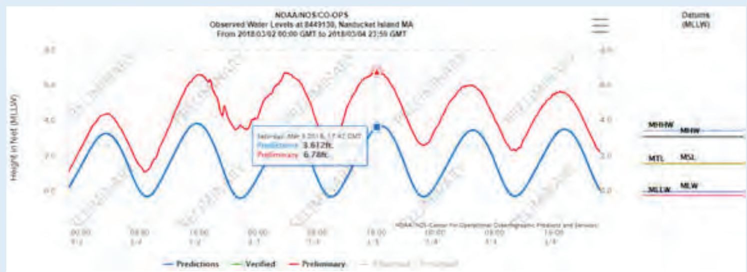
Nantucket saw flooding beginning on Friday March 2. The emergency shelter was not opened.

Nantucket Harbor experienced 4.18 feet of storm surge; the maximum flood elevation was 4.69 feet NAVD88. Multiple buildings sustained flood damage.

The top wind gust was 89 mph, downing trees and branches. Multiple neighborhoods lost power overnight. Multiple burglar alarms were set off by wind. One building experienced significant wind damage. Many residential fences were blown over.

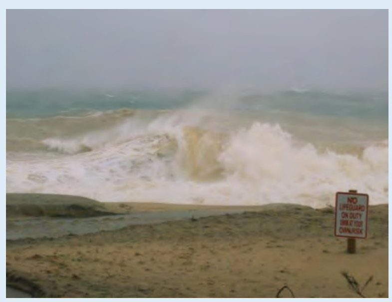
Waves damaged First Bridge on Madaket Road, and were observed hitting buildings on Washington Street. Large waves were also present in Sconset, but limited erosion was reported. The Sconset Beach Preservation Fund geotube project appeared to remain mostly intact.

Ferry Services were suspended after 6:30 am on Friday through Sunday morning.



Nantucket Harbor tide data, NOAA Gauge: Winter Storm Riley

Waves crash into Buildings



Breached Sesachacha Pond
Photo: Susan Turer

Wind damage

Many roads were impassible due to flooding, undercutting, or downed trees and power lines. First bridge on Madaket Road was damaged but remained open. Brant Point was cut off from both Easton Street and Cobblestone Hill, making it completely inaccessible.

Sesachacha Pond was breached by the Atlantic Ocean, causing inundation to extend inland and overtop Polpis Road, which was subsequently washed out.

High Tide on Easy Street

Lessons Learned from Recent Storm Events

Disasters cause extensive damage and hardship, however useful lessons can also be learned from each event. Given the multiple, large-scale coastal storm events that impacted the Island over 2017 and 2018, the Community asked itself what lessons were learned and how they can be turned into action. The following actions resulted from this reflection:

- ❑ Establish a policy to conduct a Post-Event-Review and complete an After-Action-Report within one month of every major disaster event.
- ❑ Develop Standard Operating Procedures for Roadway Barrier Deployment that address barrier locations, types, anchoring, and alternative route options).
- ❑ Ensure sufficient communication radios and vehicle chargers are available for municipal and emergency response vehicles.
- ❑ Maintain a sufficient stockpile of essential materials.
- ❑ Establish a protocol for operation of the Children's Beach Boat Ramp Flood Gate.
- ❑ Train municipal staff on the Incident Command System.
- ❑ Improve organization of electronic project-plan storage, as well as practices to find and obtain those plans, to decrease the time needed to find such plans in an emergency (it took several days to locate plans showing valve locations on a sewer force-main following a rupture caused by extreme weather conditions).
- ❑ Map all buried infrastructure in the Town's geographical information system.
- ❑ Continue public communication practices, which were effective in the 2018 storms.
- ❑ Continue tracking post event activities in *VEOCI*, which was effective following the 2018 storms.
- ❑ Improve practices related to tracking labor, equipment, and materials for storm-related activities.

Many of these actions have been incorporated into this HMP.

4.4 Existing Capabilities

The Town of Nantucket has in place a number of measures to prevent coastal flood damage. These include regulations, codes, and ordinances; a process for maintaining roads, bridges, and culverts at tidal creeks; a variety of structural flood control features in coastal areas of Nantucket; elevation of structures; and the use of warning systems. These were described in Section 3.4. Additional information is provided in this section as related to coastal flood hazards.

Regulations, Codes, and Ordinances

Regulations, codes and ordinances that apply to flood hazard mitigation are described in section 3.4.

Outreach and Education

Outreach and education efforts around coastal flooding hazards are generally the same as those implemented around inland flooding, discussed in Section 3.4. Additional, coastal-flood-specific outreach efforts include working with boat owners and marinas to ensure watercraft are removed from the water or otherwise appropriately secured prior to predicted coastal flood events.

Infrastructure and Road Protection

The role of the DPW in tracking, planning and preparing for, and responding to flooding is discussed in section 3.4.

Infrastructure constructed, at least in part, to reduce coastal flood damage include the jetties at the mouth of Nantucket Harbor and seawalls that exceed coastal base flood elevations. Bulkheads are common in the harbor area and a variety of other projects have been conducted in oceanside areas to combat erosion, but these are meant for shoreline stabilization and erosion control rather than coastal flood control.

The Children's Beach Pump Station system was designed to improve water quality being discharged to the harbor and to improve drainage from South Beach Street and Brant Point. The project was considered complete and the system operational in October 2009, and therefore the pump station was in place to support drainage efforts many of the major storm events identified in Section 4.3. Recently, several operational issues have been reported with the pump station, including those observed during inspections during high-water events as well as several pump failures. These issues have led the DPW to hire an engineering team to evaluate the performance of the system, identify improvements needed, and develop an Operations and Maintenance Plan for this system.

Building Protection

In recent years, many buildings in coastal flood zones have been elevated above the base flood level. This has been particularly true in the Brant Point neighborhood.

In the downtown area, high building density, the predominance of historic structures, and other complicating factors, have been barriers to building elevation.

Open Space

Open space in coastal areas does not have the same type of flood-mitigation capacity as those in inland areas because of the difference in the nature of inland versus coastal flooding. Nevertheless, open space creation, preservation, and enhancement do provide a degree of coastal-flood mitigation in the following ways:

- Removal of assets from and prevention of development in flood-risk zones along the coast
- Promote establishment of coastal ecosystems (such as tidal wetlands) that diminish wave action and flood elevations.

The Town of Nantucket owns a significant amount of open space on the Island, but tends not to pursue additional acquisition. Local organizations active in land acquisition and preservation are the Nantucket Conservation Foundation (NCF), the Nantucket Land Council, Inc. (NLC), and the Nantucket Land Bank (NLB). Current open space development projects include

- Washington Street Waterfront: NLB is working to acquire and clear all waterfront parcels on Washington Street (about five parcels have been purchased)
- Easy Street: NLB continues to work to acquire and clear waterfront parcels on Easy Street (29 Easy Street is currently owned by the NLB)

Storm Surge & Critical Infrastructure Report

A project was completed by Worcester Polytechnic Institute (WPI) bachelor students in 2015 that resulted in a report titled "Storm Surge & Critical Infrastructure on Nantucket." The report identifies and analyzes risks posed by storm surge for a suite of critical infrastructure. A set of GIS layers depicting the pathways by which storm surge is able to access inland areas was also prepared. The report and GIS layers represent an important increase in the Town's knowledge of its risk from hurricanes.

4.4.1 Capabilities Summary

In summary, the Town of Nantucket primarily mitigates coastal flood hazards by restricting building activities in areas with flood risk, acquiring and preserving open space in flood-risk areas, and constructing and maintaining structural coastal flood protections. The Conservation Commission, Planning Board, and Building Department administer flood-protection regulations, the Health Department performs outreach and education activities, and the Department of Public Works constructs structural mitigation projects.

Nantucket's capabilities to mitigate for coastal flooding have strengthened since the initial HMP was adopted through acquisition and preservation of coastal open space, adherence to stricter statewide floodplain regulation requirements, local adoption of the updated FEMA FIS and FIRM, and completion of the Storm Surge & Critical Infrastructure Report. Implementation of the downtown Storm water Improvement Program, though more focused on non-coastal poor-drainage flooding, should have mitigating effects on coastal flooding as well due to the interconnectedness of coastal- and non-coastal-flooding in this neighborhood. The update to the MSBC, adding freeboard requirements to buildings in flood zones, also improves the Town's capability to protect future development from coastal flooding.

4.5 Vulnerabilities and Risk Assessment

Nantucket has 1,136 buildings located within coastal FEMA flood hazard zones (AE and VE zones). Differentiating between inland and coastal flood areas was described in Section 3.5 and summarized in Table 3-2.

4.5.1 *Vulnerable Areas*

This section discusses specific areas at risk to coastal flooding within Nantucket. Critical facilities and evacuation routes are identified as applicable.

Critical Facilities and Repetitive Loss Properties

Several critical facilities are located in coastal flood zones and are therefore at risk of flooding. These include the municipal buildings 16 Broad Street, 34 Washington Street, and 37 Washington Street; the Police Station; Our Island Home and Landmark House; the sewer pumping station on Sea Street; the Steamship Dock, all four boat ramps listed in Table 2-1, and the fuel tank farm.

Repetitive-loss (RL) properties (two or more NFIP claims of more than $1,000) are located in 'Sconset, Madaket, along the southwest shore, and in the downtown and Brant Point area. See Table 4-1.

Table 4-1: Repetitive Loss Properties on Nantucket

Civic League District	Repetitive Loss Properties	Severe Repetitive Loss Properties	Total FEMA Reimbursements Paid to Repetitive Loss Properties
Downtown	11	0	$559,209
Brant Point	38	8	$4,071,746
Madaket Conservation	1	0	$169,235
Smith Point	6	1	$1,145,046
Madaket Residents	3	1	$819,100
Siasconset	9	1	$1,204,684
Cisco/Hummock Pond	1	0	$136,337
ISLAND-WIDE	**69**	**11**	**$8,105,358**

Out of the 69 RL properties on Nantucket, only four are non-residential. All four non-residential RL properties are located in Brant Point; one of the four is a Severe RL Property.

RL property-owners on Nantucket tend to be knowledgeable about the hazards their properties face. The Town will pursue actions to continue to engage those owners in mitigation activities

Downtown and Brant Point

The Nantucket Harbor area (including downtown and Brant Point) is considered to be the most vulnerable population with regard to coastal flooding. The prevalence of low-lying coastal land and the high building and population densities creates a dangerous potential for repeated flood damage, even with the protections provided by the sheltered harbor. Approximately 950 buildings in the downtown and Brant Point areas are located within 1% annual-chance and 0.2% annual-chance flood zones.

In the Nantucket Harbor Area, Easy Street, Easton Street at North Beach, and Washington Street are three essential access routes that frequently experience flooding, even during non-storm conditions. At these sites, seawater may overtop the bulkhead, or storm water may get backed-up.

Sections of Orange Street, which connects Our Island Home and the Saltmarsh Senior Center to the Downtown and Mid-Island areas, are at risk of coastal flooding.

A storm water pump station and flood gate are located at the Children's Beach Boat Ramp at the end of Harbor View Way. The DPW is responsible for the operation of the pump station and for opening and closing the flood gate. During storm events that span multiple tide cycles, private citizens have been known to open the flood gate at low tide (to facilitate drainage of water that has pooled inland), and then leave the gate open, leading to flooding conditions at the next high tide. Complicating the issue is the fact that storm water pump system has been ineffective for many recent events. The Town wishes to adopt a standard protocol regarding the Children's Beach Boat Ramp Flood Gate, and to communicate this protocol to residents.

Madaket Village

After the downtown and Brant Point area, Madaket is considered to be most vulnerable to coastal flooding due to ow-lying coastal land and relatively high building and population density. Approximately 150 dwellings in Madaket are located within 1% annual-chance and 0.2% annual-chance flood zones.

Madaket residents are potentially affected by flooding in another important way. Madaket Road is the only available means of evacuation from Madaket Village to central Nantucket during a flood event. Anyone using the road must cross the Head of Long Pond and Madaket Ditch, both of which are 1% annual-chance flood zones. Although these crossings did not flood during the No Name storm in 1992 when portions of Madaket Village flooded, a more significant storm could flood the crossings at a time when the road is most needed. Similarly, the bridge connecting Smith Point residents to Madaket has the potential to flood, although less frequently as the bridge currently has eight to ten feet of freeboard. Other risks to this bridge are more urgent, as described in Section 6.5.

Polpis and Wauwinet

Residents of Polpis and Wauwinet are similarly potentially effected by flooding that can occur where Polpis Road crosses Fulling Mill Brook, and where Wauwinet Road passes in close proximity to Polpis Harbor. During a severe storm, these residents may find that their primary means of evacuation are not available. In addition, residents who live off Polpis Road between Fulling Mill Brook and Sesachacha Pond are also at risk of isolation.

'Sconset

In 'Sconset, most dwellings and commercial establishments are located on the bluff, far above the flood zone and at risk for erosion but not chronic flooding. The exception in 'Sconset is the Codfish Park neighborhood, where 61 cottages, dwellings, garages, and outbuildings are located outside the mapped 1% annual-chance coastal floodplain, but near the edge of the 1% annual-chance flood zone with wave velocity hazard. This area did indeed experience flooding and erosion during the 1992 No Name storm, with several structures lost to the ocean. Damage to structures also occurred in the April 1997 storm.

Summary

In summary, the Madaket, Brant Point, and downtown areas are most vulnerable to *inundation* caused by coastal flooding. Efforts to mitigation for coastal flooding should be concentrated in these areas, or along evacuation routes from these areas.

Residents of Nantucket's other population centers are less likely to be affected by coastal flooding.

Historic Resources

Historic resources may be particularly at risk from coastal flooding, relative to other assets, for the following reasons:

- ❑ **Location:** Historic properties built before modern zoning regulations may be located in higher risk areas than what would be allowed under current laws. The downtown area is an example of a high density of historic properties located in a coastal flood zone.
- ❑ **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand flooding as those built more recently.
- ❑ **Age:** Buildings and materials degrade over time, and a historic property may not be able to stand up to flooding as well as it could when first constructed.
- ❑ **Sea Level Rise:** Buildings that were historically at a relatively low risk from coastal flooding may be more exposed in the present-day due to sea level rise over the last century.

Additionally, hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character. Of particular concern in coastal areas are historic buildings that are located in coastal flood zones but have basements (prohibited for new buildings under current FEMA regulations). Basement flooding can damage utilities, create mold and health risks, and undermine the foundations of a building.

4.5.2 Loss Estimates

The economic losses faced by the community from natural hazards can be estimated by reviewing historic, and modeling future, loss figures. It is difficult to accurately quantify losses, even after an event; therefore, a number of different sources are provided in this section. Taken together, they provide a range of possible loss estimates.

HAZUS-MH Vulnerability Analysis

HAZUS-MH was used to calculate coastal flood loss estimates. The software utilizes year 2010 U.S. Census data and 2010 USD. Coastal flood depths were generated through the FIT using SFHA zone, base flood elevation, and wave setup data from the Nantucket FIRM and FIS. Ground surface elevation data for the FIT tool was sourced from MassGIS digital elevation models (DEM) developed using LiDAR data collected in 2013 and 2014 as part of a Hurricane Sandy recovery project.

Detailed Hazus-MH results are included in Appendix D. Overall losses are summarized in Table 4-2, below.

Table 4-2: HAZUS-MH – Building-related Economic Loss Estimates

Category	Loss
Buildings	$122.78 million
Business Interruption	$1.00 million
Total:	**$123.78 million**

The model further estimates that 2 Police Stations would be damaged, each losing at least one day of operation; that 98 households will be displaced, with 96 individuals requiring temporary shelter; and that232 buildings would be damaged in total, with 12 of those completely destroyed.

The loss estimates for a 1-percent annual-chance flood cannot be used, alone, to calculate a meaningful annualized loss estimate; therefore, no ALE is calculated based on Hazus-MH results.

<u>Public Assistance Reimbursements</u>

Loss estimates for coastal flooding were also be generated from the value of PA grants received by Nantucket and other entities within the Town. As described in Section 3.5.1, there has been one federal disaster declarations in Nantucket since 1999 that resulted from flooding events. A total of $6,209.09 was spent on Public-Assistance-supported projects to recover from those events.

Given the ratio of structures located in inland flood zones to those in coastal flood zones (see Table 3-2), it is estimated that $6,036.62 of the figure of $6,209.09 (the majority of expense) has been due to coastal flooding. Dividing that figure by the 18 years over which PA grant data has been tracked provides an estimate of annualized losses due to coastal flooding.

*Annualized Loss Estimate: Coastal Flooding (PA-based): **$335.37***

<u>NFIP Payments</u>

As described in Section 3.5.1, the total value of paid NFIP claims since 1978 is $16.74 million. Given the ratio of structures located in inland flood zones to those in coastal flood zones, it is estimated that $16,283,067 of that total have been due to coastal flooding. Dividing that figure by the 39.75 years over which loss data has been tracked (January 1, 1978 to August 31, 2017) provides an estimate of annualized losses due to inland flooding.

*Annualized Loss Estimate: Coastal Flooding (NFIP-based): **$409,637***

NCEI Storm Events Database

The NCEI database of historic storm events was reviewed. Inland flood events (identified in the database as "Flood" or "Flash Flood" events, and differentiated from "Coastal Flood" events) have been recorded since 1996.

According to the NCEI dataset, there have been 20 significant coastal flood events on Nantucket since 1996, 8 of which caused measurable damage.

Table 4-3: NCEI Storm Events Database – Coastal Flood Events

Date	Type	Estimated Property Damage
4/19/1997	Coastal Flood	$0
1/29/1998	Coastal Flood	$0
2/24/1998	Coastal Flood	$0
1/31/2006	Coastal Flood	$5,000
4/15/2007	Coastal Flood	$5,000
4/16/2007	Coastal Flood	$5,000
4/17/2007	Coastal Flood	$10,000
11/3/2007	Coastal Flood	$0
10/18/2009	Coastal Flood	$0
9/3/2010	Coastal Flood	$0
10/29/2012	Coastal Flood	$139,000
2/9/2013	Coastal Flood	$100,000
3/7/2013	Coastal Flood	$25,000
1/3/2014	Coastal Flood	$0
3/26/2014	Coastal Flood	$0
11/2/2014	Coastal Flood	$0
1/27/2015	Coastal Flood	$50,000
2/15/2015	Coastal Flood	$0
1/24/2016	Coastal Flood	$0
2/8/2016	Coastal Flood	$0
1/4/2018	Coastal Flood	$0
1/30/2018	Coastal Flood	$0
	Total	**$339,000**

Dividing the total property damage from the NCEI figure by the 21 years over which that data has been tracked provides an estimate of annualized losses due to inland flooding.

*Annualized Loss Estimate: Coastal Flooding (NCEI-based): **$16,143***

Loss Estimates Summary

Based on the loss estimates summarized above, an average expected annualized estimated loss can be calculated. Note that Public Assistance funding is only granted for public projects, while NFIP claims are only granted for private property; therefore, the two are considered as a single unit ("PA & NFIP" in the table below).

Table 4-4: Annualized Loss Estimates for Coastal Flooding

Source	Annualized Estimated Loss
HAZUS-MH	N/A
Public Assistance	$2,068
NFIP Claims	$409,637
PA & NFIP	$409,972
NCEI	$16,143

These annualized figures may be low estimates of actual annualized losses, as PA funding, NFIP reimbursements, and NCEI loss records only account for damages reported through those programs; Nantucket has likely experienced additional losses that did not result in damage claims to FEMA or reported losses to NCEI.

4.6 Mitigation Strategies and Action

Many potential mitigation strategies for coastal flooding are essentially the same as those for inland flooding, and are not restated in this section under the headings for prevention, property protection, structural projects, emergency services, public education, and natural resource protection. Potential strategies that are more applicable to coastal flooding than inland flooding are presented below.

V-Zone Standards and Freeboard Standards

In recognition of increased flood losses in coastal environments, often due to increased development, the Association of State Floodplain Managers (ASFPM) has adopted a No Adverse Impact (NAI) floodplain management philosophy. These policies focus on individual- or community- level responsibility and mitigation of flood risk. NAI should be viewed as a set of principles to follow when designing or evaluating development activities. Implementation of NAI principles can be accomplished through planning initiatives, regulatory programs, individual- or community-based projects, and public education and outreach.

The NFIP and the accompanying locally adopted floodplain management ordinances set forth specific design requirements aimed at minimizing damage to buildings in mapped V zones caused by waves and storm induced erosion. These requirements state that new, substantially damaged, or substantially improved structures that are built in V zones must, among other requirements, be elevated on piers, piles, or other open foundation type, with the lowest horizontal structural component elevated to or above the flood elevation. The area below the flood elevation is to be kept free of obstructions, used only for building access, parking, or storage. If present, the basement area is abandoned and filled to be no higher than the existing grade. The intent of this requirement is to allow floodwaters and damaging waves to pass beneath a building without transferring any additional loads onto its foundational components.

One of the best mitigation options available, as identified by the ASFPM NAI principles, is to exceed the minimum NFIP requirements by constructing (or retrofitting) buildings located in sections of coastal A-zones to meet V-zone standards. Exceeding minimum regulatory requirements may increase costs for initial construction and maintenance, but these costs could more than be offset by long-term benefits.

Application of freeboard standards to coastal flood zone elevations is typically viewed as more effective than applying freeboard standards to inland flood zones. Freeboard standards require structures to be elevated higher than the level that FEMA requires. When used alone, freeboard standards provide additional certainty that flood levels will not damage a structure. When use in combination with V-zone standards, freeboard standards can provide an additional level of flood damage prevention.

Note that many of Nantucket's buildings are historic, and may be exempt from flood zone requirements. Special care must be taken when bringing a historic building into compliance with V-zone standards to avoid altering the building's historic character.

Hard and Soft Structural Projects

Physical structures that are capable of lessening the impacts of coastal flooding typically include seawalls, levees, and bulkheads. Because new hard structures are not allowed in the Town of Nantucket, soft solutions such as beach nourishment and green/gray hybrid approaches such as bioengineered banks must be pursued as the only available structural projects to mitigate for coastal flooding. Refer to Section 6.6 for more information.

Historic Resource Protection

As noted previously, mitigation of hazard damage to historic resources can be difficult without altering the historic character of the resource. Historic resource resiliency strategies are included in Appendix G. Some examples of actions that can be taken to mitigate coastal flooding damage to historic properties include:

- ❑ Fill Basement
- ❑ Install Sump Pumps and Backflow-Prevention Devices
- ❑ Apply water-resistant paint to help prevent infiltration
- ❑ Repoint masonry joints with watertight mortar to help prevent infiltration
- ❑ Relocate historic artifacts to safer locations, either permanently or ahead of predicted hazard events
- ❑ Elevate or relocate internal utilities
- ❑ Elevate building and install "minimization measures" or "visual mitigation" measures to retain historic appearance
- ❑ Alter parcel grading to drain water away from structures
- ❑ Anchor structures, artifacts, etc., to prevent flotation during a flood event.

4.7 Recommended Actions

4.7.1 Status of Previous Actions

A suite of mitigation actions for addressing coastal flooding were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes. Some of these are repeated from Section 3.7, given their applicability to coastal flood mitigation.

ACTION	STATUS	NOTES
Increase cooperation between the Nantucket Conservation Commission, Planning Board, Building Department, and Health Department with regard to controlling growth and development in inland flood zones.	Complete	See section 3.7
Streamline the permitting process and ensure maximum education of a developer or applicant. Develop a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to the proposed project. This list could be provided to an applicant at any Town department.	Drop	See section 3.7
Urge or petition FEMA to more critically evaluate LOMA applications that are received such that redevelopments do not potentially cause increased flooding or wave velocities to other properties.	Complete	See section 3.7
Adopt freeboard standards (two feet for dwellings and one foot for roadways) when regulating the elevation of development in flood zones.	Carry Forward	The State Building Code requires two-feet of freeboard in VE-zones. The Town has not adopted a local freeboard requirement for AE zones.
Adopt V zone construction standards for coastal A zones.	Drop	The Town feels this would be challenging to implement due to disagreements in the delineation of coastal vs. non-coastal A zones, and prefers to pursue adoption of freeboard in AE zones.
Encourage elevation of homes in the Codfish Park beach residential area to the base flood (9') plus two feet.	Drop	The State Building Code requires 2 ft of freeboard in VE-zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Codfish Park.
Encourage elevation of homes in Madaket flood zones to the base flood (8') plus two feet.	Drop	The State Building Code requires 2 ft of freeboard in VE-zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Madaket.

ACTION	STATUS	NOTES
Offer to assist in the application for FEMA funds to relocate waterfront homes if owners agree to cease utilization of hard solutions.	Complete	The Town has assisted in two cases, and can assist in the future as needed. This is now a capability.
Increase the elevation of Wauwinet Road at Polpis Harbor to the base flood (8') plus one foot.	Carry Forward	This has not yet been completed due to budget constraints.
Increase the elevation of Polpis Road at Fulling Mill Brook to the base flood (8') plus one foot.	Carry Forward	This has not yet been completed due to budget constraints. ______________________________ The condition of the culvert will require action on the near term.
Increase the elevation of Madaket Road at Head of Long Pond to the base flood (8') plus one foot.	Carry Forward	This has not yet been completed due to budget constraints. All road elevation actions are being consolidated into a new action, below.
Increase the elevation of Madaket Road at Madaket Ditch to the base flood (8') plus one foot.	Carry Forward	This has not yet been completed due to budget constraints. All road elevation actions are being consolidated into a new action, below.
Ensure that pre-disaster natural hazard mitigation is a primary consideration and major factor in any analysis of bulk fuel storage and delivery alternatives, including those alternatives that remove the tank farm from the downtown area and move fuel delivery away from the harbor.	Complete	The tank farm is being relocated to an area with minimal flood risk
If the above-referenced analyses find that the downtown tank farm should remain in place, the tank farm floodproofing should be inspected and upgraded to withstand not only waves and water velocities but also storm debris, and freeboard standards should be applied to increase the elevation of floodproofing by an additional two feet above the base flood.	Drop	The tank farm is being relocated to an area with minimal flood risk
If the above-referenced analyses find that the downtown tank farm should be relocated, it should be relocated to an area outside flood and hurricane storm surge zones, and to an area that is accessible during natural disasters.	Complete	The tank farm is being relocated to an area with minimal flood risk
Continue to make sandbags available to protect the downtown sewer pumping station	Capability	This is reclassified as a capability. Additionally, a $6.6 million upgrade to the downtown pumping station includes floodproofing, backup power, and submersible pumps.
Support privately-funded beach nourishment projects that are believed to have minimal environmental impacts.	Capability	This is reclassified as a capability. It is important to note that these projects are evaluated on a case-by-case basis.

ACTION	STATUS	NOTES
Develop a list of potential Town-funded and/or FEMA-funded beach nourishment demonstration projects and apply for funding to pursue these projects.	Complete	Several such projects have been identified; for example, the Town is completing projects at the ends of Madaket Road and Hummock Pond Road, and the Town was a participant with the Baxter Road project
Urge State regulators and the scientific community to make a determination relative to beach dewatering effectiveness.	Complete	The Town has determined not to support beach dewatering, and dewatering projects will not be approved.
Revise the setback clause of the Wetland Regulations (20 times the erosion rate or 100 feet) to be more stringent.	Complete	This is now a capability
Focus open space and conservation acquisitions on coastal properties.	Capability	This is an ongoing action performed by the Island's different private land conservation organizations. It is reclassified as a capability.
Selectively pursue conservation objectives listed in the Madaket Area Plan if coastal properties are targeted.	Drop	See section 3.7
Purchase the development rights to the 270-acre Loring Property in Madaket.	Complete	See section 3.7
Selectively pursue conservation objectives listed in the 'Sconset Area Plan if coastal properties are targeted.	Drop	See section 3.7
Adopt open space zoning.	Drop	See section 3.7

4.7.2 *New Actions and Actions to Carry Forward*

New actions were developed over the course of this Plan update; along with the actions being carried forward from the previous HMP, recommended coastal flood mitigation actions to implement are:

- ❑ Educate residents, developers, and regulators about the zoning regulation allowing height limitations in "one-hundred-year" flood zones to be defined based on the first-floor elevation as required by floodplain management regulations [updated 7/12/2016]. Target repetitive loss property owners for this education.
- ❑ Extend the above height exception to any building elevating its first floor for flood mitigation purposes, even if outside current flood zone.
- ❑ Adopt local freeboard standards for A and AE zones in addition to VE zones
- ❑ Elevate roads and harden embankments for wave action in accordance with the DPW prioritized road elevation list:
    - Madaket Road at Long Pond
    - Madaket Road at Madaket Ditch
    - Polpis Road at Sesachacha Pond
    - Wauwinet Road at Polpis Harbor

- ❑ Relocate important hard-copies of Town records (including Finance Department records and Health Department records) to a new storage location outside of the SFHA (currently located on Washington Street)
- ❑ Investigate and implement engineered flood protection solutions for the Finance Department Building (short-term) and develop options to relocate the office to a flood proof location (long-term).
- ❑ Investigate and implement actions that mitigate the repetitive damage to the Harbormaster's facility on the Town Pier.
- ❑ Initiate development of plans for a long-term Harbormaster facility, incorporating sea level rise.
- ❑ Complete repairs to Children's Beach storm water pump and outfall to improve reliability, and reduce/eliminate backflow into the pump and drainage system during high tides. This system support a drainage area of more than 150 Acres.
- ❑ Develop a protocol or formal Standard Operating Procedure for opening and closing of the tide gate at Children’s Beach boat ramp. Work with local citizens to make sure they are aware of the protocol.
- ❑ Contact the owners of Repetitive Loss Properties and nearby properties at risk to inquire about mitigation undertaken and suggest options for mitigating flooding in those areas. This should be accomplished with a letter directly mailed to each property owner.

A limited public-private partnership has been proposed by a local property owner to address issues at Fulling Mill Brook at Polpis Road. After initial scoping and meeting with stakeholders, an engineer hired by the local property owner has determined that study of the entire watershed and hydrology of the area is required. The existing road is low in elevation and becomes flooded during some storm events; the existing culverts are aged and undersized which restrict tidal flow. The engineer has proposed conducting the required studies and presenting the Town with alternatives for improvements to this area. The improvements would be geared toward greater coastal resiliency of Town infrastructure, promotion of life and safety interests given the critical-path route to the Polpis, Wauwinet, and Squam areas, and improvement to protected environmental interests.

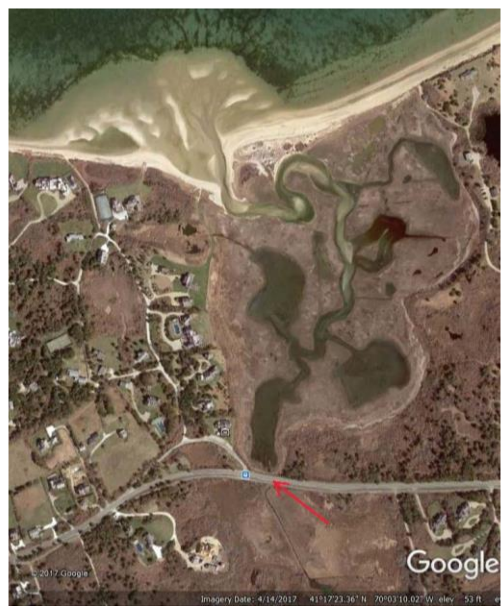


Figure 4-1: Fulling Mill Brook at Polpis Road. *Image Courtesy of Nantucket Engineering & Survey, PC*

Based on this progress in addressing flooding at this site, a new action has replaced the action from the previous plan to “elevate Polpis Road at Fulling Mill Brook” as follows:

- Participate in a limited public-private partnership with Nantucket Engineering & Survey to complete a study of the Fulling Mill Brook watershed, in particular the hydrologic conditions at Polpis Road, to identify alternatives for improvements to this area.

Actions that apply to all hazards are listed in Sections 2-14 and 11-1.

Figure 4-2: Flooding of Polpis Road at Fulling Mill Brook.
Image Courtesy of Nantucket Engineering & Survey, PC

5 HURRICANES AND TROPICAL STORMS INCLUDING HIGH WIND EVENTS

5.1 Setting

Hazards associated with tropical storms and hurricanes include winds, heavy rains, and flooding. As explained in Section 4.1 in the context of coastal flooding, Nantucket is an island community with significant coastal resources. While the coastline is susceptible to hurricane damage such as storm surge and flooding, wind damage can occur throughout the community. All of Nantucket's localities are checked in the "wind" column of Table 1-5. Hurricanes therefore have the potential to affect any portion of Nantucket.

General Wind Trends

General wind trends on Nantucket are presented in the following figures. Note in Figure 5-1 that December through February are the windiest months while June, July, and August are the least windy, on average.

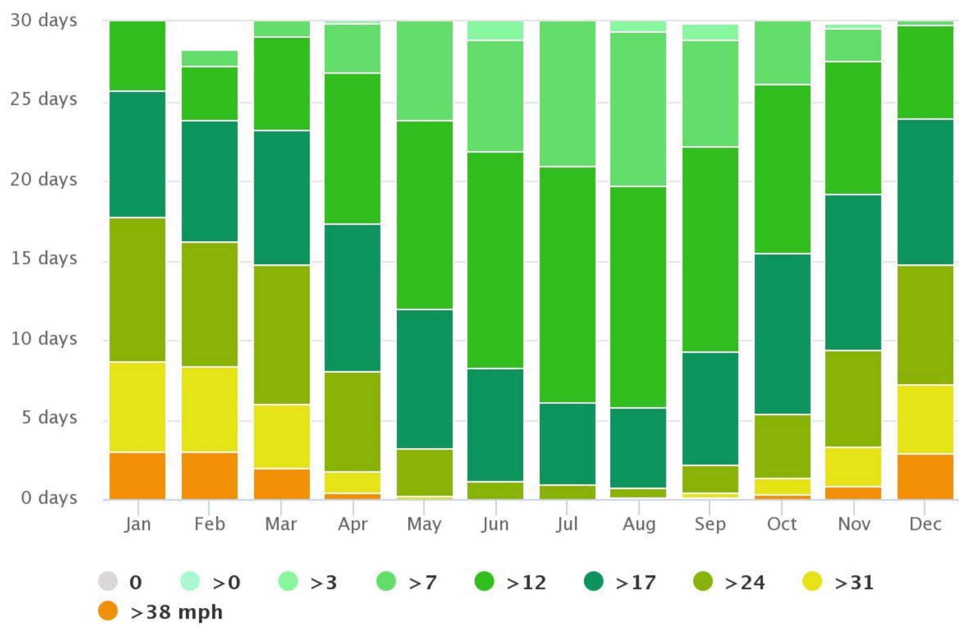
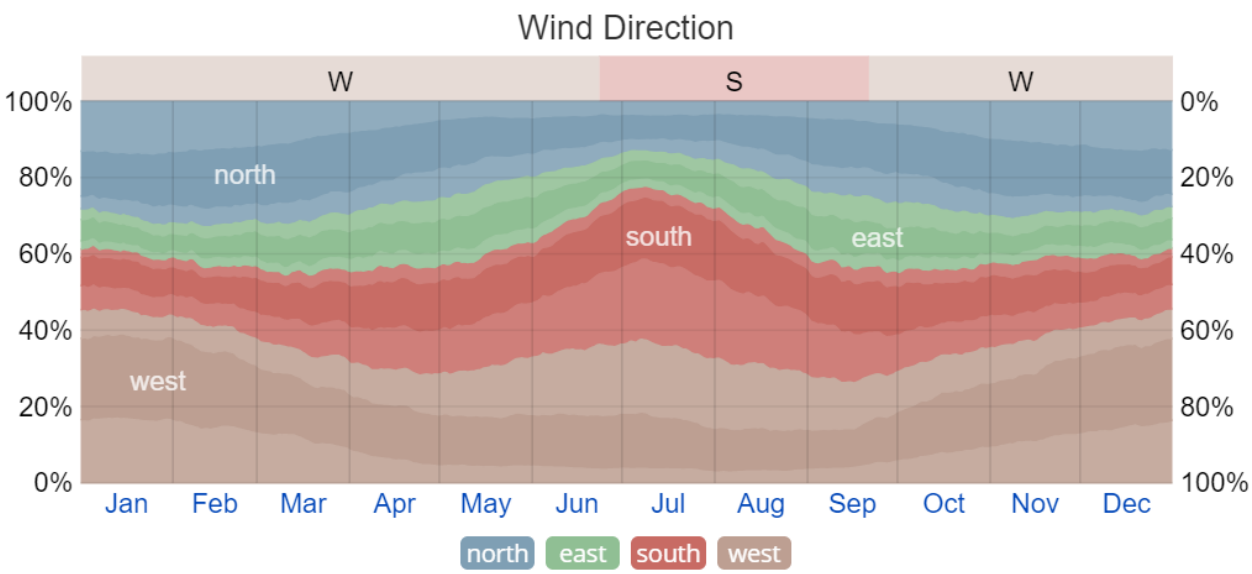


Figure 5-1: Frequency of Wind Speeds, by Month, at Nantucket Airport
Source: www.meteoblue.com

Figure 5-2 shows that winds tend to blow in from the north and west during the winter months, and from the south and west in June and July.



The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.0 mph. The lightly tinted areas at the boundaries are the percentage of hours spent in the implied intermediate directions (northeast, southeast, southwest, and northwest).

Figure 5-2: Distribution of Wind Direction by Day at Nantucket Airport

Source: www.weatherspark.com

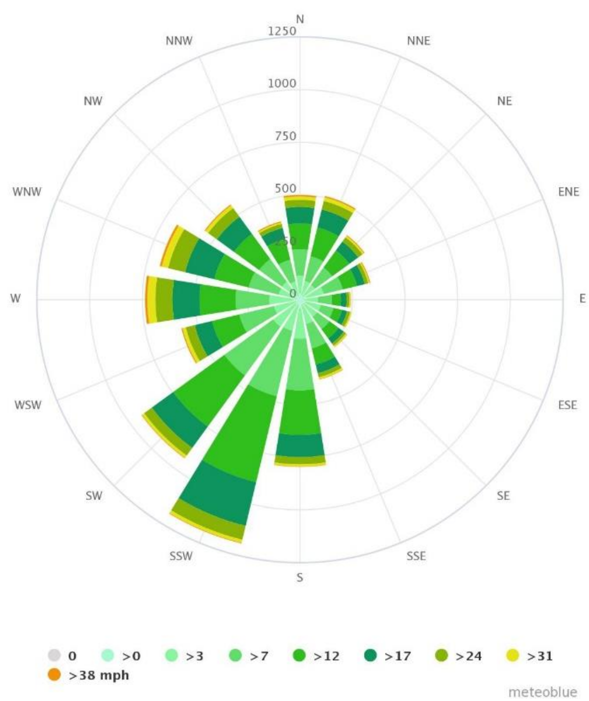


Figure 5-3: Wind Rose (Annual), Nantucket Airport

Source: www.meteoblue.com

Figure 5-3 shows how many hours per year the wind blows from the indicated direction. This figure corroborates Figure 5-2, above, with most winds blowing in from the southwest to northwest directions.

5.2 Hazard Assessment

Hurricanes are a class of tropical cyclones which are defined by the National Weather Service as non-frontal, low pressure large scale systems that develop over tropical or subtropical water and have definite organized circulations. Tropical cyclones are categorized based on the speed of the sustained (1-minute average) surface wind near the center of the storm. These categories are: Tropical

Depression (winds less than 39 mph), Tropical Storm (winds 39-74 mph, inclusive) and Hurricanes (winds at least 74 mph).

The geographical areas affected by tropical cyclones are called tropical cyclone basins. The Atlantic tropical cyclone basin is one of six in the world and includes much of the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. The official Atlantic hurricane season begins on June 1 and extends through November 30 of each year, although occasionally hurricanes occur outside this period.

Storm Surge

Abnormal high water levels along ocean coasts and interior shorelines are commonly caused by storm events. These higher than expected water levels, known as storm surges, are generally the result of regional scale meteorological disturbances. Storm surge is defined as the difference between the observed water level and the normal astronomical tide. Extratropical storms such as nor'easters have produced some of the highest storm surges and resultant damages on record. However, hurricanes have the potential to produce much higher storm surges because of the vast amount of energy released by these storm systems over relatively short duration.

A number of factors contribute to the generation of storm surges, but the fundamental forcing mechanism is wind and the resultant frictional stress it imposes on the water surface. The magnitude of storm surge within a coastal basin is governed by both the meteorological parameters of the hurricane and the physical characteristics of the basin. The meteorological aspects include the hurricane's size, measured by the radius of maximum winds; the intensity, measured by sea level pressure and maximum surface wind speeds at the storm center; the path, or forward track of the storm; and the storm's forward speed.

The Saffir-Simpson Scale

The "Saffir-Simpson Hurricane Scale" was used prior to 2009 to categorize hurricanes based upon wind speed, central pressure, and storm surge, relating these components to damage potential. In 2009, the scale was revised and is now called the "Saffir-Simpson Hurricane Wind Scale." The modified scale is more scientifically defensible and is predicated only on surface wind speeds. Storm surge is no longer part of the scale. The National Hurricane Center is considering offering specific warnings regarding storm surge based on Sea, Lake, and Overland Surges from Hurricanes (SLOSH) mapping for areas that could be impacted by a hurricane.

Hurricanes are grouped into five categories based on strength. The following descriptions are from the *2014 Connecticut Natural Hazard Mitigation Plan Update*.

- **Category 1:** Sustained winds 74-95 miles per hour (mph) (64-82 knots (kt) or 119-153 kilometers per hour (km/hr)). *Damaging winds are expected*. Some damage to building structures could occur, primarily to unanchored mobile homes (mainly pre-1994 construction). Some damage is likely due to poorly constructed signs. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possibly death. Numerous large branches of healthy trees will snap. Some trees will be uprooted, especially where the ground is saturated. Many areas will experience power outages with some downed power poles.

- **Category 2:** Sustained winds 96-110 mph (83-95 kt or 154-177 km/hr). *Very strong winds will produce widespread damage*. Some roofing material, door, and window damage of buildings will occur. Considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs is likely. A number of glass windows in high-rise buildings will be dislodged and become airborne. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possibly death. Numerous large branches will break. Many trees will be uprooted or snapped. Extensive damage to power lines and poles will likely result in widespread power outages that could last a few to several days.
- **Category 3:** Sustained winds 111-130 mph (96-113 kt or 178-209 km/hr). *Dangerous winds will cause extensive damage.* Some structural damage to houses and buildings will occur with a minor amount of wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs are destroyed. Many windows in high-rise buildings will be dislodged and become airborne. Persons struck by windborne debris risk injury and possibly death. Many trees will be snapped or uprooted and block numerous roads. Near total power loss is expected with outages that could last from several days to weeks.
- **Category 4:** Sustained winds 131-155 mph (114-135 kt or 210-249 km/hr). *Extremely dangerous winds causing devastating damage are expected.* Some wall failures with some complete roof structure failures on houses will occur. All signs are blown down. Complete destruction of mobile homes (primarily pre-1994 construction). Extensive damage to doors and windows likely. Numerous windows in high-rise buildings will be dislodged and become airborne. Windborne debris will cause extensive damage and persons struck by the wind-blown debris will be injured or killed. Most trees will be snapped or uprooted. Fallen trees could cut off residential areas for days to weeks. Electricity will be unavailable for weeks after the hurricane passes.
- **Category 5:** Sustained winds greater than 155 mph (135 kt or 249 km/hr). *Catastrophic damage is expected*. Complete roof failure on many residences and industrial buildings will occur. Some complete building failures with small buildings blown over or away are likely. All signs blow down. Complete destruction of mobile homes. Severe and extensive window and door damage will occur. Nearly all windows in high-rise buildings will be dislodged and become airborne. Severe injury or death is likely for persons struck by wind-blown debris. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months.

Table 5-1 lists the hurricane characteristics mentioned above as a function of category, as well as the expected central pressure.

Table 5-1: Hurricane Characteristics

Category	CENTRAL PRESSURE		WIND SPEED		SURGE	Damage Potential
	Millibars	Inches	MPH	Knots	Feet	
1	>980	>28.9	74-95	64-83	4-5	Minimal
2	965-979	28.5-28.9	96-110	84-96	6-8	Moderate
3	945-964	27.9-28.5	111-130	97-113	9-12	Extensive
4	920-644	27.2-27.9	131-155	114-135	13-18	Extreme
5	<920	<27.2	>155	>135	>18	Catastrophic

The Saffir-Simpson Hurricane Scale assumes an average, uniform coastline for the continental United States and was intended as a general guide for use by public safety officials during hurricane emergencies. It does not reflect the effects of varying localized bathymetry, coastline configuration, astronomical tides, barriers or other factors that may locally modify surge heights during a single hurricane event.

Climate Change

According to the Massachusetts *2013 State Hazard Mitigation Plan* and the 2011 *Massachusetts Climate Change Adaptation Report*, large storm events are becoming more frequent, and higher-intensity hurricanes are expected to become more frequent in the future.

The NOAA Geophysical Fluid Dynamics Laboratory (GFDL) reports (as of April 25, 2018) the following expected impacts of climate change on hurricanes and tropical storms:

- **More Intense Tropical Cyclones:** Anthropogenic warming by the end of the 21st century will likely cause tropical cyclones globally to be more intense on average (by 2 to 11% for an IPCC mid-range scenario).
- **More Frequent Intense Tropical Cyclones:** There are better than even odds that anthropogenic warming over the next century will lead to an increase in the occurrence of very intense tropical cyclones globally, despite a likely decrease (or little change) in the global numbers of all tropical cyclones.
- **Higher Precipitation During Tropical Cyclones:** Tropical cyclone rainfall rates will likely increase on the order of 10-15% by the end of the 21st century.
- **Higher Storm Surge Flooding:** Sea level rise should be causing higher storm surge levels for tropical cyclones that do occur, all else assumed equal.

5.3 Historic Record

According to NOAA historical records, 58 hurricane/tropical storm tracks have come within 100 miles of Nantucket since 1842. Of these 61 storms, 36 were of tropical storm intensity, 18 were Category 1 hurricanes, seven Category 2, and four Category 3 (note that storms that change in intensity are counted multiple times, once for each intensity level). Figure 5-4 shows the historical tracks of only the hurricane-intensity storms as shown by the NOAA Historical Hurricane Tracks tool. The map does not include the tracks of extra-tropical systems, tropical depressions, or tropical storms that also came within 100 miles of the planning area.

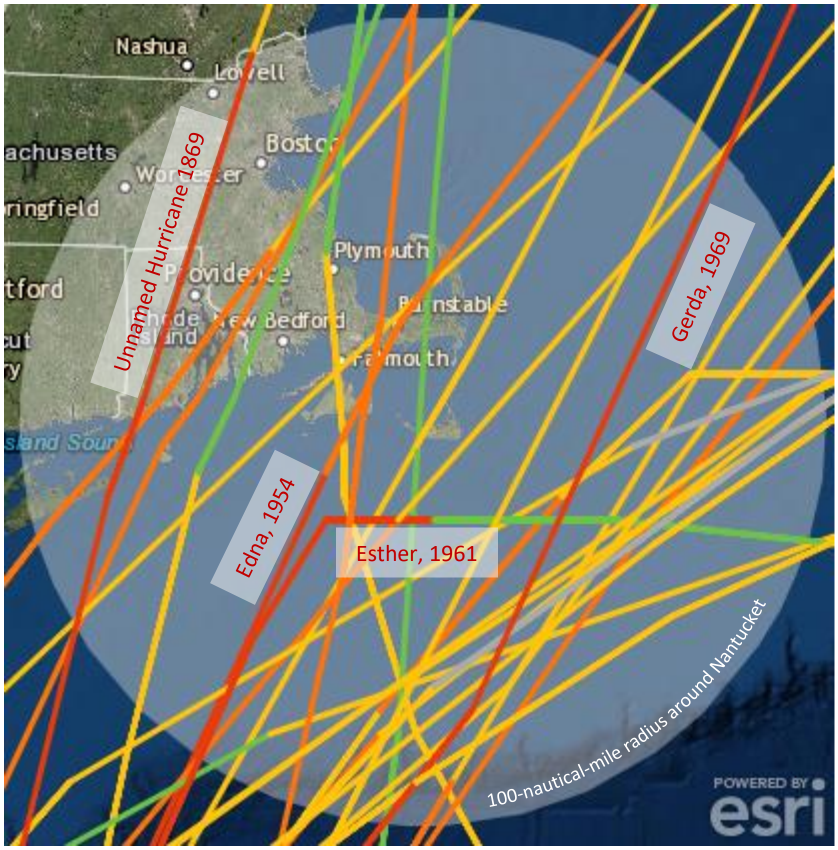


Figure 5-4: Historic Hurricane Tracks Within 100 miles of Nantucket

Red line: Category 4
Orange Line: Category 3
Yellow Line: Category 2
Green Line: Category 1
Grey Line: Tropical Storm

According to the Massachusetts *2013 State Hazard Mitigation Plan*, notable historic hurricanes that have passed within 65 miles of the state are as follows:

Table 5-2: Historical Massachusetts Hurricanes and Tropical Storms

Date	Name	Category	Landfall
August 1635	Great Colonial Hurricane of 1635	3	No
September 1815	Great September Gale of 1815	3	
September 1869	September Gale of 1869	3	No
September 1938	New England Hurricane of 1938	3	Yes
September 1944	Great Atlantic Hurricane	4	Yes
1945	Unnamed		No
1949	Unnamed		No

Date	Name	Category	Landfall
September 1954	Edna	3	Yes
October 1954	Hazel	3	No
August 1954	Carol	2-3	No
August 1955	Diane	3	No
September 1959	Gracie	3	No
September 1960	Donna	5	Yes
September 1985	Gloria	4	No
August 1991	Bob	3	Yes
July 1996	Bertha	3	No
September 1999	Floyd	4	Yes
July 2006	Beryl	Tropical Storm	No
September 2008	Hanna	1	No
August 2009	Bill	Tropical Storm	No
September 2010	Earl	4	No
August 2011	Irene	2	No
October 2012	Sandy	Tropical Storm	Yes

Significant Storms

The most devastating hurricane to strike New England, dubbed the "Long Island Express of September 21, 1938," was believed to be a Category 3 hurricane. The "Great Atlantic Hurricane" struck New England in September 1944. Hurricanes Carol and Edna struck in 1954, and back-to-back hurricanes Connie and Diane struck in 1955. In September of 1985, hurricane Gloria passed over New England. Descriptions of the four major 20th Century hurricanes affecting Nantucket are provided below. Portions of the descriptions are taken from the publication *Southern New England Tropical Storms and Hurricanes, A Ninety-eight Year Summary 1909-1997*, by David R. Vallee and Michael R. Dion of the National Weather Service in Taunton, Massachusetts.

The Great New England Hurricane of 1938 ("Long Island Express of 1938")

The Great New England Hurricane of 1938 remains one of the most destructive storms ever to strike New England. The hurricane, believed to be a Category 3, was one of the powerful "Cape Verde" hurricanes that developed in the far eastern Atlantic, near the Cape Verde Islands. The storm did not weaken on its way toward New England, due to its rapid speed and its track over the warm waters of the Gulf Stream. The storm made landfall on September 21, 1938 on Long Island, New York, crossing Long Island Sound, and then again at Milford, Connecticut. The lowest pressure at the time of landfall (27.94 inches) occurred on the south side of Long Island.

Sustained hurricane force winds occurred throughout most of southern New England. The strongest winds ever recorded in New England occurred at the Blue Hill Observatory with sustained winds of 121 mph and a peak gust of 186 mph. Sustained winds of 91 mph with a gust to 121 mph was reported on Block Island. Extensive damage occurred to roofs and trees, and widespread power outages occurred. Rainfall from the hurricane resulted in severe river flooding across sections of Massachusetts. Three to six inches fell across much of western Massachusetts, although considerably less rain occurred to the east across the remainder of Massachusetts.

The eye made landfall at the time of astronomical high tide. The hurricane produced storm tides of 18 to 25 feet from New London, Connecticut east to Cape Cod. A storm surge of 12 to 15 feet in Narragansett Bay destroyed coastal homes, marinas and yacht clubs, and downtown Providence was submerged under a storm tide of nearly 20 feet. Sections of Falmouth and New Bedford, Massachusetts were submerged under as much as eight feet of water.

The hurricane caused 564 deaths and approximately 1,700 injuries in Southern New England. Damage to fishing fleets in southern New England was catastrophic, with a total of 2,605 vessels destroyed and 3,369 damaged.

Hurricane Carol, 1954

Hurricane Carol was the most destructive hurricane to strike southern New England since the Great New England Hurricane of 1938. Carol developed in the Bahamas but did not accelerate until passing east of Cape Hatteras, North Carolina. Carol made landfall on eastern Long Island and southeastern Connecticut, moving over 35 mph.

Sustained winds of 80 to 100 mph were measured in the eastern half of Connecticut, all of Rhode Island, and most of eastern Massachusetts. Trees and power lines were blown down. The strongest wind ever recorded on Block Island, Rhode Island occurred during Carol, at 135 mph. The National Weather Service in Warwick, Rhode Island recorded sustained winds of 90 mph, with a peak gust of 105 mph. Lowest recorded pressure was 28.36 inches on the south shore of Long Island. Rainfall amounts ranged from two to five inches across most of the area. The heaviest amounts, up to six inches, occurred in Connecticut and across extreme north central Massachusetts.

Hurricane Carol made landfall just after high tide, causing coastal flooding. Storm surge levels ranged from 10 to 15 feet from the New London area eastward. Narragansett Bay and New Bedford harbor received the largest surge heights of over 14 feet in the upper reaches of both water bodies. Coastal communities from central Connecticut eastward were devastated. Entire coastal communities were nearly wiped out in New London, Groton, and Mystic, Connecticut, as well as from Westerly to Narragansett, Rhode Island. As in 1938, downtown Providence was flooded under 12 feet of water.

Hurricane Carol destroyed nearly 4,000 homes, along with 3,500 automobiles and over 3,000 boats. Most of Rhode Island, much of eastern Connecticut, and much of eastern Massachusetts lost electrical power.

Hurricane Edna, 1954

Hurricane Edna struck New England only 11 days after Hurricane Carol. Edna followed a track up the East Coast that was slightly east of Carol's track, moving toward southern New England at over 45 mph, but about 100 miles further east. Edna passed over Martha's Vineyard and Nantucket, then across the eastern tip of Cape Cod, becoming one of the only tropical systems to directly pass over Nantucket.

Winds of 75 to 95 mph were measured in eastern Massachusetts and coastal Rhode Island. Peak wind gusts included 120 mph on Martha's Vineyard, 110 mph on Block Island, and 100 mph at Hyannis, Massachusetts. The winds knocked out electrical power across sections of Rhode Island, eastern Massachusetts, and nearly all of Cape Cod, Martha's Vineyard, and Nantucket. The lowest recorded pressure was 28.02 inches at Edgartown on Martha's Vineyard.

Edna arrived during a rising tide and resulted in severe flooding across Martha's Vineyard, Nantucket and Cape Cod, where storm surges of over six feet were measured. Damage to the boating community was severe across Cape Cod, but was much less across the remainder of Massachusetts and Rhode Island. Most of the damage occurred in areas that were left weakened by Carol.

Edna's track across the extreme eastern part of the region resulted in heavy rainfall and inland flooding. Rainfall amounts of three to six inches were common, with over seven inches in northeastern Massachusetts. The total combined rainfall for Carol and Edna ranged from five to seven inches along and west of the Connecticut River and over Cape Cod, to as much as 11 inches from southeast Connecticut, across most of Rhode Island, to northeast Massachusetts. Considerable urban and small stream flooding occurred. Edna caused 21 deaths in New England.

Hurricane Bob, 1991

Hurricane Bob was the most recent hurricane to strike New England, although several tropical storms have struck since Bob's landfall in August 19, 1991. Hurricane Bob developed in the Bahamas and moved north-northeastward, paralleling the U.S. east coast. The eye of Hurricane Bob passed over Block Island and made landfall over Newport, Rhode Island.

Hurricane Bob brought sustained hurricane force winds to the coastal communities of Rhode Island and southeast Massachusetts. Coastal communities experienced sustained winds between 75 to 100 mph. Peak wind gusts to 125 mph were recorded on Cape Cod in the towns of Brewster and North Truro. The highest sustained wind of 100 mph was recorded in North Truro. Block Island reported sustained winds of 90 mph, with gusts in excess of 105 mph. Additionally, four tornadoes were reported as Hurricane Bob made landfall. Wind damage to trees and utility poles was widespread and resulted in numerous power outages. Over 60% of residents in southeast Rhode Island and southeast Massachusetts lost power. The lowest barometric pressure was recorded at 28.47 inches.

Hurricane Bob caused a storm surge of 10 to 15 feet in Buzzards Bay. The Buzzards Bay shore east to Cape Cod was hardest hit by the surge. The highest surges of 12 to 15 feet, were observed in Onset, Bourne, Mashpee and Wareham, at the head of Buzzards Bay. Extensive beach erosion occurred along the shore from Westerly, Rhode Island eastward. Some south-facing beach locations on Martha's Vineyard and Nantucket Islands reportedly lost up to 50 feet of beach to erosion.

Bob was responsible for six deaths in New England, with all of these in Connecticut. Total damage in southern New England was approximately $680 million, including about $70 million in Massachusetts.

Recent Tropical Cyclones

The most recent tropical storm to pass over Nantucket was Beryl in 2006. Beryl did not cause any significant damage due to its weakened status. According to various news reports, the storm hit Nantucket at 3:00 AM and had maximum sustained winds of 50 mph with a steady rainfall.

While no hurricanes or tropical storms have directly struck Nantucket since the previous edition of the HMP, several have passed nearby and had impacts on the Island.

- **Hurricane Bill, August 22-23, 2009 –** Hurricane Bill passed well offshore to the east of Nantucket. It brought heavy rainfall and high swells to Nantucket. Heavy rainfall led to flash flooding and inland flooding. Minor coastal flooding affected Atlantic Street running through Codfish Park on the southeastern coast of Nantucket. On the southwestern coast of Nantucket, in Madaket, three homes on Massachusetts Avenue were surrounded by ocean waters. Only one of the homes was occupied and water two and a half feet deep surrounded that home. $5,000 in property damage occurred.
- **Tropical Storm Earl, September 3-4, 2010** – Tropical Storm Early passed 98 miles southeast of Nantucket. The Island experienced tropical-storm force winds, high surf, and heavy rainfall. Minor coastal flooding and $20,000 in property damage occurred on Nantucket.
- **Tropical Storm Irene, August 28, 2011 –** Irene made landfall as a tropical storm in southeastern New York State and Connecticut. Several trees were downed across Nantucket, which experienced sustained winds of 48 to 63 miles per hour. $30,000 in property damage occurred on Nantucket.
- **Hurricane Arthur, July 4, 2014 –** Hurricane Arthur, passing east of Nantucket, brought heavy rain to Massachusetts. Nantucket experienced wind gusts of 62 miles per hour.
- **Named Storm Hermine, September 5, 2016 –** Hermine meandered off of southern New England for several days, bringing rain and below-tropical-storm force winds. Because trees were still fully leaved and there were some higher wind gusts, there was some wind damage. Multiple small boats in Nantucket were sunk or dragging-anchor in Nantucket Harbor.
- **Tropical Storm Jose, September 21, 2017** – Jose stalled about 150 miles southeast of Nantucket, bringing strong wind gusts and heavy downpours to Nantucket. Rainfall reached about 6 inches on Nantucket. Minor coastal flooding occurred in parts of the Island. Four sailboats were sunk due to rainfall, and several other boats were washed ashore due to wind and high surf.

5.4 Existing Capabilities

Watches and Warnings

The National Hurricane Center (NHC) has a number of tropical cyclone warning products. These include maps of wind speed probabilities and arrival times, track forecast cones, rainfall predictions and flash flood potential maps, and storm surge watches and warnings.

The NHC began issuing storm surge watch and warning maps recently, in 2017. These depict surge risk areas for tropical cyclones affecting the Gulf and Atlantic coasts. The new warning maps are intended to separate the storm surge inundation watches and warnings from the previously existing high wind watches and warnings. The storm watch and warning maps highlight specific areas along the coast that have a significant risk of life-threatening storm surge inundation at a given moment. Maps are available at www.nhc.noaa.gov.

Nantucket and its residents, visitors, and business owners, often make use of the National Weather Service (NWS) coastal warning system. This system specifically targets water vessel operators and typically provides information about risks to vessels from high winds and waves, though risks from sea ice may also be considered. NWS coastal warnings differ by region, but on the East Coast are generally divided as follows (http://www.nws.noaa.gov/om/marine/cwd.htm):

- **Small Craft Advisory:** sustained winds or frequent gusts between 25 and 33 knots and/or waves 5 to 7 feet and greater, area dependent.
- **Gale Warning:** sustained surface winds, or frequent gusts, in the range of 34 knots (39 mph) to 47 knots (54 mph) inclusive, either predicted or occurring, and not directly associated with a tropical cyclone.
- **Storm Warning:** sustained surface winds, or frequent gusts, in the range of 48 knots (55 mph) to 63 knots (73 mph) inclusive, either predicted or occurring, and not directly associated with a tropical cyclone.
- **Tropical Storm Warning:** tropical storm conditions (sustained winds of 39 to 73 mph) are expected somewhere within the specified coastal area within 36 hours.
- **Hurricane Force Wind Warning:** sustained winds, or frequent gusts, of 64 knots (74 mph) or greater, either predicted or occurring, and not directly associated with a tropical cyclone.
- **Hurricane Warning:** hurricane conditions (sustained winds of 74 mph or higher) are expected somewhere within the specified coastal area. Hurricane warnings are issued 36 hours in advance of the anticipated onset of tropical-storm-force winds.

Flood Damage Prevention

Existing mitigation measures appropriate for flooding have been discussed in previous sections. These include the ordinances, codes, and regulations cited in Section 2.8 that have been enacted to minimize storm damage.

DPW tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. With regard to roads, bridges, and culverts at tidal creeks, the DPW regularly maintains Town-owned roads and facilities and upgrades/improves them as needed. However, DPW does not have sufficient equipment to barricade all roadways that could potentially flood.

Harbor Damage Prevention

The Marine and Coastal Resources Department has a very proactive approach to pre-disaster mitigation when it comes to tropical storms and hurricanes, as well as other storms. The emphasis is removing people and boats from harm's way before a storm strikes. With 71 sinkings during Hurricane Bob and 63 during the No Name Storm, inspections by the Marine and Coastal Resources Department have increased sharply. All moorings are inspected on a three-year cycle. Weather is monitored on three web sites and posted at the harbor. The Department recommends that people leave the vicinity of the island before storms strike. If they can not leave, the Department can offer 125 rental moorings and a 100-slip marina. Two boats ramps are available in Madaket.

The Department tries to remove as many vessels as possible before storms. This is a difficult feat because more than 3,000 boats can be in and near the harbor on a warm, sunny summer day. In advance of Hurricane Edward (Labor Day 1996), 1,000 boats were hauled in 36 hours. Before Tropical Storm Beryl (2006), 250 boats were hauled. The Department has reduced property damage and water pollution by removing boats. The Department will place removed vessels wherever possible, including ball fields. The Department sometimes identifies everyone in the mooring field with medical problems before a storm, in order to understand who may need additional assistance during a storm.

The main town pier was constructed in 1976. The floating add-on was installed in 2001. A firefighting cart is located on the pier. The pier area also has a closed-circuit TV and lights that can be viewed on the internet.

Boat ramp repairs at the harbor were made as recently as fall 2006. The ramp was increased in width, pitch, depth. The repairs have made it easier for removal of two boats simultaneously. The Department coordinates its own seawall and jetty repairs, including permitting, and works well with the Conservation Commission. FEMA helped fund a recent bulkhead repair after it was damaged. The new bulkhead is not fastened to the pier; this allows a give-and-take with the waves that large boats need. A wave barrier is also incorporated. It was constructed winter 2005-2006 with a State and FEMA assistance.

It is important to understand that the Coast Guard has only limited shallow-water capabilities, so the Town handles these areas around Nantucket. The relationship between the Town and the Coast Guard is good.

Wind Damage

Codes and Regulations

Wind loading requirements are addressed through the Building Department's administration of building codes. Nantucket enforces the Massachusetts State Building Code (MSBC; 780 CMR). The ninth edition of the MSBC was made effective on October 20th, 2017, and is therefore the current enforceable building code for Nantucket.

The wind design factors for Nantucket vary depending on whether a building is residential or non-residential; non-residential wind design factors are further divided based on the risk category of the building. For Nantucket, basic wind speed requirements are as follows:

Table 5-3: Basic Wind Speed Parameters for Nantucket

		Non-Residential		
	Residential	**Risk Category I**	**Risk Category II**	**Risk Category III of IV**
Basic Wind Speed (mph)	140	139	140	158

The residential wind speed requirement has increased from 90 mph at the time of the initial HMP adopted in 2007, providing a much higher standard of protection against wind damage.

Tree and Debris Maintenance

DPW responds to damage from tropical storm and hurricane winds. Prior to forecast tropical storms and hurricanes, DPW will dispatch equipment and personnel to outlying areas of Nantucket such as ‘Sconset and Madaket. Over the past decade, the DPW has improved its tree limb inspection and maintenance program.

Roughly half of the roads on Nantucket are private. These private roads are normally not maintained by DPW, nor are the trees alongside them maintained by the Town. Public education for these areas is important. As an example, 30 to 40 pine trees along Russell's Way were blown down in 2004. A resident was trapped for several days. Ultimately, the Town assisted with cleanup.

Emergency Power

The Town’s Energy Office is continually working to develop microgrids, power islands, advanced inverters, and backup power on the Island, improving the resiliency of the electric grid. Over time the Office aims to build a community power system that can operate locally even with widespread power outages or even loss of power distribution coming from the mainland. The office is particularly focused on development of renewable energy sources, such as solar and wind. Two current priorities are:

- Working with Tesla to distribute Tesla Powerwall batteries to residents, providing backup power to individual homes
- Exploration of installation of solar photo-voltaic panels on the Island to allow for local power generation

The Office also communicates with the federal government and developers exploring offshore wind generation about possible "community benefits agreements" to allow the Island to benefit directly from that additional source of power.

The Energy Office reports that National Grid, the Island's energy provider, is upgrading two aging diesel generators with a new 10 MW diesel generator and a 10 MW Tesla battery. These generators will provide more resilience to the power system and reduce peak loads.

Coastal Damage Prevention

With regard to preexisting structures that were constructed to reduce coastal storm damage, examples include the jetties at the mouth of Nantucket Harbor and seawalls that exceed coastal base flood elevations. Numerous concrete, steel, and wood bulkheads in the harbor area have been erected and maintained over the years to stabilize the shoreline and stop erosion.

A variety of other projects have been conducted in other areas to combat erosion, such as beach nourishment; installation and operation of a beach dewatering system at two 'Sconset beaches; bluff toe protection in Sconset; and riprap, bulkheads, seawalls, and related structures that pre-date the regulations that no longer allow their construction. These will be discussed further in Section 6.4.

Emergency Services

According to the 2013 Nantucket CEMP, the municipal responsibilities relative to hurricane mitigation and preparedness include:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Nantucket is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Limit new construction to areas that are not vulnerable to direct hurricane effects.
- Make informed decisions concerning protecting natural attributes such as beaches and dunes with breakwaters and sea walls. Review National Flood Insurance Rate Maps and Hurricane Evacuation Maps for possible impact on the community.
- Maintain plans for managing all hurricane emergency response activities.
- Ensure that warning/notification systems and equipment is ready for use at the hurricane warning stage.
- Review mutual aid agreements.

- ❑ Designate suitable wind and flood resistant shelters in the community and make their locations known to the public.
- ❑ Prepare for coordination of evacuation from potentially impacted areas including alternate transportation systems and locations of special needs facilities.

The Water Companies have active roles in pre-disaster mitigation. Before storms, water tanks are filled and equipment is secured. Through careful preparation, fire protection and potable supply are available during and after natural disasters. Generators are located at the wellfields and pumping stations. Hurricanes are specifically addressed in the water system emergency plan. This is important, for example, because a tree was once blown over during a hurricane/tropical storm and broke a water main.

The Massachusetts Property Insurance Underwriting Association also participates in hurricane mitigation by distributing a flyer to its policyholders. The hurricane preparedness flyer includes tips for protecting the homeowner family and the home, organized in the categories "preparing ahead of a storm," "when a hurricane watch is issued," "when a hurricane warning is issued," and "after a hurricane." The flyer also includes a hurricane disaster supply kit checklist and tips for developing a family communication plan.

<u>Public Shelter Demand and Capacity</u>

According to the May, 2016 U.S. Army Corps of Engineers "Massachusetts Hurricane Evacuation Study," during a Category 1 or 2 Hurricane, 269 to 517 individuals may require shelter (depending on tourist volume during the event), while during a Category 3 or 4 Hurricane, 459 to 863 individuals may require shelter. The Study notes that sheltering capacity on the Island is 400 individuals. This capacity is lower than that described by Nantucket officials (see Section 0); the High School Shelter has a 500-person capacity, and the new Police Station/Emergency Operations Center acts as a secondary shelter.

Nevertheless, the Town of Nantucket appears to have lower than adequate facilities to handle sheltering needs during a major hurricane or a hurricane during high tourist season. However, plans are underway to expand the Island's sheltering capacity (see Section 0), and formalizing the secondary shelter at the 4 Fairgrounds Road facility will increase the Town's official sheltering capacity. Furthermore, recall from Section 2.9 that non-residents would be asked to take shelter in hotels and inns before using the public shelters.

5.4.1 Capabilities Summary

In summary, the Town of Nantucket primarily mitigates hurricane hazards by enforcing the state building code, supporting emergency services, tree trimming, and maintaining emergency shelters.

Nantucket's capabilities to mitigate for hurricanes have strengthened since the initial HMP was adopted through improvements to its tree limb inspection and maintenance program, the upgrade to the state building code, and the creation of the Energy Office. Capabilities are expected to continue to strengthen as the Energy Office expands local energy production capacity, and as sheltering capacity increases.

5.5 Vulnerabilities and Risk Assessment

Nantucket is particularly vulnerable to hurricanes despite moderate hurricane occurrences when compared with other areas within the Atlantic Tropical Cyclone basin. The location of Nantucket at the extreme southeast corner of the New England region, protruding into the Atlantic Ocean toward the north-northeast path taken by many tropical systems, places it in the potential path of many tropical storms and hurricanes. The coastline geometry; bathymetry; and hurricane direction, intensity, and forward speed are influential parameters that affect resulting hazards to Nantucket.

According to the Massachusetts Hazard Mitigation Plan, New England is considered to be long overdue for another major hurricane strike. Based on past hurricane and tropical storm landfalls, the frequency of hurricanes to hit the Massachusetts coastline is an average of once out of every six years. Nantucket's position southeast of New England places it in the path of more tropical storms and hurricanes than central New England. For example, tropical storm Jose in 2017 passed closer to Nantucket than any other New England community.

According to the presentation "Fundamentals of Catastrophe Modeling" by AIR Worldwide Corporation, June 30, 2006, each year Massachusetts has a 1% probability of a $5 billion loss. Factoring in development and growth of property values, the probability of a $5 billion loss in the next ten years is 15%. Furthermore, Nantucket, Martha's Vineyard, Cape Cod, and the Buzzards Bay towns have the highest risk for residential property loss in Massachusetts, should a hurricane occur.

The areas impacted by hurricane storm surge are shown on Figure 5-5. This map was developed in 2013 by the National Hurricane Center using Sea Lake and Overland Surge from Hurricanes (SLOSH) data. This figure shows the potential surge areas for Category 1 and 2, Category 3, and Category 4 hurricanes, respectively. Inundation areas reflect "worst case" combinations of hurricane direction, forward speed, landfall point, and high astronomical tide.

Inundation areas were derived from application of the National Hurricane Center's "SLOSH" model. The SLOSH model was developed by the National Weather Service and first used for real-time forecasting of surges from hurricanes within selected Gulf of Mexico and Atlantic coastal basins. SLOSH's success in surge forecasting has led to utilization of the model for hurricane preparedness planning. The model calculates storm surge heights for the open ocean and coastal regions affected by a given hurricane. The model also calculates surge heights for bays, estuaries, coastal rivers, and adjacent upland areas susceptible to inundation from the storm surge.

Significant man-made or natural barriers (i.e., dunes, islands, etc.) are represented by the model and their effects are simulated in the calculation of surge heights. The model does not provide predictions based on rainfall amounts or interior freshwater flooding. It is assumed that Flood

Insurance Rate Maps will be used to plan for evacuation of non-tidal areas. A detailed description of the SLOSH model is given in the *Southern Massachusetts Hurricane Evacuation Study Technical Data Report*.

Based on the model, storm surge from Category 4 hurricanes will cause flooding beyond what would be expected from a 1% annual-chance or 0.2% annual-chance flood event. Specific areas of note where storm surge areas extend beyond the FEMA 1% annual-chance and 0.2% annual-chance flood zones include parts of Madaket and downtown that are on the margins of the mapped flood zones. For example, the critical facility Our Island Home is believed to be in a surge area, but not a mapped flood zone.

Other critical facilities in surge areas include the municipal buildings 16 Broad Street, 34 Washington Street, and 37 Washington Street; the Police Station; Landmark House; the sewer pumping station; the Steamship Dock, all four boat ramps listed in Table 2-1, and the fuel tank farm. In addition, Madaket and some of the localities along Polpis Road and Wauwinet Road are vulnerable to isolation during storm surge events by sea level rise.

Property parcels at risk from inundation due to hurricanes of varying intensities are summarized in Table 5-4

Table 5-4: Properties at Risk from Hurricane Inundation

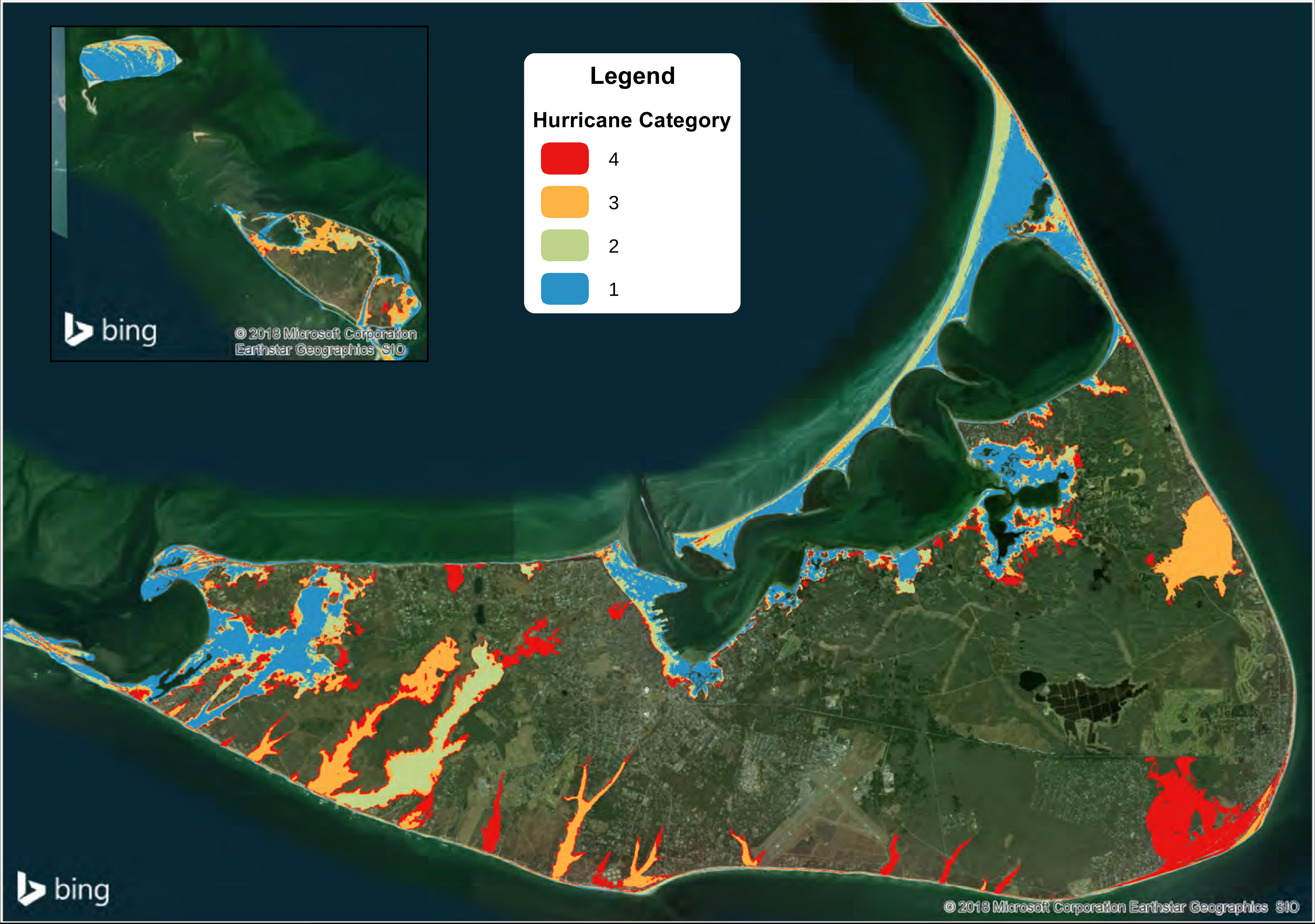
Hurricane Intensity	Number of Parcels at Risk	Total Value of Parcels at Risk
Category 1	1,550	$6,710,667,600
Category 2	2,024	$7,801,183,200
Category 3	2,596	$8,955,202,500
Category 4	3,302	$10,401,542,800

Historic Resources

Historic resources may be particularly at risk from hurricane winds, relative to other assets, for the following reasons:

- **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand high winds as those built more recently.
- **Age:** Buildings and materials degrade over time, and a historic property may not be able to stand up to high winds as well as it could when first constructed.

Buildings directly on the water, as well as the steeples of historic churches, may be particularly at risk. It is important to note that hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character.



SOURCE(S):
MASS GIS

Figure 5-5
Hurricane Surge Inundation Zones

MXD: U:\Y\2967-09\Maps\Fig5-1_hurr_inundationl1.mxd

Town of Nantucket
Natural Hazard Mitigation Plan

LOCATION: **Nantucket, MA**

Map By:	MER
MMI#:	2967-09
Original:	3/7/2018
Revision:	
Scale:	1:87,536

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5.5.1 Loss Estimates

The economic losses faced by the community from natural hazards can be estimated by reviewing historic, and modeling future, loss figures. It is difficult to accurately quantify losses, even after an event; therefore, a number of different sources are provided in this section. Taken together, they provide a range of possible loss estimates.

HAZUS-MH Vulnerability Analysis

HAZUS-MH was used to calculate hurricane loss estimates based only on the effects of hurricane winds; during an actual hurricane, losses would likely be higher due to the combined effects of wind, surge, and rain. Losses due to coastal and inland flooding, which may be triggered by a hurricane or tropical storm, are presented in chapters 3 and 4. *HAZUS-MH* software utilizes year 2010 U.S. Census data and 2010 USD.

A suite of probabilistic hurricane scenarios was modeled. Hurricanes with intensities with return-periods of 10, 20, 50, 100, 200, 500, and 1,000 years were modeled. Detailed Hazus-MH results are included in Appendix D. Overall losses are summarized in Table 5-5, below.

Table 5-5: HAZUS-MH – Hurricane Loss Estimates

Return Period	Buildings Damaged	Displaced Households	Needing Shelter	Economic Loss ($millions)		
				Property Damage	Business Interruption	Total
10	23	0	0	$2.434	$0.006	$2.440
20	514	0	0	$14.560	$0.912	$15.472
50	2,769	0	0	$74.003	$8.355	$82.358
100	5,155	6	0	$215.503	$29.438	$244.941
200	6,962	52	5	$440.762	$60.997	$501.759
500	8,886	239	38	$930.415	$131.039	$1,061.454
1000	9,781	531	88	$1,286.388	$171.265	$1,457.653
Annualized				**$8.924**	**$1.102**	**$10.026**

*Annualized Loss Estimate: Hurricane (HAZUS-MH-based): **$10,026,000***

Public Assistance Reimbursements

Loss estimates for hurricane wind were also generated from the value of PA grants received by Nantucket and other entities within the Town. There has been one federal disaster declaration in Nantucket since 1999 that resulted from a high wind event.

Disaster Number	Declaration Date	Incident Type	Incident Dates	Number of Projects	Federal Share	Total Cost
3330	08/26/2011	Hurricane Irene	8/26/11 to 9/5/11	1	$7,033.91	$9,379.55
4097	12/19/2012	Hurricane Sandy	10/27/12 to 11/8/12	3	$24,046.07	$32,061.43
Total						$41,440.98

Note that Hurricane Earl in 2010 caused damage primarily through flooding, and was used to estimate losses in Chapters 3 and 4 of this Plan.

Dividing the $41,440.98 figure by the 18 years over which PA grant data has been tracked provides an estimate of annualized losses due to hurricane wind.

*Annualized Loss Estimate: Hurricane Wind (PA-based): **$2,302.28***

NCEI Storm Events Database

The NCEI database of historic storm events was reviewed to determine the cost of hurricane events to Nantucket. Hurricane events (storms reviewed in the database were the "Hurricane," Tropical Storm," and "Tropical Depression" types) have been recorded since 1996.

According to the NCEI dataset, there have been six significant tropical storm events on Nantucket since 1996, five of which caused measurable damage.

Table 5-6: NCEI Storm Events Database – Hurricane Events

Date	Event	Estimated Property Damage
8/22/2009	Hurricane Bill	$5,000
9/3/2010	Tropical Storm Earl	$20,000
8/28/2011	Tropical Storm Irene	$30,000
7/4/2014	Hurricane Arthur	$0
9/5/2016	Tropical Depression Hermine	$40,000
9/21/2017	Tropical Storm Jose	$70,000
	Total	**$165,000**

Dividing the total property damage from the NCEI figure by the 21 years over which that data has been tracked provides an estimate of annualized losses due to hurricanes and tropical storms.

*Annualized Loss Estimate: Hurricane Wind (NCEI-based): **$7,857***

Loss Estimates Summary

Based on the loss estimates summarized above, an average expected annualized estimated loss can be calculated. Note that Public Assistance funding is only granted for public projects, and therefore likely significantly underestimates total losses.

Table 5-7: Annualized Loss Estimates for Hurricane Events

Source	Annualized Estimated Loss
HAZUS-MH	$10,026,000
Public Assistance	$2,302
NCEI	$7,857

The high HAZUS-MH estimate likely overestimates costs due to true hurricanes and tropical storms, but may better represents losses due to high wind, generally. In fact, reviewing the NCEI database for all high wind events (excluding tornadoes, straight-line winds, and other thunderstorm winds) reveals 141 significant events since 1996, with a total cost of $644,890, and an annualized cost of $30,709. While using this approach does significantly raise the NCEI loss estimate, it is still well below the HAZUS-MH generated loss estimate. This may be because the NCEI database's relatively short data-collection period has not captured any significant hurricanes. Overall, the NCEI data simply does not capture the extreme events that are possible.

5.6 Mitigation Strategies and Action

Many potential mitigation measures for hurricanes include those appropriate for flooding. These were presented in Sections 3.6 and 4.6. However, hurricane mitigation measures must also address the effects of heavy winds and rain that are inherently caused by hurricanes. Mitigation for wind damage is therefore emphasized in the subsections below.

5.6.1 Prevention

Although hurricanes and tropical storms cannot be prevented, a number of methods are available to continue preventing damage from the storms, and perhaps to increase damage prevention. The Comprehensive Community Plan and Status Chart recommend the following types of prevention for hazard mitigation:

- ❑ Add additional boat ramps at all harbors for emergency preparedness purposes and backup storage sites for vessels hauled during emergencies.
- ❑ Add boats ramps and storage areas for emergency response.
- ❑ Utilize opportunities to place utilities underground.
- ❑ Continue the program of placing utilities underground in the historic districts of Nantucket and Siasconset and as opportunities arise, elsewhere throughout the island.
- ❑ Develop a Nantucket local energy generation plan to guide investments in and development of local power generation (through wind, solar, and other renewable sources as well as fuel-powered generators), storage (through local batteries), and microgridding.

5.6.2 Property Protection

Potential mitigation measures for property protection during hurricanes include designs for hazard-resistant construction and retrofitting techniques. These may take the form of increased wind and flood resistance, as well as the use of storm shutters over exposed glass and the inclusion of hurricane straps to hold roofs to buildings. In addition, living and working areas can be elevated to allow a storm surge to pass safely underneath.

The American Red Cross (ARC) has published a guidebook entitled *Standards for Hurricane Evacuation Shelter Selection* (ARC Publication #4496). The publication provides guidelines for selecting shelters relative to resilience from storm surges, flooding, and hurricane winds. Several FEMA publications provide design criteria for shelters, including *Design and Construction Guidance for Community Shelters* (FEMA Publication #361). A reference by the International Code Council (ICC) and the National Storm Shelter Association, *Standard on the Design and Construction of Storm Shelters* (ICC-500), also provides design criteria. In general, recommended design wind speeds range from 160 to 250 miles per hour (mph) in these publications.

The FEMA PDM program is the current FEMA mitigation grant program best suited to funding wind mitigation projects. The PDM program recognizes four categories of projects for wind damage mitigation in critical facilities as follows:

- "Shutter mitigation" projects protect all windows and doors of a structure with shutters or other systems that meet debris impact and wind pressure design requirements. All openings of a building are to be protected.
- "Load path" projects improve and upgrade the structural system of a building to transfer loads from the roof to the foundation. This retrofit provides positive connection from the roof framing to the walls, better connections within the wall framing, and connections from the wall framing to the foundation system.
- "Roof projects" involve retrofitting a building's roof by improving and upgrading the roof deck and roof coverings to secure the building envelope and integrity during a wind event.
- "Code plus" projects are those designed to exceed the local building codes and standards to achieve a greater level of protection.

The Building Department should make literature available to developers during the permitting process regarding these design standards. The Health Department should continue its outreach and education for retrofitting of existing structures.

5.6.3 Public Education and Awareness

The public, especially those individuals living within hurricane storm surge evacuation zones, should be made aware of evacuation routes and available shelters. A number of specific proposals for improved *public education* are recommended to prevent damage and loss of life during hurricanes. These are common to all hazards in this plan, and are listed in Section 11.1.

5.6.4 Emergency Services

A natural hazard mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for hurricanes include diligent use of forecasting, implementation of warning systems such as Reverse 911 to provide information on the time of occurrence and magnitude of a storm, and early evacuation of neighborhoods and localities. Although evacuation of Nantucket as a whole may not be feasible, the long lead time before a predicted hurricane strike may provide for significant off-island evacuations.

Based on the above guidelines, a number of specific proposals for improved *emergency services* are recommended to prevent damage from inland and urban flooding. These are common to all hazards in this plan, and are listed in Section 11.1.

5.6.5 Structural Projects

Structural mitigation for hurricane storm surges is generally focused on constructing seawalls, which provide better protection than bulkheads. The Town of Nantucket is not in a position to construct new seawalls, as they are not permitted. However, previous recommendations for coastal flood mitigation provided in Section 4.6 will provide mitigation for coastal flooding caused by hurricanes.

5.7 Recommended Actions

5.7.1 Status of Previous Recommendations

A suite of mitigation actions for addressing coastal flooding were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes. Some of these are repeated from Section 3.7, given their applicability to coastal flood mitigation.

ACTION	STATUS	NOTES
Recommendations for mitigation of hurricane and tropical storm winds		
Increase tree limb maintenance and inspections, especially in the downtown and 'Sconset areas.	Complete	This is now a capability
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	Drop	Utilities are placed underground on a case by case basis in new developments. Replace "pursue funding to place them underground in existing developed areas" with "Identify and pursue a pilot utility-burial project."
Provide funding for additional Marine Department staff to assist with boat removal before storms.	Capability	This is reclassified as a capability
Designate official sites on land for boat storage during storm events.	Capability	This is accomplished through the Harbor Management Plan. It is reclassified as a capability.

Note that the 2007 HMP listed recommendations for mitigating coastal and non-coastal flooding caused by hurricanes in both this section and sections 3.7 and 4.7. This update has streamlined the narrative by only listing those actions in their relevant sections, and not repeating them here.

5.7.2 New Actions and Actions to Carry Forward

All coastal- and non-coastal-flooding related actions are listed in sections 3.7 and 4.7, and are not repeated here.

One new action to mitigate the wind hazard posed by hurricanes was identified during development of this plan:

- ❑ Incorporate "code plus" wind-load requirements (more restrictive coding to make a building more resilient, specifically to wind hazards) into new critical and essential facility permitting, specifically,
  - The new fuel tank farm
  - The new Fire Department facility
  - The new hospital building
  - Any new or renovated pumping stations
- ❑ Perform an inventory and condition assessment of Town owned trees by a certified arborist that identifies a maintenance, pruning and removal schedules. Develop a risk rating model to identify trees and locations vulnerable to personal injury and property damage caused by storms.

- Document the plan that identifies the haul-out capacity and timely removal of boats from the water in an emergency situation. The Town currently works with local businesses to coordinate the hauling of boats in the event of an imminent storm. This plan should be formalized in writing and the responsibilities of the Town and private providers should be defined.

Mitigation actions that apply to all hazards are listed in Sections 2-14 and 11-1.

6 SEA LEVEL RISE, SHORELINE CHANGE, AND EROSION

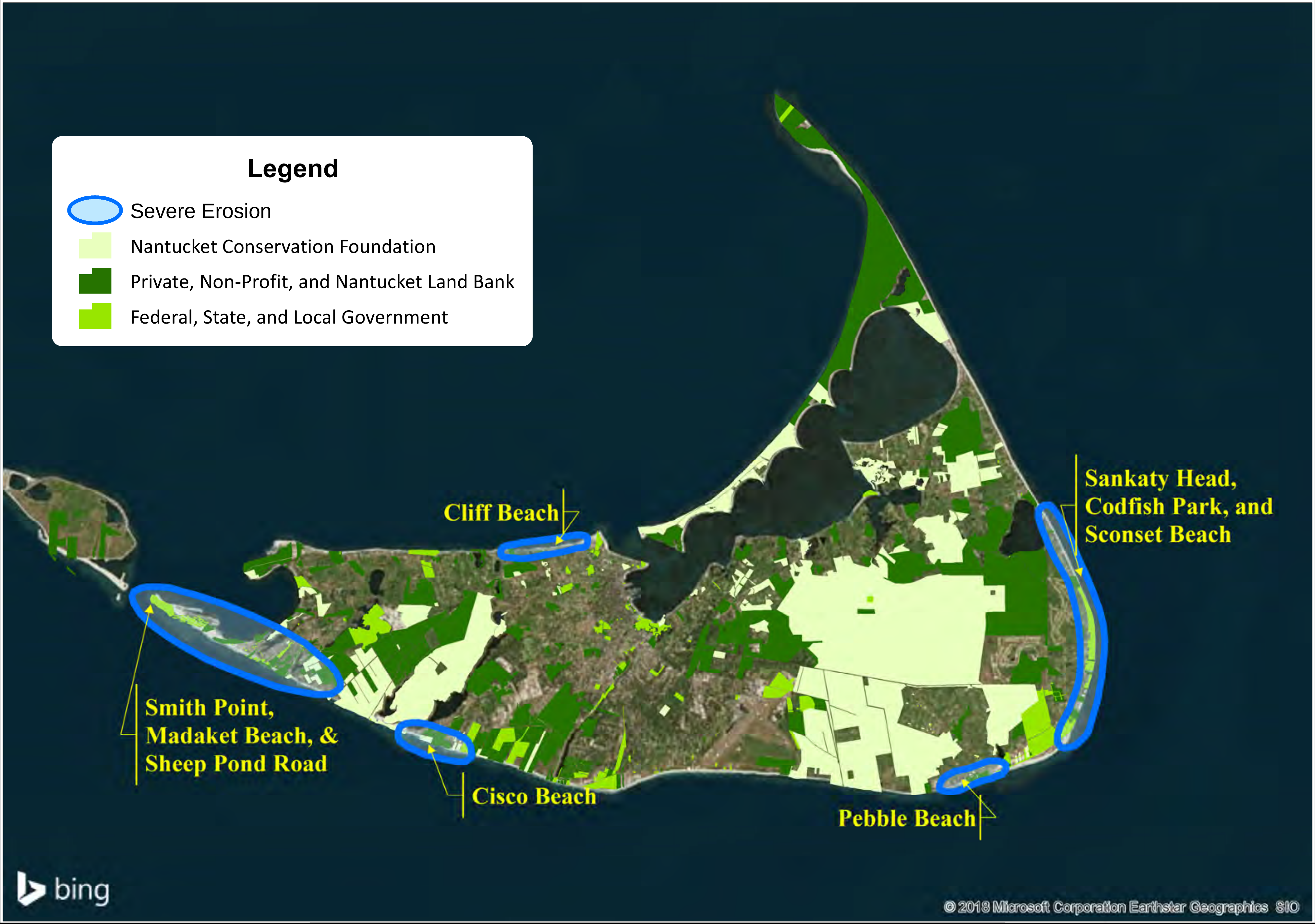
6.1 Setting

Sea level rise is a phenomenon that affects coastal and tidal areas, as well as adjacent lands that are at risk of erosion. As such, the entire community of Nantucket is at risk of the effects of sea level rise, although the timing of the impacts from this phenomenon will vary significantly with distance from the shoreline.

Coastal erosion and shoreline change will one day affect the entire island of Nantucket, even as the more immediate concerns are focused on the shoreline. Although the entire perimeter of the island (along with Muskeget and Tuckernuck) is vulnerable relative to erosion and shoreline change due to the lack of bedrock, the areas of Nantucket that currently or have recently suffered from severe erosion and shoreline change include those listed below and depicted on Figure 6-1:

- Codfish Park in ‘Sconset
- Sconset Beach in ‘Sconset
- Low Beach in ‘Sconset
- Pebble Beach along the south shore
- Cisco Beach along the south shore
- Sheep Pond Road along the south shore toward Madaket
- Madaket Beach in Madaket
- Smith Point in Madaket
- Cliff Beach along the north shore

These localities are checked in the "coastal flooding" and "coastal erosion" columns of Table 1-5.



SOURCE(S): MASS GIS	N **Figure 6-1: Current Areas of Severe Erosion** MXD: U:\Y\2967-09\Maps\Fig6-1_areas of severe erosion1.mxd	**Town of Nantucket** **Natural Hazard Mitigation Plan** **LOCATION: Nantucket, MA**	**Map By:** MER **MMI#:** 2967-09 **Original:** 09/05/2017 **Revision:** **Scale:** 1 in equals 10,000 ft	MILONE & MACBROOM 99 Realty Drive Cheshire, Connecticut 06410 Phone: (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

6.2 Hazard Assessment

Although erosion and shoreline change have long been recognized as coastal hazards, it is only recently that the chronic problem of sea level rise has been closely connected to the acute threats of erosion and shoreline change. Indeed, sea level rise will increase the incidence, severity, and adverse effects of erosion and shoreline change.

6.2.1 Sea Level Rise

Sea levels are currently rising along the Atlantic Coast as a result of climate change which is attributable to greenhouse gas emissions, as well as other factors noted on Page 6-5. Rising sea levels will inundate low areas, increase erosion of beaches and bluffs, increase the incidence of flooding from storm surges, and enable saltwater to advance upstream and intrude further into aquifers.

Rising sea level affects both the natural and the human-made environments. Future sea level rise could result in the disappearance of a large percentage of Nantucket's coastal wetlands, unless they can advance as quickly as the rising level. Saltwater advancing upstream along estuaries can alter the point at which flocculation leads to sedimentation and the creation of shoals.

As sea level rises, storm surges from hurricanes and nor'easters will reach further inland as they are starting from a higher base level. By the end of the 21st century, it is possible that a Category 1 hurricane storm surge will be similar to what is now a Category 3 hurricane storm surge.

FEMA coastal base flood elevations, which are currently at 8 to 9 feet (NGVD) depending on the location, will progressively rise. This means that the 1% annual-chance and 0.2% annual-chance flood levels will affect lands that are currently at unaffected elevations. This will exacerbate the problem of coastal and near-coastal inland flooding within Nantucket.

As sea level rises, drainage systems become less effective. Rainstorms will have the potential to cause greater flooding. Nantucket already experiences problems with inadequate storm drainage in areas such as Brant Point and downtown. As sea level rises, these areas will likely experience increased flooding.

Between 2000 and 2010, the population of Nantucket increased by 6.8%. As coastal population densities increase, greater numbers of people and assets are at risk. For example, increased storm surges due to rising sea levels has the potential to flood important low-lying arterial roadways that currently flood only infrequently.

6.2.2 Erosion and Shoreline Change

Nantucket Island continues along the path that started 12,000 years ago after the last glaciation, slowly giving way to the advancing Atlantic Ocean. This net loss of land is due partly to active erosion of bluffs, dunes, beaches, etc.; and partly to passive submergence caused by a the natural component of relative sea level rise. The erosion and passive submergence together cause a net loss of land resulting in shoreline change.

As stated in the Massachusetts Hazard Mitigation Plan, coastal erosion and shoreline change can result in significant economic loss through the destruction of buildings, roads, infrastructure, natural resources and wildlife habitats. Damage often results from the combination of an episodic event with severe storm waves and dune or bluff erosion.

The Massachusetts Coastal Zone Management (CZM) program provides a good description of erosion and shoreline change processes on its web site. Erosion, transport, and the accretion that results are continuous and interrelated processes. Each day wind, waves, and currents move sand, pebbles, and other small materials along the shore or out to sea. Shorelines also change seasonally, tending to accrete slowly during the summer months when sediments are deposited by relatively low energy waves and erode dramatically during the winter when sediments are moved offshore by high energy storm waves, such as those generated by nor'easters.

The source of the sand that created and continues to feed the beaches, dunes, and barrier beaches in Massachusetts comes primarily from the erosion of coastal landforms. For example, the material eroded from the Atlantic-facing coastal bluffs of the Cape Cod National Seashore supplies sand to downdrift (i.e., down current) beaches of the Cape.

Nantucket Officials, including the Emergency Management Agency, classify erosion as the Town's primary risk.

While erosion is necessary and natural, is has the potential to damage coastal property and infrastructure. According to CZM, erosion can expose septic systems and sewer pipes, contaminating shellfish beds and other resources; release oil, gasoline, and other toxins to the marine environment; and sweep construction materials and other debris out to sea. Public safety is jeopardized when buildings collapse or water supplies are contaminated.

According to USGS, four possible erosional outcomes can occur during a storm and storm surge event. "Swash" occurs when the maximum elevation of wave runup is higher than the beach but still lower than the base of the dune or bluff. This results in the erosion of the beach. "Collision" occurs when the maximum elevation of wave runup is higher than the base of the dune or bluff, but lower than the top of the dune or bluff. Collision results in severe erosion of the dune or bluff. "Overwash" occurs when the maximum elevation of wave runup is higher than the top of the dune or bluff. Overwash can result in damage to structures behind the dune. Finally, "inundation" occurs when the base tide and surge level is higher than the beach and dune. This is the most dangerous of the four outcomes with regard to flood damage.

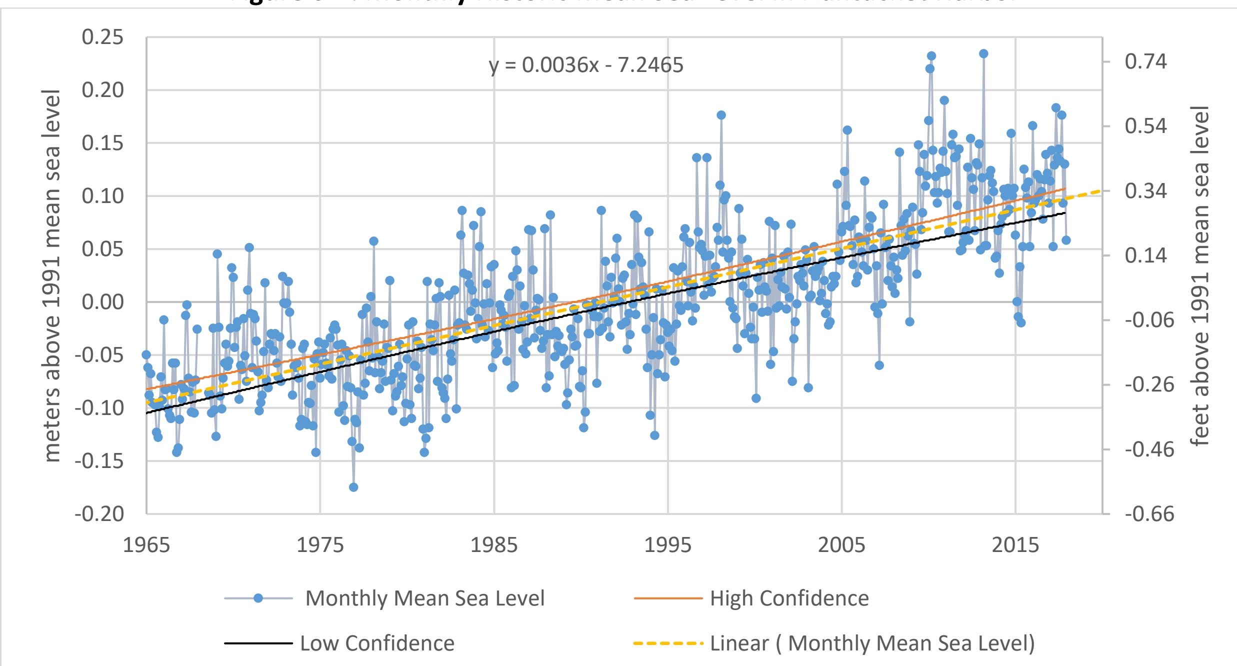
CZM notes that shoreline change can result in significant "economic and emotional loss" in the current land use system of fixed property lines and ownership. However, attempting to halt the natural process of erosion with seawalls and other hard structures can shift the problem, subjecting other property owners to similar losses. Also, without the sediment load associated with erosion, beaches and dunes can be threatened and may slowly disappear as the sand sources that sustain them are eliminated. The challenge is to site coastal development in a manner that allows natural physical coastal processes such as erosion to continue.

6.3 Historic Record

6.3.1 Sea Level Rise

A tide gauge is operated by NOAA within Nantucket Harbor, on the Steamship Wharf. This gauge has been operating since January 1, 1965. According to data collected by this gauge (available online at tidesandcurrents.noaa.gov), the mean sea level (MSL) in Nantucket Harbor is negative (-) 0.32 feet, or 0.32 feet below the North American Vertical Datum of 1988 (NAVD88). The average maximum elevation of high tide (mean higher-high water, or MHHW) is 1.80 feet above the MSL, or 1.48 feet elevation, NAVD88. Examination of fifty-two years of tidal data collected at this gauge (from January 1965 through December 2017) show that MSL has been increasing at a rate of 0.14 inches (0.0117 feet, 3.57 millimeters) per year. See Figure 6-2.

Figure 6-2: Monthly Historic Mean Sea Level in Nantucket Harbor



Global climate change will cause the rate of sea level rise on the Nantucket coast to accelerate moving forward. It has long been expected that the rate of sea level rise in Massachusetts will be slightly higher than the global projections due to the local effects of regional subsidence. More recent studies have asserted that changes in ocean circulation will increase the relative sea level rise along the Atlantic coast even more. Future sea level rise risks are discussed further in Section 6.5.

6.3.2 *Erosion and Shoreline Change*

Historical Shoreline Change

The earliest records of shoreline change for Nantucket are available from a review of historical topographic maps and nautical charts. These maps have documented striking changes in the southwestern portion of Nantucket from Madaket to Muskeget Island. The Nantucket Shoals Nautical Chart from 1791 depicts a barrier island between Muskeget and Tuckernuck that disappeared the next century. This barrier island was aligned with the southern shore of Nantucket Island at Madaket, whereas Muskeget and Tuckernuck were located behind (north) of the barrier island and the shoreline alignment.

The topographic map from 1893 shows that the barrier island was gone by then, with a long barrier beach extending from Madaket (where Smith Point is currently located) to a position southwest of Tuckernuck. The barrier beach and Tuckernuck were separated by a very narrow strait. The 1903 Nantucket Shoals Nautical Chart shows a continuation of this northward erosional progression, with the southern shore of Tuckernuck finally merged with the barrier beach and aligned with the southern shore of Nantucket at Madaket. The maps from 1791 through 1903 also show a progressive shrinking of Muskeget Island.

By 1944, topographic maps show the disappearance of the barrier beach west of Madaket and a wide expanse of water between Tuckernuck Island and Smith Point (the western extent of the Madaket barrier beach system).

The aforementioned maps document a significant northward shift of the southern shoreline. For example, Hummock Pond was a U-shaped pond in 1893. By 1945, the beach south of the pond had advanced northward far enough that it decreased the width of water connecting the two arms of the U. Hummock Pond is now two separate ponds, with the beach advancing so far to the north that it merged with the peninsula between the two arms. Likewise, several north-south ponds along the southern shoreline have disappeared over the same time frame, including Nobadeer Pond, Madequecham Pond, and most of Sheep Pond.

It is more difficult to detect changes in the shoreline in the 'Sconset area based on a review of the historical maps. However, the topographic maps from 1945 and 1951 depict many more homes in the Codfish Park area as compared to the same area today. Specifically, homes on the east side of Codfish Park Road are clearly visible in the historical topographic maps, whereas the area east of the road is currently occupied by the beach and the ocean.

Massachusetts Shoreline Change Project

Recent research by performed by the Massachusetts agency of Coastal Zone Management (CZM) as part of its StormSmarts Coasts Project has continued to shed light on changes to the Nantucket shoreline. The Massachusetts Shoreline Change Project digitized high water line (the landward limit of wave runup at the time of local high tide) data from the mid-1800s to 2009 using historical and modern sources. The most recent shoreline data was extracted from orthophotographs and Lidar. Shoreline-perpendicular transects intersecting each of the up-to eight historical shorelines at 50-meter intervals were then used to calculate short- and long-term shoreline change rates for the entire Massachusetts coast. Results are available through interactive maps and downloadable files for use in a GIS, as well as in a report.

The Massachusetts CZM Shoreline Change Project was most recently updated in 2013, with historic shorelines mapped from the mid-1800s through 2009. The 2013 project report, *Massachusetts Shoreline Change Mapping and Analysis Project, 2013 Update* (Thieler, et. Al. 2013) described the project's findings for Nantucket as follows:

Long-term shoreline-change rates were calculated at 2,227 transects covering 91 miles of Nantucket shoreline. Generally, erosion was observed on the Atlantic Ocean-facing shores of Nantucket, Tuckernuck, and Muskeget Islands, and accretion at the end of barrier spits. The maximum erosion rate (7.2 ±1.3 meters per year) was found to be occurring on a barrier spit on Muskeget Island. Tuckernuck Island and the southern shore of Nantucket Island were also found to have high long-term erosion rates; the average long-term erosion rate for Nantucket's southern shore is 2.1 ±0.5 meters per year. The highest long-term accretion rate of 4.3 ±3.7 meters per year was observed on the eastern side of Muskeget Island.

Short-term linear-regression change-rates were calculated at 1,983 transects along 74 miles of Nantucket shoreline. The maximum short-term linear regression erosion rate 12.4 ±1.5 meters per year was measured at Tuckernuck Island. Tom Nevers Beach also had high short-term erosion rates up to 4.9 ±1.5 meters per year. For the short-term, the average rate of change for the Nantucket southern shore was 1.2 ±2.6 meters per year, which is not a statistically significant trend and reflects the mobility of this beach system. The short-term maximum linear regression accretion rate of 5.5 ±4.6 meters per year was located at the end of a spit on Esther Island at the entrance to Madaket Harbor.

In the Low Beach area, the study demonstrated that the shoreline is very unstable. Between 1846 and 1887, the beach reportedly accreted 238 feet; from 1887-1955 it eroded 32 feet; and from 1955-1978, this same beach eroded 204 feet. Despite the apparent long-term net stability of the beach, any buildings constructed here when the beach was accreting would have subsequently been destroyed when it eroded.

Table 6-1 lists erosion and accretion data for a selection of transects around the perimeter of Nantucket Island located near critical facilities and other points of interest. This information was taken from an independent review of the CZM Shoreline Change Project maps conducted for this natural hazard mitigation plan.

Table 6-1: Erosion and Accretion Rates in Selected Nantucket Coastal Transects

Location*	Transect #	Long Term**		Short Term**	
		Net Change (ft)	Rate (ft/yr)	Net Change (ft)	Rate (ft/yr)
Wauwinet: Outer Shore	0150	-521.23	-3.9 ±1.49	-81.63	-2.1 ±5.29
Sconset: Baxter Road	0254	-151.41	-0.82 ±0.38	-65.58	-1.61 ±4.57
Sconset: Codfish Park	0331	202.85	0.92 ±2.4	-168.5	-5.18 ±2.37
Tom Nevers	0409	-251.8	-0.98 ±2.2	-506.86	-16.17 ±4.8
South of Airport	0515	-1473.43	-9.19 ±1.05	-136.84	-4.3 ±1.61
Surfside: WWTF	0594	987.3	5.18 ±1.39	237.11	6.99 ±14.59
Surfside: Hummock Pond	0687	-1086.55	-6.59 ±0.55	-305.71	-9.65 ±2.6
Sheep Pond Road	0761	-1743.54	-10.79 ±1.15	-325.07	-9.68 ±7.19
Smith Point	0802	-1890.26	-11.68 ±1.41	-194.03	-5.31 ±8.04
Madaket: Little Neck	1106	14.5	-0.3 ±1.04	-12.17	-0.36 ±4.98
Madaket: Warren Landing	1116	-54.66	-0.33 ±0.1	-23.26	-0.75 ±2.31
Dionis: Fishers Landing	1205	230.48	2.23 ±1.52	-138.94	-4.49 ±6.01
Dionis Beach	1277	-288.29	-1.74 ±0.25	-49.15	-1.57 ±1.94
Jetties Beach West	1346	911.94	6.5 ±1.65	-51.77	-1.71 ±1.02
Jetties Beach East	1350	730.22	5.84 ±2.16	-114.6	-3.71 ±3.58
Downtown	1401	-39.99	-0.03 ±0.65	-6.3	-0.43
Shimmo Creek	1463	-34.42	-0.1 ±0.21	-12.86	-0.39 ±7.64
Quaise Point	1538	-57.38	-0.13 ±0.64	-64.8	-4.49 ±-9999
Wauwinet Inner Shore	1678	895.64	5.28 ±8.49	-10.86	-7.45 ±56.01

** Note that one sample transect was chosen for each general location listed in this column. Due to the close spacing of the transects, each location is crossed by multiple transects, each with different erosion or accretion rates. In some cases, a single area may be crossed by both transects that show erosion and transects that show accretion (for example, Madaket: Little Neck).*

*** Positive values indicate accretion (shoreline movement out into the ocean). Negative values indicate erosion (shoreline movement inland).*

Figure 6-3 depicts areas of shifting, long-term erosion, alternating accretion and erosion, and relatively stable areas from 1846 through 2009. It is important to note that this figure provides only a very generalized depiction of trends. The Massachusetts Shoreline Change maps should be reviewed for details.

SOURCE(S):
MASS GIS

N

Figure 6-2: Areas of Erosion and Accretion, 1846-2009

MXD: U:\Y\2967-09\Maps\Fig6_2shoreline change1.mxd

Town of Nantucket
Natural Hazard Mitigation Plan

LOCATION: Nantucket, MA

Map By: MER
MMI#: 2967-09
Original: 09/05/2017
Revision:
Scale: 1 in equals 10,000 ft

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Notable Erosion Events

"Selected Resources of the Island of Nantucket"

A detailed record of erosion and shoreline change from 1896 through 1962 is available from the University of Massachusetts Cooperative Extension Service publication "Selected Resources of the Island of Nantucket" (1966). Table 6-2 lists the incidents reported in the publication. This list is not meant to be exhaustive or inclusive of all major shoreline change and erosion events.

Table 6-2: Notable Storm Damage, 1896-1962

Date	Description
12/15/1896	Ocean broke through at Haulover (head of harbor).
1/25/1905	Harbor level 7.5 feet above normal low water.
1/18/1908	Bluff erosion up to 25 feet in Surfside area.
1/10/1914	Ocean broke through at Great Point; severe erosion.
1/16/1915	Sound broke through Coatue; erosion of Nantucket Cliffs.
8/16/1925	Bluff erosion at Surfside and Madaket; flooding of all south shore ponds.
1/26-29/1933	Ocean broke through at Haulover; bluff erosion at Squam and Nantucket Cliffs; flooding of Miacomet and Hummock Ponds.
9/21/1938	Hurricane of '38: Bluff erosion along entire south shore; ocean broke through at Broad Creek (this area is no longer a creek; instead it comprises the southern curve of Madaket Harbor).
3/2/1947	Heavy surf and flooding at Madaket; washover of ocean to Hummock Pond and Sheep Pond; bluff erosion at Cisco.
8/31/1954	Hurricane Carol: Smith's Point cut off from Nantucket.
9/11/1954	Hurricane Edna: Bluff erosion along entire south shore; Nobadeer Valley flooded (southeast of airport); washover of ocean to Hummock Pond.
1/7/1958	Ocean washover at Broad Creek.
9/20/1961	Hurricane Ester: Ocean washover at Broad Creek; heavy surf with 20' waves at Madaket.
10/20-24/1961	Heavy surf with 20' waves along south shore; Madaket ocean side erodes 40'; harbor water level 5' above normal.
11/14-15/1962	Harbor water level 6.5' above normal.

Massachusetts 2013 State Hazard Mitigation Plan

It is understood that much of the severe erosion facing Nantucket occurs during discrete storm events. The 2013 update to the Massachusetts Hazard Mitigation Plan lists a number of large coastal storm events that have had major impacts on the Massachusetts coastline. Some of the most memorable coastal storms are listed here, however all significant coastal storms impacting Nantucket are identified previously in Section 4.3. The memorable storms and erosion events include:

- September 1954: Hurricane Carol
- September 1954: Hurricane Edna
- February 1978: Nor'easter – strong northeast winds, a slow-moving storm system, and astronomically high tides caused serious coastal flooding, beach erosion, broken seawalls, and property loss.

- August 1991: Hurricane Bob
- October 1991: Nor'easter ("Perfect Storm") – high winds and waves over 30 feet caused flooding and wind damage
- December 1992: Nor'easter ("No Name Storm") – $12.6 million in public infrastructure damage and $12.7 million in NFIP claims.
- March & April, 2001: Winter Storm, Heavy Rainfall, Flooding – widespread coastal flooding, damage to homes
- January 2005: Nor'easter – heavy snow and high winds
- October 2005: Coastal Storm – a strong nor'easter combined with the remnants of Tropical Storm Wilma created rainfall, winds, and coastal flooding.
- April 2007: Coastal Storm – high rainfall
- August 2011: Tropical Storm Irene – significant rain, storm surge, flooding, and wind damage. Most damage occurred inland.
- October 2012: Hurricane Sandy – high winds and storm surge.

The Massachusetts State HMP notes that "the return period of an episodic erosion event is directly related to the return period of a coastal storm, hurricane, or tropical storm."

Other Data Sources

The NCEI reports that Nantucket suffered erosion during the 1992 No Name Storm, a December 1993 storm, an April 1997 storm, a January 1998 storm, and a February 1998 storm. During the 1992 No Name Storm, several homes were washed out to sea in Codfish Park and the beach suffered severe erosion. During the April 1997 storm, the homes in Codfish Park were evacuated and a portion of one home was lost. During the January 1998 storm, the Pebble Beach parking lot was lost to erosion and had to be relocated. The next month during the February 1998 storm, 12 to 15 feet of bluff was lost in 'Sconset.

A group of consecutive storms can have a significant impact. According to the article "Tempering the Wrath of Mother Nature" (The Nantucket Independent, August 24, 2005), the storms of winter 2004-2005 took an average of 15 feet of bluff along Baxter Road in 'Sconset.

Severe erosion occurred during the spring nor'easter of April 16-17, 2007. During this storm, southeast wind gusts of 64 mph and 18 to 20-foot waves re-severed Esther Island from Smith Point and undermined one of the homes on Sheep Pond Road, causing it to fall onto Madaket Beach. Erosion controls along Baxter Road in 'Sconset were destroyed.

Other recent erosion events are listed in the NCEI database or recorded through the Massachusetts MyCoast project (https://mycoast.org/ma), which allows members of the public to report shoreline change events. Events listed include:

- **October 29-30, 2012**
- **February 9-10, 2013 –** The Blizzard of 2013 caused significant beach erosion, damaging sand fencing.

- **March 7-8, 2013 –** Sheep Pond Road was flooded and water eroded the foundation of a building.
- **January 3, 2014**
- **July 7, 2014**
- **December 9, 2014**
- **January 27-28, 2015 –** pockets of structural damage and seawall failure occurred
- **February 15, 2015 –** The barrier beach at Folger's Marsh was breached.
- **August 16, 2017** – Waves on the south shore were estimated at 12 feet, with strong rip currents in place.
- **September 21, 2017** – Tropical Storm Jose caused high winds and waves. Numerous boats were washed ashore or sunk.
- **October 30, 2017 –** The remains of Tropical Storm Philippe caused winds and waves that impacted the western coastline of Nantucket. Large waves and swells washed over the head of Hither Creek and eroded a new channel that exposed Millie's bridge (Ames Ave. over Hither Creek) and its embankment to scour. DPW used an emergency contract to protect the embankment using large concrete blocks (3800#) and redirect the scour away from the structure. Within a month the flow over the head of the creek stopped and the area with erosion was filled with sand. The extent of change is shown in the photographs below, comparing the difference seen in Google earth from April 2017 and February 2018. Because of these changes, the bridge is likely vulnerable more vulnerable to direct wave action and scour. Note the house seen on the beach at the end of California Ave. has been demolished.

- **January 3-5, 2018** – Winter Storm Grayson brought rain, wind, and coastal flooding to Nantucket. Many low-lying areas of Downtown were flooded. Easton Street was flooded by four feet of water, and a car was seen floating down the street. Easy Street and Washington were flooded as well. A couple of homes on Washington Street were shifted on their foundations by floodwaters. More than 20 people had to be rescued during the storm , and at least two families were displaced. The Town opened the emergency shelter as a precaution going into the overnight.

- **January 30, 2018** – A coastal storm passed offshore of Nantucket and brought a storm surge and flooding to Nantucket. Easy Street, Easton Street, and Washington were all reported flooded, but not to the extent of January's storm.
- **March 2-4, 2018 –** A powerful nor'easter named Winter Storm Riley brought a storm surge that lasted multiple tide cycles. Sustained wind from the north led to wave driven flooding that reached Madaket Road at Long Pond, causing scouring on the north side of the roadway. DPW placed large concrete blocks to dissipate wave energy and mitigate erosion of the roadway and culvert. The same event led to scouring and wash over occurred at the culvert on Polpis Road at Fulling Mill Creek requiring concrete block protection. Sustained wind from the east lead to breach of Sesachacha Pond and wave driven flooding and storm surge that caused undermining of the embankment and roadway on Polpis Rd. Despite the placement of concrete blocks to protect the embankment on March 4th and early in the duration of the storm, several days of sustained wind and waves damaged the pavement and undercut the subgrade by at least 12 feet in several locations (closing the road in both directions). The roadway was reconstructed as needed, along with armoring of the embankment and installation of large concrete blocks to protect the roadway. Erosion produced by the storm was also observed at Children's Beach. Overall, east and north facing infrastructure and assets were most vulnerable to damage in this storm.

6.4 Existing Capabilities

Coastal Zone Management Program

The CZM Shoreline Change Project is available to help educate residents and property owners about erosion and shoreline change. To help make informed and responsible decisions, CZM states that coastal managers, shorefront landowners, and potential property buyers need information on both current and historical shoreline trends, including reliable measurements of erosion and accretion rates in non-stable areas. The goal of the Shoreline Change Project is to develop and distribute scientific data that will help inform local land use decisions.

The Shoreline Change Project presents long-term and short-term shoreline change rates at 40-meter intervals along the entire Massachusetts coast. In a broad sense, this information may provide useful insight into the erosional forces at work along the Massachusetts coast. But CZM cautions users of this tool when applying this information to specific property or local sections of coastline, and advises that one should consult with a professional when attempting to use the Shoreline Change Project data for planning purposes.

Climate/Coastal Resilience Planning

Nantucket is in the process of developing a Climate/Coastal Resilience Plan (CRP), which will be a comprehensive plan to address sea level rise, coastal storms, and a changing coastal hazard regime. The resilience planning process expected to be completed in 2019.

Codes and Regulations

Although Nantucket does not have codes or regulations that specifically address hazards posed by sea-level-rise, important pieces are indeed in place in the form of the ordinances, codes, and regulations cited in Section 2.9 that have been enacted to minimize storm, erosion, and flood damage.

Infrastructure Protection

Recall from Sections 3.4 and 4.4 that DPW tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. At the ‘Sconset WWTP, the Town must plan a new location for the effluent beds if the bluff at Low Beach erodes to within 100 feet of a permanent marker. The marker is 300 feet from the ocean and 100 feet from the beds. At the Surfside WWTP, bathymetric mapping has indicated that erosion and accretion will occur, and the shoreline will be stable for 20 to 25 years. Funding for the plant takes the life span of the plant and effluent beds into account.

Erosion Control

With regard to pre-existing structures that were constructed to reduce erosion and stabilize shorelines, examples include the jetties at the mouth of Nantucket Harbor and numerous concrete, steel, and wood bulkheads in the harbor area.

A variety of other projects have been conducted in other areas to combat erosion, such as beach nourishment, and riprap, bulkheads, seawalls, and related structures that pre-date the regulations that no longer allow their construction. Specifically, three ongoing bank protection and beach nourishment projects are implemented at:

- Hummock Pond
- Madaket Road
- Quaise Road

Beach nourishment is described in Section 6.6.

Homes and the Sankaty Lighthouse are being moved back (retreating from the shoreline) in the eastern part of Nantucket. Private funds were raised for the lighthouse project, and private funds are typically used for home relocation.

An erosion control project on Baxter Road is a private effort protecting a portion of Baxter Road. It is a coastal engineering structure of sand-filled geotubes used in combination with sand nourishment. Plantings in the bank above further help to maintain the upper slope. While it is an example of hybrid techniques being used for erosion control, the Commonwealth of Massachusetts does not consider a geotube to be a hybrid technique. In addition, this Hazard Mitigation Plan does not include a technical review or endorsement of the efforts. Instead, this narrative has been included to demonstrate to FEMA that efforts to address erosion are present in the Town of Nantucket.

6.4.1 Capabilities Summary

In summary, the Town of Nantucket primarily mitigates sea level rise, erosion, and shoreline change hazards through implementation of erosion control projects, development of long-range shoreline change planning documents, and ongoing monitoring and public education.

Nantucket's capabilities to mitigate for shoreline change have increased since the previous edition of this HMP, in large part during the completion of coastal planning documents; these include the 2009 Nantucket Master Plan and its associated Area Plans, which address shoreline change issues, and the 2014 Coastal Management Plan, which established priorities and procedures for protecting and managing town-owned infrastructure and public access points adjacent to the coastline. Through the Town's development of a Climate/Coastal Resilience Plan, its capabilities are expected to increase further, as it will have a unified guiding document to help with future decision-making.

6.5 Vulnerabilities and Risk Assessment

Sea Level Rise

According to the USGS publication "National Assessment of Coastal Vulnerability to Sea-Level Rise: Preliminary Results for the U.S. Atlantic Coast," the ***coastal vulnerability index*** of the Nantucket shoreline as related to sea level rise varies from "moderate" to "very high," depending on the location. The "moderate" score has an associated relative sea level rise projection of 2.5 to 2.95 mm/year, the "high" score translates to 2.95 to 3.16 mm/year, and the "very high" score translates to greater than 3.16 mm/year. "Very low" and "low" coastal vulnerability indices were not assigned to Nantucket. These are reserved for rocky shores such as those found in Maine.

Transportation infrastructure in Nantucket at risk to adverse effects from sea-level rise includes portions of the roads listed in Table 2-2, such as Broad Street, Washington Street, North Beach Street, South Beach Street, Easton Street, Polpis Road, Wauwinet Road, Madaket Road, Cambridge Street, Tennessee Avenue, and Codfish Park Road. Without improvements, many of these roads will have more difficulty draining due to rising base level, and will flood more frequently due to winds or even small storm surges.

Port facilities on the water's edge are particularly vulnerable to sea level rise. Docks, piers, boat ramps, jetties, and other facilities are deliberately set at an optimal elevation relative to the water level, and therefore a rise in sea level leaves them at a less optimal elevation. However, unlike roads, these facilities tend to be rebuilt relatively frequently as compared with the time it takes for a substantial rise in sea level.

Commercial, industrial, and residential properties along the coastline are also vulnerable to sea level rise. In general, these are the same areas that were identified in Sections 4.0 and 5.0 in the context of coastal flooding and hurricanes, respectively. The most vulnerable areas are those where topography is relatively flat, such as Brant Point, and areas adjacent to Nantucket harbor and tidal creeks and waterways.

All of the critical facilities in coastal flood zones and storm surge areas are vulnerable to sea level rise. These include the municipal buildings 16 Broad Street, 34 Washington Street, and 37 Washington Street; the Police Station; Our Island Home and Landmark House; the sewer pumping station; the Steamship Dock, all four boat ramps listed in Table 2-1, and the fuel tank farm. In addition, Madaket is vulnerable to isolation caused by sea level rise, although the speed of sea level rise allows for transportation improvements to remedy this situation.

GIS analysis of Nantucket topography shows that 4,153 parcels on the Island are completely or partially less than 15-feet above the current mean-higher-high-water elevation. The combined present-day values of these parcels is over $12 billion. These parcels are all expected to be at risk from future flooding as sea level rise raises base flood elevations.

Historic Resources

Historic properties may be particularly at risk from sea level rise. As noted in Section 4.5.1, historic buildings initially sited in areas with relatively low risk of coastal inundation may be at higher exposure today due to sea level rise. Additionally, sea level rise mitigation activities such as elevation or relocation may be more difficult to implement to a historic property without altering its historic character.

Erosion and Shoreline Change

The entire community of Nantucket is vulnerable to erosion and shoreline change in the long term. In the short term, coastal erosion and shoreline change vulnerabilities vary across Town. GIS analysis was used to produce a variety of potential erosion risk zones based on distance from the shoreline and Massachusetts Shoreline Change Project erosion rates. A selection of these were used to calculate the value of at-risk parcels; these are presented below.

Table 6-3: Parcels in Erosion Risk Zones

Erosion Risk Zone	Number of Parcels at Risk	Total Value of Parcels at Risk
250 ft of MHHW	1,505	$6,514,459,500
500 ft of MHHW	2,287	$8,536,605,200
30-year Erosion Zone	1,441	$5,230,312,000
50-year Erosion Zone	2,099	$6,080,290,000

The 250- and 500-foot risk zones were delineated by mapping all areas within those distances from the MHHW line. The 30- and 50-year erosion zones were delineated by taking the averages of the short-term *and long-term erosion rates calculated in the Massachusetts Shoreline Change Project, and projecting them 30 and 50 years into the future, respectively. Note that these are estimated risk zones and do not represent predictions or regulatory zones.*

Vulnerabilities are greatest in the following areas:

Codfish Park in ‘Sconset

This area has suffered repeatedly and significant erosion has occurred most during the 1992 No Name Storm, a December 1993 storm, an April 1997 storm, and a February 1998 storm. Since then, the beach has accreted somewhat and the erosion problem is temporarily on hold. However, it is believed that erosion will again threaten this area. Although critical facilities are not immediately affected, more than 50 homes are located on the beach *below* the bluff, and these homes are extremely vulnerable to erosion and subsequent loss.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 0.49 - 1.21 ft/yr accretion
- ❑ Short Term: 5.05 - 4.2 ft/yr erosion

Sankaty Head and ‘Sconset Beach

Severe erosion has recently plagued these areas, and Sankaty Head Lighthouse has been relocated farther back from the shoreline. Homes along Baxter Road have been moved back as well, and a number of erosion control projects have been implemented or are underway along this area. Erosion of the steep bluff here threatens both private homes and Baxter Road itself.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 0.85 ft/yr erosion - 0.72 ft/yr accretion
- ❑ Short Term: 9.68 - 3.84 ft/yr erosion

Low Beach in ‘Sconset

Low Beach has accreted and eroded over a very wide range in the last 100 years. If the bluff erodes to within 100 feet of a permanent marker, the Town must plan a new location for the effluent beds at the ‘Sconset WWTP, which is one of the designated critical facilities.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 2.66 - 4.3 ft/yr accretion
- ❑ Short Term: 4.63 ft/yr erosion - 6.0 ft/yr accretion

Pebble Beach along the south shore

Portions of Tom Nevers Road have been lost to erosion, but homes have not yet been lost. The bluff in this area has undergone some striking erosion. A parking lot was lost during a January 1998 storm. However, critical facilities are not affected.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 0.85 - 3.71 ft/yr erosion
- ❑ Short Term: 4.53 - 16.17 ft/yr erosion

Nobadeer Beach along the south shore

Similar to other south shore areas, this is near the portion of Nantucket that is eroding most rapidly. One very critical facility – the airport – is located north of this stretch of beach.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 8.46 - 7.51 ft/yr erosion
- ❑ Short Term: 3.51 ft/yr erosion - 0.56 ft/yr accretion

Surfside

The shoreline here is relatively stable. This area is densely developed with homes and is also the site of the Surfside WWTP, one of the designated critical facilities.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 2.1 ft/yr erosion - 5.22 ft/yr accretion
- ❑ Short Term: 2.4 ft/yr erosion - 7.84 ft/yr accretion

Cisco Beach along the south shore

Similar to Tom Nevers Road, the road has been lost but no homes have been cut off. The bluff in this area has undergone some striking erosion, and this is near the portion of Nantucket that is eroding most rapidly.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 9.22 - 6.04 ft/yr erosion
- ❑ Short Term: 9.78 - 2.36 ft/yr erosion

Sheep Pond Road along the south shore toward Madaket

Sheep Pond Road, as well as numerous homes, have historically been lost to erosion, and continue to be at risk of erosion, in this area; however, critical facilities are not affected.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 11.55 - 10.63 ft/yr erosion
- ❑ Short Term: 9.74 - 4.82 ft/yr erosion

Madaket Beach in Madaket

In this area of rapid erosion, roads and homes have been lost, and other continue to be at risk without protection from a bluff. Critical facilities are not affected in this area.

Massachusetts Shoreline Change Project figures for this area:

- ❑ Long Term: 11.55 - 10.79 ft/yr erosion
- ❑ Short Term: 9.94 - 6.3 ft/yr erosion

Smith Point in Madaket

Smith Point is no longer home to many dwellings. The iconic "Stilt House" in this area was elevated above the flood hazard zone, but after significant storms in 2017 and 2018, major erosion of the land around and below the structure led to its abandonment and eventual demolition. Millie's Bridge, which connects Smith Point to the rest of Nantucket, is at risk of damage from flooding and erosion and has historically experienced scour; significant damage to the bridge would result in the isolation of all Smith Point residents. Heavy surf from the April 16-17, 2007 nor'easter severed the end of Smith Point, known as Esther Island; there is now no official road to the three cottages on Esther. Critical facilities are not affected in this area.

Massachusetts Shoreline Change Project figures for this area:

- Long Term: 11.74 - 11.19 ft/yr erosion
- Short Term: 9.55 - 3.84 ft/yr erosion

Dionis to Cliff Beach along the north shore

Although the south shore is known for the most rapid erosion rates, portions of the north shore are subject to erosion as well.

Massachusetts Shoreline Change Project figures for this area:

- Long Term: 2.69 - 0.95 ft/yr erosion
- Short Term: 3.97 - 0.0 ft/yr erosion

Historic Resources

Historic properties initially built in locations outside of shoreline change risk zones may now be exposed to risk due to changes that have occurred since that time. Additionally, shoreline change mitigation activities such as relocation may be more difficult to implement to a historic property without altering its historic character.

6.6 Mitigation Strategies and Action

Land use planning in coastal areas must take into account the phenomenon of sea level rise. Three fundamental long-term responses to sea level rise are typically reported in the literature. These are *retreat*, *accommodation*, and *protection*. These three responses are applicable to erosion and shoreline change, as well.

Retreat

Retreat refers to the eventual abandonment of the coastal zone, allowing nature to take its course. This allows for existing coastal ecosystems to shift landward. Retreat may be motivated by excessive economic or environmental impacts of hard or soft measures of protection. Retreat may be implemented through anticipatory land use planning, regulation, and building codes, or could be motivated through economic incentives.

As a general rule, retreat is feasible in parts of Nantucket, and has been used with moderate success in some cases (Sankaty Head Lighthouse) and less success in others (some private homes). Retreat will continue to be practiced in Nantucket, but is not feasible in the most densely developed areas such as downtown.

Accommodation

Accommodation allows for the continued use of land at risk, but does not prevent the land from flooding. Measures associated with accommodation may take the form of elevating buildings on piles, and establishing other means of flood hazard mitigation. Accommodation may evolve without any governmental action, but could be assisted by strengthening flood preparation and flood insurance programs. Protective measures are implemented by authorities currently responsible for water resource and coastal protection. Policies should be developed with the ultimate goal to protect coastal property values, or they will be at risk of not being accepted by the community.

Accommodation is feasible only in the limited parts of Nantucket where flooding from storm surges is more problematic than erosion, such as Brant Point and Madaket where many homes have been elevated above the base flood elevation. Overall, accommodation will very likely continue to be practiced in Nantucket,.

Protection

Protection is the construction of structures meant to protect land from inundation and flooding. These may be hard structures such as dikes and sea walls, or soft solutions including beach nourishment. Of the hard structures, three main structures are utilized to hold back the sea. These are seawalls, bulkheads, and revetments. Seawalls are designed to withstand the full force of waves, and are used if significant wave impact at the project site is expected to be greater than three feet. Bulkheads are designed to retain fill and generally are not exposed to severe wave action. Revetments are designed to protect shorelines against erosion by currents and light wave action. Beach nourishment is discussed in a separate subsection below.

New hard structures are not permitted in Nantucket. Therefore, beach nourishment is the primary means of protection available to Nantucket. It is still a relatively unused solution in Nantucket and in Massachusetts, in general. It is believed that beach nourishment projects will increase as retreat, accommodation, and hard solutions become more difficult, costly, or unlawful to use.

As a general proposition, holding back the sea with structures results in large-scale elimination of wetlands, beaches, mudflats, and other coastal habitat. As shoreline erosion advances toward the structure, if sediment is not replaced at an adequate rate, the coastal fringe will eventually disappear under the water surface. This is why beaches in front of bulkheads and seawalls tend to disappear over time.

Elevation of Roads and Land

Elevation of land and infrastructure is another form of protection from sea level rise. Elevation has the important advantage that many types of drainage systems will continue to work properly, as the same or greater head gradient will exist between the drainage system and sea level. Elevation of road surfaces can be achieved in connection with repaving or re-grading of roads. In some communities, continued elevation of roads parallel to water bodies can create a diking effect, protecting areas landward of the road. In these cases, care must be taken that road elevation does not cause excessive runoff and flooding problems in other areas that become diked by the elevated roadways.

Nantucket has a few roads that are parallel to, located within, or located at the edge of coastal flood zones. A few are located downtown, one (Tennessee Avenue) is located in Madaket, and a few are located in 'Sconset. In addition, Polpis Road runs along the coastal flood zone of Nantucket Harbor in several locations.

Freeboard Standards and Application of V Zone Codes in A Zones

Regulatory tools include applying freeboard standards to coastal flood zone elevations such that structures would be elevated higher than FEMA requires; and application of VE zone building codes (that protect structures from wave and velocity damage) in coastal AE zones (where regulations merely protect structures from inundation). These approaches have been utilized in many New England communities. An example of a recent flood damage prevention regulation amendment to require VE zone standards in coastal AE zones can be found in Old Saybrook, Connecticut.

Soft Infrastructure

Soft infrastructure, also known as "**Living Shorelines**," aims to defend against inundation and wave power by dissipating and absorbing energy, rather than deflecting or reflecting it. Often, these techniques are also designed to enhance habitat and water quality, and to preserve the natural processes and connections between riparian, intertidal, and subaqueous areas. They can be particularly important in areas vulnerable to erosion where hard infrastructure may serve to accelerate erosion on adjacent sites.

Some specific living shoreline approaches include the following:

Beach Nourishment/Replenishment

Beach Replenishment involves importing sand to an eroding or eroded beach from sediment-rich areas, such as a harbor undergoing dredging. The slope and width of a beach affects wave setup and runup, and can have a direct impact on flood elevations. Overall, beaches can reduce flood risks and erosion hazards while creating public recreation opportunities, aesthetic value, and in the right conditions support unique habitats (climatetechwiki.org). Because beach nourishment does not stop erosion and shoreline change, it must be repeated as necessary to slow the progress of erosion and shoreline change. In many parts of the United States where hard solutions are not feasible or prudent, beach nourishment is the only means available for slowing the retreat of the shoreline. Unlike hard shoreline protection measure, beach replenishment avoids addition of potentially dangerous hard debris to the high energy coastal area.

Dune Management

Dune Management stabilizes these natural flood barriers to protect against surges while maintaining important natural resources. The Federal Emergency Management Agency (FEMA) describes dunes as “important first lines of defense against coastal storms” that can “reduce losses to inland coastal development.” The Lake Huron Centre for Coastal Conservation lists the benefits of dunes as including shore protection, water purification, biological diversity, erosion control, and acting as a source of sediment for natural beach replenishment.

Hybrid Techniques

Hybrid Techniques incorporate non-structural approaches for erosion control in combination with more traditional approaches, such as a rock structure, to support vegetation growth. Hybrid techniques are typically applied in areas of higher wave energy. An erosion control project on Baxter Road is a private effort protecting a portion of Baxter Road. It is a coastal engineering structure of sand-filled geotubes used in combination with sand nourishment. Plantings in the bank above further help to maintain the upper slope. While it is an example of hybrid techniques being used for erosion control, the Commonwealth of Massachusetts does not consider a geotube to be a hybrid technique. In addition, this Hazard Mitigation Plan does not include a technical review or endorsement of the efforts.

Tidal Wetland Management creates or supports the natural flood mitigation capabilities of this rare ecosystem. Tidal Wetlands have been found to reduce wave energy and decrease water surface elevations at their inland edges during storm surges. Preservation of tidal wetlands also prevent development in hazardous areas and support important habitat.

Massachusetts Coastal Hazards Commission

Final recommendations were released by the Massachusetts Coastal Hazards Commission (MA CHC) in May 2007. This one-time report had numerous recommendations, mostly directed at the State, with a significant selection that may be applicable to, or possible to implement for, the Town of Nantucket.

MA CHC Recommendations Relevant to Nantucket

Text has been abridged for this document.

- Evaluate distribution of hazard & emergency management information to coastal communities before and during storm events. Ensure the public is kept informed with hazard information and necessary actions to take. Use electronic media, public outreach forums, & distributed literature. Target high risk populations & locations.
- Educate communities about acquisition of storm-damaged properties using the Community Preservation Act or other available sources of funding.
- Update State Building Code requirements for coastal construction; encourage collaboration between Building Inspectors and Conservation Commissions.
- Coordinate permitting & approval by local departments to promote better understanding of a project and related permits.
- Develop best management practices or performance standards for "Land Subject to Coastal Storm Flowage."
- Prioritize culverts & tide gates for replacement due to flood hazards or environmental resource concerns; address flooding, wetlands hydrology, and maintenance in the early stages of new or replacement transportation projects.
- Implement a program of regional sand management that promotes nourishment as the preferred alternative for coastal hazard protection.

Climate/Coastal Resilience Planning

Nantucket retained a consulting firm in December 2017, to begin development of a Climate/Coastal Resilience Plan for the Town. This plan will focus on policy and regulatory tools that can be implemented to ensure the continued resilience of the Island in the face of rising seas and increasingly severe and frequent coastal storms. The document will include and implementation plan for integration of recommendations into the municipal code the town's Master Plan, and other town plans (including this HMP). The plan will also be a first step in a more comprehensive climate resilience plan process that will follow the Massachusetts Municipal Vulnerability Planning (MVP) program framework, and will make the Town a certified MVP community.

Other Potential Mitigation Options

The 2009 Nantucket Master Plan, 2006 Madaket Area Plan, 2007 'Sconset Area Plan, 2008 Surfside Area Plan, and 2008 Tin Nevers Area Plan, include a number of recommendations that are related to erosion and shoreline change hazard mitigation. These include:

- ❑ Encourage environmentally responsible technologies (including septic technologies) to protect beaches, dunes, and coastal banks
- ❑ Protect the shorelines from encroachment by development
- ❑ Develop alternative access route to Madaket via Eel Point Rd & Warren's Landing
- ❑ Support research in 'Sconset to abate erosion of easternmost coastline
- ❑ Acknowledge critical importance of dunes and beach areas in Surfside neighborhood

- ❑ Address erosion in Tom Nevers (average loss of 15-feet per year in some places)
- ❑ Install removable steps from Tom Nevers Field to beach to protect bluff from erosion caused by pedestrian traffic

Some of these recommendations may or may not be advisable, in light of the discussions in this section.

6.7 Recommended Actions

6.7.1 *Status of Previous Recommendations*

A suite of mitigation actions for addressing erosion, shoreline change, and sea level rise were proposed in the previous edition of this HMP. The 2007 HMP listed recommendations for mitigating coastal and non-coastal flooding caused by hurricanes in both this section and sections 3.7 and 4.7. This update has streamlined the narrative by not repeating actions listed in sections 3.7 and 4.7 here. Because all of the actions in this section in the previous plan were repeated from earlier sections, none are listed here.

6.7.2 *New Actions and Actions to Carry Forward*

Note that all inland- and coastal-flooding related are actions listed in sections 3.7 and 4.7, and are not repeated here. New or carried-forward actions to mitigate the hazard posed by sea level rise, erosion, and shoreline change are:

- ❑ Complete the Climate/Coastal Resilience Plan and Become an MVP Community
- ❑ Update the Nantucket and Madaket Harbors Action Plan (HAP) to incorporate needs for Hazard Mitigation and Coastal Resilience
- ❑ Implement a project to map the near shore sand and sediment transport to develop a sand-budget model for monitoring island wide coastal erosion. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep. Mapping in high resolution monitors the movement of sand shoals and identifies location of marine habitat on the sea floor.
- ❑ Implement a project to map the harbor floors (Madaket, Polpis and Nantucket) to measure and monitor sediment transport. Information will be used to develop dredging and disposal plan, as well as the Harbor management Plan. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep.

Mitigation actions that apply to all hazards are listed in Sections 2-14 and 11-1.

7 SUMMER STORMS & TORNADOES

7.1 Setting

Like hurricanes and winter storms, summer storms and tornadoes have the potential to affect any area within the Town of Nantucket. Furthermore, because these types of storms and the hazards that result (wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the Town without harming another. The entire Town of Nantucket is therefore susceptible to summer storms and tornadoes. Refer to the "wind," "lightning," and "hail" columns of Table 1-5.

7.2 Hazard Assessment

Heavy wind including tornadoes and downbursts; lightning; heavy rain or hail; and flash floods are the primary hazards associated with summer storms. Inland flooding was covered in Section 3.0, and will not be discussed in detail here.

Tornadoes

Tornadoes are spawned by certain thunderstorms. The Fujita scale was accepted as the official classification system for tornado damage for many years following its publication in 1971. The Fujita scale rated the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. The scale ranked tornadoes using the now-familiar notation of F0 through F5, increasing with wind speed and intensity. The following graphic of the Fujita scale is provided by FEMA. A description of the scale follows in Table 7-1.

Fujita Tornado Scale

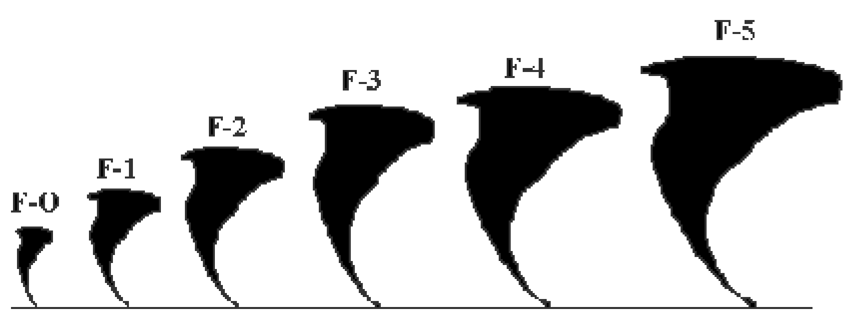

Table 7-1
Fujita Scale

F-Scale Number	Intensity	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted.
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

The Enhanced Fujita Scale was released by NOAA for implementation on February 1, 2007. According to the NOAA web site, the Enhanced Fujita Scale was developed in response to a number of weaknesses to the Fujita Scale that were apparent over the years, including the subjectivity of the original scale based on damage, the use of the worst damage to classify the tornado, the fact that structures have different construction depending on location within the United States, and an overestimation of wind speeds for F3 and greater. The Enhanced F-scale is still a set of wind estimates based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 specific indicators. Table 7-2 relates the Fujita and enhanced Fujita scales.

Table 7-2
Enhanced Fujita Scale

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

The historic record of tornadoes is discussed in Section 7.3. The pattern of occurrence in Massachusetts is expected to remain unchanged. According to the Massachusetts Natural Hazard Mitigation Plan, the highest relative risk for tornadoes in the state will continue to be from central to northeast Massachusetts. Although the potential for a strike in Nantucket is always present, Nantucket has not been struck by a tornado since record keeping began in the middle of the 20th century. Overall, the risk to the Town of Nantucket is believed to be low for any given year.

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states, but they have occurred along the Massachusetts coastline. Waterspouts occasionally move inland, becoming tornadoes and causing damage and injuries. In the western United States, they occur with cold late fall or late winter storms, during a time when you least expect tornado development. In the northeast, it appears that waterspouts, like tornadoes, may occur at any time with the correct conditions. Overall, the risk to the Town of Nantucket is believed to be low to moderate for any given year.

Lightning

Lightning is a circuit of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs.

In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud to cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom of a second cloud. Cloud to ground lightning is the most dangerous. In summertime, most cloud to ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

Lightning reportedly kills an average of 87 people per year in the United States, in addition to an average of 300 lightning injuries per year. Most lightning deaths and injuries occur outdoors, with

45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities.

Although lightning is usually associated with thunderstorms, it can occur on almost any day. The likelihood of lightning strikes in Nantucket is very high during any given thunderstorm. In addition, several notable areas of Nantucket are more susceptible than others due to high elevations at Sankaty Head, 'Sconset, and the Cliff Road area. In their Area Plan, residents of Tom Nevers have expressed specific concern about the risk of lightning strikes.

Downbursts

A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes in New England. These "straight line" winds are distinguishable from tornadic activity by the pattern of destruction and debris. Depending on the size and location of these events, the destruction to property may be significant. Downbursts may be categorized as microbursts (affecting an area less than 2.5 miles in diameter) or macrobursts (affecting an area at least 2.5 miles in diameter).

It is difficult to find statistical data regarding frequency of downburst activity. However, downburst activity is, on occasion, mistaken for tornado activity in Massachusetts, indicating that it is a relatively uncommon yet persistent hazard. The risk to the Town of Nantucket is believed to be low to moderate for any given year.

Hail

Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than a pound have been recorded. While crops are the major victims of hail, it is also a hazard to vehicles and property.

Hailstorms typically occur in at least one part of Massachusetts each year during a severe thunderstorm. Overall, the risk of at least one hailstorm occurring in the Town of Nantucket is low to moderate in any given year.

7.3 Historic Record

Convective thunderstorms are less common on Nantucket than on mainland Massachusetts. This is due to ocean waters mitigating the temperature differentials that can occur throughout the course of a day. Nevertheless, frontal storms can and do occur on Nantucket, causing heavy rain and wind numerous times each year. For example, a quick perusal of the NCEI database lists a severe thunderstorm with wind gusts of 60 mph recorded at Nantucket Airport on April 9, 2000.

Worcester County and areas just to its west have been dubbed the "tornado alley" of Massachusetts, as the majority of significant tornadoes in Massachusetts weather history have occurred in that region. According to the Massachusetts Hazard Mitigation Plan, the most destructive tornado in New England history was the Worcester tornado of June 9, 1953. The tornado hit at about 3:30 p.m. and passed through Barre, Rutland, Holden, Worcester, Shrewsbury, Westborough, Southborough and Fayville. It killed 94 people and left almost 1,300 people injured. With wind speeds between 200 to 260 mph, the force of the tornado carried debris miles away and into the Atlantic Ocean. Based on the extent of destruction, it was believed that this tornado may have been an F5.

Two other deadly tornadoes occurred subsequently in Massachusetts: the May 29, 1995 Great Barrington tornado, an F4, which claimed three lives and injured 24; and the August 28, 1973 West Stockbridge tornado, a F4, which killed four and injured 36.

According to the Massachusetts Hazard Mitigation Plan, six waterspouts were observed in Massachusetts between 1995 and 2004, with the most recent having been seen in Rockport in May 2000. However, since that time, a waterspout was reported off Cape Cod during a nor'easter that became a severe short-term winter storm on December 9, 2005.

The NCEI does not list any tornado, funnel cloud, or waterspout activity for Nantucket for the period of record (1950-present). Although the NCEI database is heavily subjective as it relies on local reports in addition to National Weather Service information, it appears that tornado, funnel cloud, or waterspout activity is rare for Nantucket.

Between 1950 and 2017, hail was recorded only once for Nantucket, with a report of 0.75-inch hailstones on April 6, 1982. It is likely that additional hail events have struck Nantucket, but they can be very localized and underreported.

Recent recorded summer storm events in the NCEI storm database include:

- ❑ **July 23, 2011** – Severe thunderstorms produced damaging winds. Shingles were blown off a house on Barrett Farm Road by thunderstorm winds, causing around $1,000 of damage.
- ❑ **March 25, 2016** – Lightning struck a house on Wanoma Way, damaging the chimney and causing around $1,000 in damage.
- ❑ **April 28, 2017** – Two lightning strikes caused around $10,000 in damage. The first strike was to a home on Friendship lane, causing a small portion of the wall to be blown out and the flashing near the chimney to be bent upward. The second strike was to the Nantucket High School, causing a gymnasium window to be broken.

7.4 Existing Capabilities

Warning is the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. A severe thunderstorm watch is issued by the National Weather Service when the weather conditions are such that a severe thunderstorm (damaging winds 58 miles per hour or more, or hail three-fourths of an inch in diameter or greater) is likely to develop. A severe thunderstorm warning is issued when a severe thunderstorm has been sighted or indicated by weather radar. Tables 7-3 and 7-4 list the NOAA Watches and Warnings, respectively, as pertaining to summer storms and tornadoes observed in the 2013 CEMP:

Table 7-3
NOAA Weather Watches

Weather Condition	Meaning	Actions
Severe Thunderstorm	Severe thunderstorms are possible in your area.	Notify your personnel, and watch for severe weather.
Tornado	Tornadoes are possible in your area.	Notify your personnel, and be prepared to move quickly if a warning is issued.
Flash Flood	It is possible that rains will cause flash flooding in your area.	Notify your personnel to watch for street or river flooding.

Table 7-4
NOAA Weather Warnings

Weather Condition	Meaning	Actions
Severe Thunderstorm	Severe thunderstorms are occurring or are imminent in your area.	Notify your personnel and watch for severe conditions or damage (i.e. downed power lines and trees. Take appropriate actions listed in department and City EOP.
Tornado	Tornadoes are occurring or are imminent in your area.	Notify your personnel, watch for severe weather and insure personnel and equipment are protected. Take appropriate actions listed in department and City emergency plans.
Flash Flood	Flash flooding is occurring or imminent in your area.	Notify personnel to watch local rivers and streams. Be prepared to evacuate low-lying areas. Take appropriate actions listed in department and City emergency plans.

Aside from warnings, several other methods of mitigation for wind damage are employed in Nantucket. Continued location of utilities underground is an important method of reducing wind damage to utilities and the resulting loss of services. The Nantucket DPW conducts tree and tree limb removal in public right-of-ways. Prior to forecast summer storms, DPW will dispatch equipment and personnel to outlying areas of Nantucket such as ‘Sconset and Madaket. But in general, half of the roads on Nantucket are private. These are normally not maintained by DPW, nor are trees maintained by the Town. Public education for these areas is important. As an example, 30 to 40 pine trees along Russell's Way were blown down two years ago. A resident was trapped for several days. Ultimately, the Town assisted with cleanup.

As explained in Section 5.4, wind loading requirements are addressed through the Building Department's administration of the most current Massachusetts State Building Code. The current enforceable building code was made effective by the State on October 20, 2017. The current wind design codes range from 139 mph to 158 mph, depending on the building use (see Table 5-3).

The detailed responsibilities of the Marine and Coastal Resources Department described in Section 5.4 are applicable to summer storms with high winds as well, although it is understood that summer storm intensity is more difficult to predict than tropical storms and hurricanes.

According to the 2013 Nantucket CEMP, the municipal responsibilities relative to tornado mitigation and preparedness include:

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual.
- Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- Periodically test and exercise tornado response plans.
- Put emergency Management on standby at tornado 'watch' stage.

7.4.1 Capabilities Summary

Nantucket's capabilities with regards to mitigating hazards posed by summer storms and tornadoes are, for the most part, identical to those relevant to mitigating hurricanes. The Town enforces the state building code, supports emergency services, performs tree trimming, and maintains emergency shelters. The primary summer storm and tornado mitigation capability is emergency warning.

Nantucket's capabilities to mitigate for summer storms and tornadoes have strengthened since the initial HMP was adopted. The Town has made improvements to its tree limb inspection and maintenance program, the state building code has been upgraded, and the creation of the Energy Office has, and will continue to, expand local energy production capacity. Nantucket's public warning system has also improved, though more improvement, specifically with the goal of reaching more temporary visitors during tourist months, is desired.

7.5 Vulnerabilities and Risk Assessment

The central and southern United States are at higher risk for lightning and thunderstorms than the northeast. However, more deaths from lightning occur on the East Coast than elsewhere, according to FEMA. Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Straight-line winds occur as the first gust of a thunderstorm or from the downburst from a thunderstorm, and have no associated rotation.

Although most of Nantucket is shrubby, two areas of the Town are particularly susceptible to damage from high winds due to heavily treed landscapes and high residential densities. These are 'Sconset and downtown Nantucket, where 150-foot elm trees are common. Tree limbs may not be suited to withstand high winds. If trees fall in these areas, the proximity of structures puts them at risk for damage.

Likewise, the downtown and 'Sconset areas are more vulnerable to lightning due to the presence of tall structures, and in the case of 'Sconset and the Cliff Road area, structures at higher elevations.

Historic Resources

As with hurricanes and tropical storms, historic resources may be particularly at risk from summer storms and tornadoes, relative to other assets, for the following reasons:

- **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand high winds as those built more recently.
- **Age:** Buildings and materials degrade over time, and a historic property may not be able to stand up to high winds as well as it could when first constructed.

The steeples of historic churches may be particularly at risk. It is important to note that hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character.

7.5.1 Loss Estimates

The economic losses faced by the community from natural hazards can be estimated by reviewing historic, and modeling future, loss figures. It is difficult to accurately quantify losses, even after an event; therefore, a number of different sources are provided in this section. Taken together, they provide a range of possible loss estimates.

NCEI Storm Events Database

The NCEI database of historic storm events was reviewed to determine the cost of summer storm, tornado, and related events to Nantucket. Tornado events have been recorded since 1950, thunderstorm-wind and hail events since 1955, and other summer-storm-related events (additional storms reviewed in the database included the "funnel cloud" and "lightening" types) have been recorded since 1996. To ensure most storms were captured by this analysis, the database was reviewed only as far back as 1955.

According to the NCEI dataset, there have been 7 significant summer-storm-type events on Nantucket since 1955, 3 of which caused measureable damage.

Table 7-1: NCEI Storm Events Database – Summer Storm Events

Date	Type	Estimated Property Damage
4/1/1958	Thunderstorm Wind	$0
4/6/1982	Hail	$0
9/9/1998	Funnel Cloud	$0
4/9/2000	Thunderstorm Wind	$0
7/23/2011	Thunderstorm Wind	$1,000
3/25/2016	Lightning	$1,000
4/28/2017	Lightning	$10,000
	TOTAL	**$12,000**

Dividing the total property damage from the NCEI figure by the 62 years over which that data has been tracked provides an estimate of annualized losses due to summer storms.

*Annualized Loss Estimate: Summer Storms (NCEI-based): **$194***

Loss Estimates Summary

The NCEI is the only source of data on losses due to summer storms and tornadoes.

The Nantucket EMD estimates that the cost to the police department to respond to a typical thunderstorm event is $524. Assuming the Town experiences multiple thunderstorms in a given year, this figure indicates that the annualized cost dues to summer storm events is likely significantly higher than the estimate based on NCEI data.

7.6 Mitigation Strategies and Action

Both the FEMA and the NOAA websites contain valuable information regarding preparing for a protecting oneself during a tornado, as well as information on a number of other natural hazards. This information is available at:

FEMA
http://www.fema.gov/library/prepandprev.shtm.

NOAA
http://www.nssl.noaa.gov/NWSTornado/

Available information from FEMA includes:

- Design and construction guidance for community shelters.
- Recommendations to better protect from tornado damage for your business, community, and home. This includes construction and design guidelines for business and homes, as well as guidelines for creating and identifying shelters.
- Ways to better protect property from wind damage.
- Ways to protect property from flooding damage.
- Construction of safe rooms within homes.

NOAA information includes a discussion of family preparedness procedures and the best physical locations during a storm event.

Specific mitigation steps that can be taken to prevent property damage and protect property are given below.

Prevention

- ❑ Continue or increase the Town-wide tree limb inspection program to ensure that the potential for downed power lines is minimized.
- ❑ Place utilities underground. The Comprehensive Community Plan and Mid-Island Area Plan, in particular, discuss the need for underground utilities.

Property protection

- ❑ Encourage, or consider requiring, the use of storm shutters along the coastline.
- ❑ Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards.

7.7 Recommended Actions

7.7.1 Status of Previous Recommendations

A suite of mitigation actions for addressing for winds, hail, tornadoes, and downbursts were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes.

ACTION	STATUS	NOTES
Increase tree limb maintenance and inspections, especially in the downtown and 'Sconset areas.	Complete	See section 5.7
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	Capability	See section 5.7
The following actions, taken from Section 3.7, are recommended to mitigate for heavy rains and flash flooding caused by thunderstorms:		
Sesachacha Pond is drawn down twice each year to prevent high water levels. This should be continued as long as it protects Polpis Road from flooding.	Capability	See section 3.7
Conduct master drainage studies for problem areas, such as the broad area between Madaket Road and Hummock Pond Road, to ensure that individual repairs and upgrades fit seamlessly with upstream and downstream drainage systems.	Drop	See section 3.7
Improve the storm drainage system on Pleasant Street to reduce flooding.	Complete	See section 3.7
Complete the Orange Street drainage system upgrade to reduce flooding and allow better drainage of upstream areas.	Complete	See section 3.7

7.7.2 New Actions and Actions to Carry Forward

No new or carried-forward actions relate only to the hazard posed by summer storms.

New actions identified during development of this plan update include:

- ❑ Ensure the Nantucket Building Department is fully educated on the 2017 building codes.
- ❑ Provide information on the benefits and applicability of lightning-rods to land-use and building permit applicants; in addition, make this information available on the Town website.

Important recommendations that apply to all hazards are listed in Sections 2-14 and 11-1.

8 WINTER STORMS

8.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any part of the Town of Nantucket. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. The entire Town of Nantucket is therefore susceptible to winter storms. One need only refer to the "coastal flooding," "wind," "falling trees & branches," "snow," "blizzard," and "ice" columns of Table 1-5 to understand the widespread effects of winter storms.

A particularly troublesome problem in Nantucket is that of drifting snow, because it can renders roads impassable only hours after plowing. Drifting snow is most problematic at the following nine locations, due to their positions downwind from clear areas without windbreaks.

- Milestone Road along Conservation land
- Polpis Road at Golf Course
- Polpis Road near Pinelands
- Cliff Road west of Gosnold Road
- Eel Point Road
- Red Barn Road
- Bartlett Farm Road
- West Miacomet Road at Golf Course
- Hummock Pond Road at Cemetery

8.2 Hazard Assessment

This section focuses on those effects commonly associated with winter storms, including those from blizzards, ice storms, heavy snow, freezing rain and extreme cold. Most deaths from winter storms are indirectly related to the storm, such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects include loss of power and heat.

According to the National Weather Service, approximately 70% of winter deaths related to snow and ice occur in automobiles, and approximately 25% of deaths occur from people being caught in the cold. In relation to deaths from exposure to cold, 50% are people over 60 years old, 75% are male, and 20% occur in the home.

The classic winter storm in New England is the nor'easter, which is caused by a warm moist, low pressure system moving up from the south colliding with a cold, dry high pressure system moving down from the north. Wind driven waves can batter the coastline, causing flooding and severe beach erosion. Coupled with a high tide, the low pressure of a nor'easter can have an effect similar to a storm surge from a hurricane.

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets and extreme cold. The National Weather Service defines a blizzard as winds over 35 mph with snow and blowing snow reducing visibility to near zero.

Massachusetts experiences at least one severe winter storm every five years, although a variety of small and medium snow and ice storms occur nearly every winter. The likelihood of a nor'easter occurring in any given winter is therefore considered high, and the likelihood of other winter storms occurring in any given winter is very high.

8.3 Historic Record

According to the Massachusetts Hazard Mitigation Plan, the last three Presidential disaster declarations in Massachusetts (April 2004, December 2003, and February 2003) were the result of winter nor'easters. Winter weather disaster declarations and emergency declarations involving Nantucket County in the last 30 years are listed below along with the FEMA disaster identification numbers:

- Blizzard of 1978, February 1978 – FEMA-546 – Counties of Barnstable, Bristol, Dukes, Essex, Nantucket, Norfolk, Plymouth, and Suffolk;
- December Blizzard, December 1992 – FEMA-975 – Counties of Barnstable, Dukes, Essex, Plymouth, and Suffolk are listed; Nantucket County is not listed but was heavily damaged;
- March Blizzard, March 1993 – FEMA-3103 – All 14 Counties;
- January Blizzard, January 1996 – FEMA-1090 – All 14 Counties;
- March Blizzard, March 2001 – FEMA-3165 – Counties of Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, and Worcester;
- February Snowstorm, February 17-18, 2003 – FEMA-3175-EM – All 14 Counties;
- December Snowstorm, Dec. 5-6, 2003 – FEMA-3191-EM – Counties of Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, and Worcester
- Snowstorm, January 22-23, 2005 – FEMA-3201 – All 14 Counties.

The NCEI includes documentation of other severe winter storms that were not necessarily disaster declarations. These include nor'easters in December 1993, December 1995, January and February 1998, and February 2006, with the latter coincident with a severe blizzard.

According to the Town of Nantucket Annual Report for fiscal year 2004-2005, a major Christmas nor'easter dumped 30 inches of snow on Nantucket and winds gusted to 110 mph. Power outages in some parts of the Town lasted four days. The main shelter was opened and 90 people sought shelter. The Landmark House was evacuated due to a loss of heat. Nantucket applied for and received a FEMA reimbursement for $123,000 toward qualified expenses.

Since the previous edition of this plan, the following winter storm events have occurred, as listed in the NCEI:

- **January 3, 2014 –** A coastal storm brought heavy snow, bitter cold, coastal flooding, and strong winds to Massachusetts. Winds on Nantucket were recorded at 26-41 miles per hour. Visibility during the storm was reduced to below a quarter mile.
- **March 26, 2014 –** A large ocean storm brought extremely strong winds and heavy snow to the Cape and Islands. Visibilities at or below one quarter mile and frequent wind gusts over 35 mph and as high as 82 mph were recorded at the peak of the blizzard conditions. The strongest winds occurred coincident with the blizzard conditions, though gustier winds lasted a couple of hours longer than the snow did. Snowfall amounts were highest on Nantucket with 8-10 inches reported. A large branch was downed onto Highland Avenue, blocking the road. Several large branches were downed on the east end of Nantucket Island. Wires were downed, resulting in 1200 customers without power. Milestone Road was blocked by multiple downed trees as well as snow drifts. $30,000 in damages occurred.
- **January 26, 2015 –** The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts coast. Gusts reached hurricane force at a few locations in Massachusetts including Nantucket (78 mph). Nantucket experienced moderate to major coastal flooding with some areas experiencing inundation in excess of 3 feet and pockets of structural damage, especially where sea walls and other protective devices were compromised. Blizzard conditions occurred at Nantucket Memorial Airport from approximately 6 am to 5 pm. Even outside this time frame, near blizzard conditions occurred with strong gusty winds and limited visibilities. Approximately a foot of snow fell on Nantucket Island. Due to power outages to most, if not all of Nantucket Island, 86 people stayed the night in the Red Cross Shelter set up at Nantucket High School.
- **February 15, 2015 –** A storm just southeast of Nantucket brought heavy snow to all of southern New England and blizzard conditions and coastal flooding to coastal areas. While blizzard conditions were met on Nantucket for a brief time (8:40am-1:10pm), near blizzard conditions continued for nearly 14 hours. Roughly nine inches of snow fell. Sustained wind speeds of 49 mph and gusts to 65 mph at the peak of the storm were recorded.
- **January 1, 2016 –** Nearly a foot of snow fell on Nantucket. Snow was difficult to measure as strong, gusty winds occurred simultaneously, resulting in blowing and drifting of snow. Winds gusted as high as 73 mph as measured by an amateur radio operator on their home weather station.
- **February 8, 2016 –** Five to six inches of snow fell across Nantucket. Blizzard conditions occurred at Nantucket from 9:20 am to 2:23 pm. Snow began prior to blizzard conditions being observed and continued after they ceased. Sustained winds of 46 mph and a wind gust of 58 mph were recorded. An amateur radio operator recorded a 65 mph wind gust at their home in the Quidnet section of Nantucket. No damage was reported.
- **January 7, 2017** – Seven to eight inches of snow fell on Nantucket during from the morning of January 7 to the early morning of January 8. Conditions briefly approached blizzard criteria between 7:25 PM and 7:34 PM.

8.4 Existing Capabilities

Flood Damage Prevention

Existing programs applicable to coastal flooding and storm surges are the same as those discussed in Sections 4.4 and 5.4. For example, the Town of Nantucket has in place a number of measures to prevent coastal flood damage including regulations, codes, and ordinances; a process for maintaining roads, bridges, and culverts at tidal creeks; a variety of structural flood control features in coastal areas of Nantucket; elevation of structures; and the use of warning systems.

Regulations, codes and ordinances that apply to flood hazard mitigation include Chapter 136 of the Nantucket Code and the accompanying Wetland Regulations; Chapter 139 of the Nantucket Code and the provisions of the Flood Hazard Overlay Zone; and the Subdivision Regulations. The pertinent components of these regulations, codes, and ordinances were listed in Section 2.8. The Conservation Commission, Planning Board, and Building Department are all charged with administering portions of these regulations during new or substantial construction. Through non-regulatory outreach programs, the Health Department educated property owners, merchants, and residents in flood zones to move critical equipment and property off the first floor, above flood elevations.

DPW tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. With regard to roads, bridges, and culverts at tidal creeks, the DPW regularly maintains Town-owned roads and facilities and upgrades/improves them as needed. For example, the Madaket Road crossings at the Head of Long Pond and Madaket Ditch were replaced with larger culverts under the direction of DPW. However, DPW does not have sufficient equipment to barricade all roadways that could potentially flood.

With regard to preexisting structures that were constructed (in part) to reduce coastal flood damage, examples include the jetties at the mouth of Nantucket Harbor and seawalls that exceed coastal base flood elevations. Bulkheads are common in the harbor area and a variety of other projects have been conducted in oceanside areas to combat erosion, but these are meant for shoreline stabilization and erosion control rather than coastal flood control.

Only a few structures in coastal flood zones have been elevated above the base flood level. Because many beachfront dwellings are located on bluffs, they do not need to be elevated.

Harbor Damage Prevention

The responsibilities of the Marine and Coastal Resources Department described in Section 5.4 are applicable to winter storms with high winds as well, although it is understood that fewer boaters utilize the waters of Nantucket during the winter. Thus, it is easier to prepare for nor'easters than tropical storms and hurricanes with regard to sending boaters back to the mainland, or removing vessels and then locating removed vessels on the island.

Snow and Ice Removal

Programs that are specific to winter storms are generally those related to preparing plows, sand and salt trucks, and other associated snow removal and response preparations. Nantucket DPW conducts snow removal and deicing on roads; and tree and tree limb removal in right-of-ways. During a significant winter storm a few years ago, DPW expenses for snow removal were approximately $300,000. Prior to forecast winter storms, DPW will dispatch equipment and personnel to outlying areas of Nantucket such as ‘Sconset and Madaket.

In recent years, the Town has begun to hire private local contractors to supplement the DPW plow fleet; this has improved snow clearing from municipal roads, but has created a backlog of private road-clearing needs that previously had been served by those same private contractors. Occasionally, if possible, the Town will solicit assistance from the Airport’s snow clearing equipment.

About half of the roads on Nantucket are private. These are normally not plowed by the DPW, nor are trees maintained by the Town. Public education for these areas is important. As an example, 30 to 40 pine trees along Russell's Way were blown down many years ago. A resident was trapped for several days. Ultimately, the Town assisted with cleanup.

Since the previous edition of the HMP, new protocols have been implemented for mitigating snow drifting on Milestone Road; snow fencing is deployed farther from the road than in the past, which has helped significantly. Milestone Road poses a particular challenge during snow events, and the Town is not always able to keep up with plowing needs.

Wind Damage Prevention

As explained in Sections 5.4 and 7.4, wind loading requirements are addressed through the Building Department's administration of building codes. The current enforceable building code is believed to be antiquated. The new building code was supposed to take effect in September 2006, and is meant to be enforceable by March 2007. The wind design codes will change from 90 mph to 120 mph, providing a much higher standard of protection against wind damage.

Emergency Services

The Water Companies have active roles in pre-disaster mitigation. Before storms, water tanks are filled and equipment is secured. Through careful preparation, fire protection and potable supply are available during and after natural disasters. Generators are located at the wellfields and pumping stations.

According to the 2013 Nantucket CEMP, the municipal responsibilities relative to winter storm mitigation and preparedness include:

- ❑ Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.

- ❑ As it is almost guaranteed that winter storms will occur annually in Massachusetts, local government bodies should give special consideration to budgeting fiscal resources with snow management in mind.
- ❑ Maintain plans for managing all winter storm emergency response activities.
- ❑ Ensure that warning/notification and communications systems are in Readiness.
- ❑ Ensure that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order.
- ❑ Review mutual aid agreements.
- ❑ Designate suitable shelters throughout the community and make their locations known to the public.
- ❑ Implement public information procedures during storm 'warning' stage.
- ❑ Prepare for possible evacuation and sheltering of some populations impacted by the storm (especially the elderly and special needs).

8.4.1 Capabilities Summary

In summary Nantucket's winter storm mitigation capabilities are similar to its hurricane mitigation capabilities, and include actions to reduce damages from flood, wind, and snow and ice. The Town enforces the state building code, supports emergency services, performs tree trimming, and maintains emergency shelters. Street and roof clearing, as well as snow-drift prevention, are essential parts of the Town's winter-storm mitigation capabilities

Nantucket's capabilities to mitigate for winter storms have strengthened since the initial HMP was adopted. The Town has made improvements to its tree limb inspection and maintenance program, the state building code has been upgraded, and the creation of the Energy Office has, and will continue to, expand local energy production capacity. Nantucket has improved its snow-drift control methods, and by increased contracting to private companies has increased its road clearing capacity.

8.5 Vulnerabilities and Risk Assessment

As mentioned for summer storms, the treed landscapes of downtown and 'Sconset, where 150-foot elm trees are commonly in close proximity to densely populated residential areas, poses problems in relation to blizzard and ice condition damage. Tree limbs may not be suited to withstand high wind and snow or ice loads. If trees fall in these areas, the proximity of structures puts them at risk for damage.

As noted in Section 8.1, drifting snow is a significant problem in nine specific areas, although it can occur anywhere:

- ❑ <u>Milestone Road along conservation lands</u> – Drifting snow is caused, in part, by the re-creation of 1,100 acres of cleared pasture conditions on the north side of the road. As noted in section 8.4, improved snow fencing protocols have mitigated some of the snow-drift problems, but bigger storms remain more difficult to control. Because Milestone Road is one of only two routes available for 'Sconset residents to reach the central part of the Nantucket, it is critical that is remain passable for important emergency access.

- Polpis Road at Golf Course – Similar to Milestone Road, drifts can affect access along Polpis Road downwind of the golf course, northwest of 'Sconset. With Polpis Road subject to drifting along with Milestone Road, 'Sconset can become completely isolated.
- Polpis Road near Pinelands
- Cliff Road west of Gosnold Road
- Eel Point Road – Damage from winter storms is particularly troublesome along Eel Point Road because electrical power to Madaket runs is along Eel Point Road instead of Madaket Road. When drifting occurs and the private section of the road can not be traversed, power outages can become difficult to fix. A recent winter storm caused a three-day loss of power in Madaket.
- Red Barn Road – Drifts in this location can block the only route for Sheep Pond Road residents to evacuate during winter storms.
- Bartlett Farm Road – Drifts in this location affect main a farm, such that overall vulnerability is low.
- West Miacomet Road at Golf Course
- Hummock Pond Road at Cemetery – This is an area where alternate routes are available for evacuation, should drifting occur. Nevertheless, the drifting snow problem is common, and this is typically DWP's third plowing priority after Milestone Road and Polpis Road.

Even without drifts, winter storms present some potentially unique transportation vulnerabilities. There is a high propensity for traffic accidents during heavy snow and even light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots, as well as the accessibility to medical and shelter facilities. Stranded motorists, especially senior and/or handicapped citizens, are at a particularly high risk during a blizzard.

Navigation hazards can occur during winter storms and cold periods. The Nantucket Harbor channel needs to be kept clear because it is the only way in and out of the harbor. One problem that is unique to Nantucket is that winter storms with prolonged cold and wind can push ice into the harbor or freeze the harbor, cutting off access to many supplies, goods, and labor that come from the mainland, such as food. Additionally, as explained in Section 2.9, fuels are delivered to the tank farm by tanker trucks arriving at the Steamship Dock and by barges that dock at the Nantucket Boat Basin Marina. Freezing of the harbor or channel can therefore stop fuel delivery to Nantucket.

Indirect effects from channel and harbor freezing can also occur. For example, ice can move channel markers. Buoys must be very secure during these conditions. Docks can become hazards during storms if they break free.

With regard to coastal flooding, the same vulnerable populations discussed in Section 4.5 and 6.5 are vulnerable to flooding caused by nor'easters. Further "flood" damage could be caused by flooding from frozen water pipes.

<u>Historic Resources</u>

Historic resources may be particularly at risk from winter storms, relative to other assets, for the following reasons:

- ❑ **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand heavy snow loads as those built more recently.
- ❑ **Age:** Buildings and materials degrade over time, and a historic property may not be able to stand up to heavy snow loads as well as it could when first constructed. Many years of freezing and thawing, in particular, may have weakened construction material.
- ❑ **Insulation/Weather Proofing:** Older buildings may be less-well insulated and weather-proofed than newer buildings. This may allow for colder temperatures to impact indoor utilities. Additionally, poorly weather-proofed buildings may be susceptible to humidity build-up within walls, leading to mold and material degradation.
- ❑ **Utilities:** Older utilities in historic buildings may not be able to hold up against cold temperatures as well as newer utilities.

Additionally, hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character.

8.5.1 Loss Estimates

The economic losses faced by the community from natural hazards can be estimated by reviewing historic, and modeling future, loss figures. It is difficult to accurately quantify losses, even after an event; therefore, a number of different sources are provided in this section. Taken together, they provide a range of possible loss estimates.

<u>Public Assistance Reimbursements</u>

Loss estimates for winter storms were generated from the value of PA grants received by Nantucket and other entities within the Town. There have been five federal disaster declarations in Nantucket since 1999 that resulted from winter storm events.

Table 8-1: Public Assistance Reimbursements for Nantucket

Disaster Number	Declaration Date	Incident Type	Incident Dates	Number of Projects	Federal Share	Total Cost
4214	04/13/2015	Winter Storm, Snowstorm, Flooding	1/26/15 to 1/29/15	4	$851,808	$1,135,743
3201	02/17/2005	Blizzard	1/22/05 to 1/23/05	2	$122,933	$163,910
3175	03/11/2003	Snow "Presidents Day Storm II"	2/17/03 to 2/18/03	2	$30,972	$41,296
					Total	**$1,340,949**

Dividing the total figure by the 18 years over which PA grant data has been tracked provides an estimate of annualized losses due to winter storms.

Annualized Loss Estimate: Winter Storms (PA-based): $74,497

<u>NCEI Storm Events Database</u>

The NCEI database of historic storm events was reviewed to determine the cost of winter events to Nantucket. Winter storm events (storms reviewed in the database were the “Blizzard,” “Heavy Snow,” “Ice Storm,” “Winter Storm,” and “Winter Weather” types) have been recorded since 1996.

According to the NCEI dataset, there have been 42 significant winter storm events on Nantucket since 1996, 4 of which caused measureable damage.

Table 8-2: NCEI Storm Events Database – Winter Storm Events Causing Property Damage

Date	Type	Estimated Property Damage
1/7/1996	Heavy Snow	$400,000
3/6/2003	Winter Storm	$20,000
2/12/2006	Winter Storm	$10,000
3/26/2014	Blizzard	$30,000
	TOTAL	**$460,000**

Dividing the total property damage from the NCEI figure by the 21 years over which that data has been tracked provides an estimate of annualized losses due to winter storms.

*Annualized Loss Estimate: Hurricane Wind (NCEI-based): **$21,905***

<u>Loss Estimates Summary</u>

Based on the loss estimates summarized above, an average expected annualized estimated loss can be calculated.

Table 8-3: Annualized Loss Estimates for Winter Storm Events

Source	Annualized Estimated Loss
Public Assistance	$74,497
NCEI	$21,905

The Nantucket EMD estimates that the cost to the police department to respond to a typical winter storm event is $1,985.

8.6 Mitigation Strategies and Action

Potential mitigation measures for storm surges and flooding caused by nor'easters include those appropriate for flooding. These were presented in Sections 3.6 and 4.6 and are not repeated herein. However, winter storm mitigation measures must also address wind, blizzard, snow, and ice hazards. These are emphasized in the following subsections. Note that natural resource protection and structural projects are generally not applicable categories of hazard mitigation for wind, blizzard, snow, and ice hazards.

8.6.1 Prevention

Cold air, snow, and ice cannot be prevented from impacting any particular area. Thus, mitigation should be focused on property protection, infrastructure protection, emergency services (discussed below), and prevention of damage to structures and utilities as caused by breakage of tree limbs.

Previous recommendations for tree limb inspections and maintenance in Sections 5.0 and 7.0 are thus applicable to winter storm hazards, as well. As recommended in the Comprehensive Community Plan and Status Chart and the Mid-Island Area Plan, utilities in Nantucket should be placed underground where possible. This could occur in connection with new development, and in connection with redevelopment or streetscape work in the downtown, mid-island, and 'Sconset areas. If utilities are underground, then heavy snow, ice, and winter winds cannot damage or destroy them.

Of all the areas with drifting snow, it is most important to address the problem of drifting snow on Milestone Road, because access between the mid-island and 'Sconset must be maintained. Conservation groups should be urged to partially restore windbreaks along Milestone Road. Furthermore, two (or more) parallel sequences of snow fencing should be placed along Milestone Road.

Preventing damage to boats, and to structures from boats that have become free, is important during nor'easters just as it would be during hurricanes and tropical storms. While it is understood that significantly fewer boats are present in the waters of Nantucket in the winter as compared to the summer, their prompt removal before storms is recommended to maximize mitigation. Thus, the Town should provide funding for additional Marine Department staff to assist with boat removal before storms, and designate official sites on land for boat storage during storm events.

Finally, it is of utmost importance to keep Nantucket Harbor open and available to the Steamship Authority and Coast Guard during long cold spells. If the harbor freezes, the Town can become cut off from its supply of food, fuels, and labor. Thus, the Town should utilize available technology and warning systems to ensure that adequate equipment is available to keep the harbor open before deep cold spells occur.

8.6.2 Property Protection

Property can be protected during winter storms through the use of shutters, storm doors, storm windows, weather stripping, and other means of keeping cold air outdoors and heat indoors. Where flat roofs are used on structures, snow removal is important as the heavy load from collecting snow may exceed the bearing capacity of the structure. Heating coils may be used to remove snow from flat roofs. Pipes should be adequately insulated to protect against freezing and bursting. All of these recommendations apply to new construction, although they may also be applied to existing buildings during renovations.

8.6.3 *Public Education and Awareness*

The public is typically more aware of the hazardous effects of snow, ice, and cold weather than they are with regard to other hazards discussed in this plan. Nevertheless, people are still stranded in automobiles, get caught outside their homes in adverse weather conditions, and suffer heart failure while shoveling during each winter in Connecticut. Public education should therefore focus on safety tips and reminders to individuals about how to prepare for cold weather.

8.6.4 *Emergency Services*

Plowing the access to and from critical facilities, such as hospitals and the shelters that were listed on Table 2-1, should be prioritized. It is recognized that this may not be a priority to all residents, as people typically expect their own roads to be cleared as soon as possible.

Of all the areas with drifting snow, it is most important to address the problem of drifting snow on Milestone Road, because access between the mid-island and 'Sconset must be maintained. Plowing should be as frequent as necessary to reduce drifting.

8.7 Recommended Actions

8.7.1 *Status of Previous Recommendations*

A suite of mitigation actions for addressing winter storms were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes.

Most of the recommendations in Sections 4.7, 5.7, and 6.7 for mitigating coastal flooding and hurricane storm surges are suitable for mitigation of coastal flooding caused by nor'easters. These are not repeated in this subsection. The actions listed here are applicable to other aspects of winter storms such as winds, snow, and ice. Note that the 2007 HMP listed recommendations relevant to high winds in both this section and sections 5.7. This update has streamlined the narrative by not repeating those actions here.

ACTION	STATUS	NOTES
Increase plowing of Milestone Road in snow drift areas.	Capability	Town has improved overall road clearing capabilities.
Urge conservation groups to restore windbreaks along Milestone Road.	Capability	Trees have been planted along road for windbreaking purposes.

ACTION	STATUS	NOTES
Continue to use two rows of snow fencing along Milestone Road.	Capability	Town installs snow fencing during the winter months, and has relocated fence line from previous years to improve effectiveness.
Utilize available technology and warning systems to ensure that adequate icebreaking equipment is available to keep Harbor open.	Capability	Maintaining harbor navigability is a top priority for the Town
Mobilize emergency equipment and personnel to Madaket village in advance of predicted nor'easters.	Carry Forward	Madaket does not have a site capable of housing personnel; replace action with "develop local capacity for housing emergency equipment and personnel in Madaket village during a storm (most likely this will be accomplished in the local fire or police branch).
Mobilize emergency equipment and personnel to 'Sconset village in advance of predicted nor'easters.	Carry Forward	'Sconset does not have a site capable of housing personnel; replace action with "develop local capacity for housing emergency equipment and personnel in 'Sconset village during a storm (most likely this will be accomplished in the local fire or police branch).

8.7.2 New Actions and Actions to Carry Forward

No new actions were developed over the course of this Plan update, however some listed in the previous Plan have been carried forward here. Carried-forward summer storm and tornado mitigation actions are listed below.

- ❑ Develop local capacity for housing emergency equipment and personnel in Madaket village during a storm, in case of isolation due to road closure.
- ❑ Develop local capacity for housing emergency equipment and personnel in 'Sconset village during a storm, in case of isolation due to road closure.

Mitigation actions that apply to all hazards are listed in Sections 2-14 and 11-1.

9 WILDFIRES

9.1 Setting

The ensuing discussion about wildfires is focused on the undeveloped wooded, shrubby, or grassland areas of Nantucket, and low-density suburban type development found at the margins of these areas known as the wildland interface. Structural fires in high-density "urban" village centers such as downtown and ‘Sconset are not covered. As a result, only some of Nantucket's localities are checked in the two wildfire columns of Table 1-5.

9.2 Hazard Assessment

The Massachusetts Hazard Mitigation Plan defines "wildfire" as a highly destructive, uncontrollable fire. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially under dry conditions. Wildfires as also known as "wildland fires."

Nationwide, humans have caused approximately 90% of all wildfires in the last decade. Accidental and negligent acts include unattended campfires, sparks, burning debris, and irresponsibly discarded cigarettes. The remaining 10% of fires are caused mostly by lightning. Nevertheless, wildfires are also a natural process, and their suppression is now recognized to have created a larger fire hazard, as live and dead vegetation accumulates in areas where fire has been prevented. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas.

Consequently, federal, state and local agencies are committed to finding ways, such as prescribed burning to reintroduce fire into natural ecosystems, while recognizing that firefighting and suppression are still important.

Massachusetts has particular vulnerability to fire hazards where urban development and wildland areas are in close proximity. The "wildland/urban interface" is where many fires are fought. The wildland areas are subject to fires because of weather conditions and fuel supply. An isolated wildland fires may not be a threat, but the combined effect of having residences, businesses, and lifelines near a wildland area causes increased risk to life and property. Thus, a fire that might have been allowed to burn itself out with a minimum of firefighting or containment in the past, must now be fought to prevent fire damage to surrounding homes and commercial areas, as well as smoke threats to health and safety in these areas.

According to the Cape Cod Emergency Preparedness Handbook, wildfire season in New England typically begins in March and ends in November. Most wildfires occur in April and May when the majority of vegetation is less green than it is after May and June.

9.3 Historic Record

According to the Massachusetts Hazard Mitigation Plan, wildfires have historically been a problem in the State. Approximately 3,000 wildfires burned more than 2,600 acres in Massachusetts during calendar year 2002. In calendar year 2003, nearly 2,000 wildfires burned over 1,600 acres.

According to the Cape Cod Emergency Preparedness Handbook, large wildfires in the Cape Cod and Islands region occurred in 1907 (the great forest fire of the Bourne-Sandwich area), 1964 (a large brush fire in South Sandwich), and 1965 (a forest fire that jumped Route 6 in Sandwich). The 1964 and 1965 fires occurred during the 1960s drought.

Although formal records of large fires on Nantucket are not available, brush fires have occurred on the island. Landfill fires can be particularly problematic. A large fire at the landfill burned for several days in 2004.

A large fire on Nantucket occurred on April 1, 2007. According to the Nantucket Inquirer and Mirror, the brush fire was caused by a prescribed burn that became uncontrollable, lasting from 10 AM until 9 PM. The total area of burn was 75 acres in the middle moors near Altar Rock, on Nantucket Conservation Foundation land (45 acres larger than the 30 planned acres of prescribed burn). The Nantucket Airport navigational beacon was in danger, but was protected by firefighters. Other critical facilities were not in danger during the wildfire.

To fight the fire, equipment was brought in from the main fire station, the 'Sconset and Madaket stations, and the Nantucket Airport. Additionally, for the first time in recent history, equipment was brought in from off-island (the Hyannis, Cotuit, Osterville-Centerville, and Yarmouth fire departments), although it arrived too late to help battle most of the fire.

The "7 Upper Tawpawshaw Road Brush Fire" occurred March 23, 2016. This 33-acre brush fire required 33 crew members, rental of 3 pieces of equipment, and repair of one piece of equipment belonging to Nantucket Memorial airport.

9.4 Existing Capabilities

Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. For example, in fiscal year 2004-2005, the Nantucket Fire Department received funding for a new wildland engine for Siasconset and a new wildland tender for the central fire station. Both will be useful for fighting wildland and structural fires on Nantucket. The Fire Department also received grants in fiscal year 2004-2005 for a new pumper, a new thermal imaging camera, education, and training.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the Nantucket Fire Department goes to the fires on the island. This proactive approach is believed to be effective for controlling wildfires.

Education is also an important element of existing mitigation. Several informational pamphlets and books are available at the front desk of the Fire Department, including "Is Your Home

Protected From Wildfire Disaster? – A Homeowner's Guide to Wildfire Retrofit." This booklet includes tips for residents to minimize risk from wildfires and escape from wildfires.

The Water Companies clearly have active roles in wildfire mitigation. Through careful preparation, fire protection and potable supply are available during and after natural disasters. The Fire Department has some of its own water storage, but relies on the water systems. All water service areas have fire protection. Fires are specifically addressed in the water system emergency plan. A forest management system is in place to protect system components. If a wildfire occurs, the pump house at Lovers Lane is soaked to prevent damage to the facility.

The land conservation organizations of Nantucket (NCF, NLC, NLB, and Mass Audubon) administer a prescribed burn program on Nantucket Island, and have to varying degrees mutual aid agreements worked out with the Town to assist if wildfire fighting. The Nantucket Fire Department also has a mutual aid agreement with Nantucket Memorial Airport, which has its own wildfire reduction program and wildfire-fighting crew and equipment responsible for protecting the airport property.

Finally, the Building Department has a role in fire mitigation as well. Fireproof roof shingles are required in 'Sconset, downtown, and mid-island areas. Although this requirement is directed primarily at preventing structural fires, it reduced wildfire potential at wildland interfaces.

9.4.1 Capabilities Summary

Nantucket mitigates wildfires primarily through expansion of fire-fighting water sources, prescribed burning and fire-break creation, and mutual aid agreements.

In 2018, the Town received a grant to complete an Island-wide Community Wildfire Protection Plan. It is expected that the plan will be completed by the end of 2019.

Nantucket's capabilities to mitigate for wildfires have strengthened since the initial HMP was adopted through improved agreements with land conservation organizations and prescribed burning programs. The Town continues to explore water service expansion.

9.5 Vulnerabilities and Risk Assessment

Overall risk of wildfires, brush fires, and the like is considered low as compared to arid, semi-arid, and mountainous regions of the United States. However, according to the Massachusetts Hazard Mitigation Plan, particular areas of the State at risk to wildfire include "the Southeastern area of Plymouth County, Cape Cod, and the Islands, where forested areas pose wildland fire and urban interface fire hazards" and "These areas include rural areas where personnel and specialized equipment to handle major fires are scarce, as well as the wildland/urban interface areas around open spaces such as federal and state parks."

Sources:
Town of Nantucket

N

Figure 9-1: Wildfire Risk Areas

MXD: U:\Y\2967-09\Maps\Fig9-1Wildfire Risk1.mxd

Town of Nantucket
Natural Hazard Mitigation Plan

LOCATION: **Nantucket, MA**

Map By:	MER
MMI#:	2967-09
Original:	3/7/2018
Revision:	9/05/2017
Scale:	1:120,000

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In general, areas with high wildfires have the following characteristics:

- History of fires
- Steep terrain
- Wooded areas within 100 feet of homes
- Individual trees within 30 feet of homes
- Public water system with hydrants is not available
- Limited access for firefighting vehicles and equipment

Three general areas of wildfire risk on Nantucket have been identified on Figure 9-1. Golf courses, cleared land, shrubby or grassy land, and areas of public water supply with fire protection are considered at low risk. Not all areas at risk for fires are highly vulnerable, due to lack of affected populations and infrastructure. The most vulnerable populations and critical facilities are those that are considered to be at the wildland interface. For example, some of the more modest homes in Nantucket have brush growing right up to the edges of the houses, creating an unsafe situation, whereas the larger, more landscaped homes do not have this problem because of expansive lawn areas that surround the homes.

The following areas are considered to be relatively vulnerable to wildfires:

- Maddequet/Eel Point Road;
- Margins of the Mid-Island Area;
- Shawkemo/Quaise;
- Inland parts of Polpis, Wauwinet, and Quidnet; and
- Margins of Tom Nevers/Southeast Quarter.

Few of the critical facilities are considered to be vulnerable. Many of the critical facilities are in areas of public water supply with fire protection, minimizing vulnerability. The transit and fuel facilities along New South Road near the airport are located in an area that is considered at risk, but the firefighting capabilities of the Town and Airport minimize the overall vulnerability. The telephone/microwave station off Eel Point Road is in an area of moderate risk, but access to the site by firefighting vehicles and equipment is adequate. Finally, the airport's navigational tower is considered to be at risk, based on the April 1, 2007 fire.

Historic Resources

Historic resources may be particularly at risk from wildfires, relative to other assets, for the following reasons:

- **Construction:** Historic buildings constructed before modern building and fire codes may not be prepared for wildfire as those built more recently. Fire suppression systems, for example, may not have been installed.
- **Material:** Historic buildings may not have incorporated fire-resistant materials into their construction.

Additionally, hazard mitigation activities may be more difficult to implement to a historic property without altering its historic character.

9.5.1 Loss Estimates

There are limited sources available to estimate losses due to wildfires on Nantucket, especially since wildfires, when they do occur on the Island, rarely impact buildings with measurable values. Taken together, the estimates below provide a range of possible loss estimates.

State Hazard Mitigation Plan

The State Hazard Mitigation Plan includes loss estimates. According to that plan, the annualized estimated loss for wildfire hazards on Nantucket is approximately $2,000.

*Annualized Loss Estimate: Wildfire (State HMP-based): **$2,000***

Municipal Reporting

According to the Nantucket EMD, the typical cost to respond to a multi-acre wildfire is $2,940.

The Nantucket Fire Department provided costs from a sample fire in 2016 ("7 Upper Tawpawshaw Road Brush Fire," 3/23/2016). This 33-acre brush fire required 33 crew members, rental of 3 pieces of equipment, and repair of one piece of equipment belonging to Nantucket Memorial airport. The total cost to the Town to respond to the fire was $14,457. Property damage was limited to open conservation land and is not included in the loss estimate. This fire was unusually large, and unusual in that it required bringing in resources from outside the Fire Department.

Loss Estimates Summary

Based on the loss estimates summarized above, the expected annualized estimated loss from a wildfire is likely around $6,500.

Table 9-1: Annualized Loss Estimates for Winter Wildfire Events

Source	Annualized Estimated Loss
State HMP	$2,000
NEMA	2,940
NFD	14,457

9.6 Mitigation Strategies and Action

Potential mitigation measures for wildfires include a mixture of prevention, education, and emergency planning. Although educational materials are available at the Fire Department building, they should be made available at the Building Department and Health Department offices as well. Education of homeowners on methods of protecting their homes is far more effective than trying to steer growth away from potential wildfire areas, especially given that the available land that is environmentally appropriate for development may be forested and located within inland areas.

Water system improvements are an important class of potential mitigation for wildfires. The following recommendations are actions water companies can take to mitigate wildfires:

- ❑ Extend the public water supply systems into areas within growth boundaries that require water for fire protection.
- ❑ Identify and upgrade those portions of the public water supply systems that are substandard from the standpoint of adequate pressure and volume for fire-fighting purposes.
- ❑ Explore innovative solutions to fire protection where it is not feasible to extend a conventional water system. This recommendation is also suited for the DPW and Fire departments.

The NCF, Nantucket Land Council, Nantucket Land Bank, and Massachusetts Audubon Society administer a prescribed burn program on Nantucket Island. Therefore, their collective staff have significant training in the handling of fires. The Nantucket Fire Department may be able to obtain assistance from these groups during brush fires or wildfires. The Fire Department should explore the possibility of formalizing a mutual aid relationship with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society. This is especially pertinent after the April 1, 2007 blaze was caused by a prescribed burn program.

Finally, utilities should be placed underground where possible. This could occur in connection with new development, and in connection with redevelopment or streetscape work in the downtown, mid-island, and 'Sconset areas. If utilities are underground, then fires cannot damage or destroy them.

9.7 Recommended Actions

9.7.1 Status of Previous Recommendations

A suite of mitigation actions for addressing wildfire mitigation were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes.

ACTION	STATUS	NOTES
Distribute copies of the booklet "Is Your Home Protected From Wildfire Disaster? – A Homeowner's Guide to Wildfire Retrofit" when developers and homeowners pick up or drop off applications in the Building Department and Health Department.	Capability	This is now a capability
Extend the public water supply systems into areas within reasonable growth boundaries that may benefit from water for fire protection.	Carry Forward	Town has extended water supply, but is interested in continuing to do so. Carry forward action as "develop strategic firefighting-water supply improvement plan to prioritize and guide future water system expansion and alternate firefighting water solution development"

ACTION	STATUS	NOTES
Identify and upgrade those portions of the public water supply systems that are substandard from the standpoint of adequate pressure and volume for fire-fighting purposes.	Capability	Ongoing part of Fire Department and DPW operations
Explore alternate solutions to fire protection where it is not feasible to extend a conventional water system.	Carry Forward	This action is partially complete; for example, two to the Tankers have had their water capacity increased. There continue to be issues in certain areas due to access and water sources. Carry forward action as “develop strategic firefighting-water supply improvement plan to prioritize and guide future water system expansion and alternate firefighting water solution development” Actions may include: - Construct dry-wells - Improve emergency access to freshwater ponds - Construct underground water tanks - Construct aboveground water tanks
Develop fire ponds in vulnerable areas without public water systems.	Carry Forward	This action is partially complete; water sources are available in some areas, but access continues to be an issue. Carry forward action but revise as noted in previous action, above.
Develop a mutual aid relationship with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.	Carry Forward	Action is underway. Fire Department & Nantucket Land Bank are developing a formal Memorandum of Understanding for assistance in large area wildland fires.
Locate utilities underground wherever it is feasible.	Capability	See Section 5.7

9.7.2 *New Actions and Actions to Carry Forward*

New actions were developed over the course of this Plan update; along with the actions being carried forward from the previous HMP, recommended wildfire mitigation actions to implement are listed below.

- ❑ Complete the Community Wildfire Protection Plan
- ❑ Complete mutual aid agreement with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.

Important recommendations that apply to all hazards are listed in Sections 2-14 and 11-1.

10 EARTHQUAKES

10.1 Setting

The entire Town of Nantucket is susceptible to earthquakes. As a result, all of Nantucket's localities are checked in the "shaking" column of Table 1-5. However, even though earthquakes have the potential to occur anywhere in the Town of Nantucket, the effects may be felt differently in some areas based on the type of geology.

10.2 Hazard Assessment

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and phone lines, and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time without warning.

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. The magnitude and intensity of an earthquake is determined by the use of the Richter scale and the Mercalli scale, respectively.

The Richter scale defines the magnitude of an earthquake. Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The magnitude of an earthquake is determined from the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called micro-earthquakes, and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

The effect of an earthquake on the Earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects.

The following is an abbreviated description of the 12 levels of Modified Mercalli intensity from the United States Geologic Survey:

I. Not felt except by a very few under especially favorable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.

IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rail bent.

XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are destroyed. Object thrown in the air.

Some earthquakes in Massachusetts are not associated with specific known faults, as opposed to seismic activity in California. Many earthquakes with epicenters in Massachusetts are referred to as intra-plate activity. Bedrock in Massachusetts, and New England in general, is highly capable of transmitting seismic energy; thus, the area impacted by an earthquake in Massachusetts can be four to 40 times greater than that of California.

Some earthquakes in Massachusetts occur at fault intersections along northwest-trending faults (Barosh, 1990). A zone of northwest-trending faults across New Hampshire extends offshore east of Boston through the epicenter of the 1755 Cape Ann earthquake. Such faults are believed to be related to the transform faults in the North Atlantic Basin and apparently are due to its continued expansion. The Cape Ann quake had an apparent Intensity of VIII, an estimated magnitude of 5.8, and is the largest recorded for the northeastern U.S. (Woodhouse and Barosh, 1991).

Liquefaction is defined as the transformation of water-saturated granular material from the solid state to a liquid state. Earthquake-induced ground motion can cause the ground to flow and/or lose its strength. Fill material has a much higher potential for liquefaction as compared to other surficial materials.

10.3 Historic Record

According to the USGS Earthquake Hazards Program, Massachusetts is a region of very minor seismic activity. This assessment is based on lack of historical and instrumental reports of strong earthquakes. However, earthquakes do occur in this region, and Connecticut, Rhode Island, Massachusetts, and New Hampshire regularly register seismic events.

According to the Massachusetts Natural Hazard Mitigation Plan, of the 4,738 earthquakes recorded in the Northeast Earthquake Catalog through 1989, 1,215 occurred within the boundaries of the six New England States, and 316 earthquakes were recorded in Massachusetts between 1627 and 1989. Between 1924 and 1989, there have been 96 earthquakes in the Northeast with a magnitude of 4.5 or greater on the Richter scale. Out of these 96 earthquakes, eight were within the six New England States and the other 88 within New York State or the Province of Quebec. Many of these earthquakes were so strong that they were felt throughout New England.

A good accounting of Massachusetts earthquakes is provided in the Earthquake Information Bulletin (1973, von Hake). The initial settlers of the early 17th century compiled the extensive historical accounts that are now available. Strong earthquakes in the St. Lawrence Valley in 1638, 1661, 1663, and 1732 were felt in Massachusetts. The 1638 and 1663 shocks damaged chimneys at Plymouth, Salem, and Lynn. On June 11, 1643, Newbury, Massachusetts, was strongly shaken. In 1727 an earthquake described as "tremendous" in one report and "violent" in another caused much damage at Newbury. The shock was felt from the Kennebec River to the Delaware River and from ships at sea to the extreme western settlements. Several strong aftershocks were reported through the next year.

Eastern Massachusetts was shaken moderately on February 17, 1737, and June 24, 1741. Then on June 14, 1744, large numbers of bricks were shaken from tops of chimneys at Boston and other towns and stone walls were shaken down. The earthquake was reportedly felt at Falmouth, Maine.

On November 18, 1755, one of the most significant earthquakes in the northeastern region occurred off Cape Ann. At Boston, walls and chimneys were thrown down and stone fences were knocked down (intensity VIII, Modified Mercalli scale). Some descriptions mentioned violent movement of the ground, like waves of the sea, making it necessary to cling to something to prevent being thrown to the ground. At Pembroke and Scituate, small chasms opened in the earth through which fine sand reached the surface. Large numbers of fish were killed and many people on vessels felt shocks as if the ships were striking bottom. This earthquake was felt from

Lake George, New York, to a point at sea 200 miles east of Cape Ann, and from Chesapeake Bay to the Annapolis River, Nova Scotia, about 300,000 square miles.

Little information is known about an earthquake that occurred on October 5, 1817. Walls were reported thrown down at Woburn, but additional details are lacking. Moderate earthquakes in 1847, 1852, 1854, 1876, 1880, 1903, 1907, 1925, 1940, and 1963 were felt over limited areas of eastern Massachusetts. The epicenter of the 1925 shock was located off Cape Ann; the quake was reportedly felt from Providence to Kennebunk, Maine. The residents of Nantucket were jolted by a moderate earthquake on October 24, 1965; very slight damage was reported, doors, windows, and dishes rattled, and house timbers creaked. A magnitude 5.8 earthquake occurred 38 miles from Richmond, Virginia on August 23, 2011. The quake was felt from Georgia to Maine and reportedly as far west as Chicago. Residents of Massachusetts reported experiencing swaying during the earthquake although widespread damage was constrained to an area from central Virginia to southern Maryland. According to Cornell University, the August 23 quake was the largest event to occur in the east central United States since instrumental recordings have been available to seismologists. In April 2012, an earthquake swarm occurred on the continental shelf about 250 miles east of Boston; the largest earthquake measured 4.4 on the Richter scale.

10.4 Existing Capabilities

According to the 2013 Nantucket CEMP, the municipal responsibilities relative to earthquake mitigation and preparedness include:

- Community leaders in cooperation with Emergency Management Personnel should obtain local geological information and identify and assess structures and land areas that are especially vulnerable to earthquake impact and define methods to minimize the risk.
- Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
- Periodic evaluation, repair, and/or improvement should be made to older public structures.
- Emergency earthquake public information and instructions should be developed and disseminated.
- Earthquake drills should be held in schools, businesses, special care facilities, and other public gathering places.
- Earthquake response plans should be maintained and ready for immediate use.
- All equipment, supplies and facilities that would be needed for management of an earthquake occurrence should be maintained for readiness.
- Emergency Management personnel should receive periodic training in earthquake response.
- If the designated EOC is in a building that would probably not withstand earthquake impact, another building should be chosen for an earthquake EOC.
- Mass Care shelters for earthquake victims should be pre-designated in structures that would be most likely to withstand earthquake impact see the Resource Manual for Mass Care Shelters.

- It is assumed that all special needs facilities could be impacted to some extent by earthquake effects therefore preparedness measures should be in place to address the needs of all special needs facilities listed in the resource manual section of this plan.
- Most likely the entire population of the community will be affected by a seismic event. Estimate the maximum peak population affected, considering peak tourism, special event populations and work hours.

Structural requirements for earthquake damage mitigation are addressed through the Building Department's administration of the Massachusetts State Building Codes. The current enforceable building code, edition nine, was made effective October 20, 2017.

Earthquakes are specifically addressed in the Water Company's water system emergency plans. The main Wannacomet water system storage tank is designed to withstand earthquakes.

10.4.1 Capabilities Summary

Nantucket mitigates earthquakes through response training, utility reinforcement, and maintenance of sufficient sheltering capacity. Nantucket's geology makes the risk of a significant earthquake occurring on the Island very low, and its building stock of almost entirely wood-frame structures makes its vulnerability very low as well. The reality of the Town being an Island, and thus easily isolated from the mainland, has led the Town to be well-prepared for isolating events. All of these factors together mean that Nantucket is considered to have sufficient mitigation capabilities for an earthquake event.

10.5 Vulnerabilities and Risk Assessment

According to the Massachusetts Hazard Mitigation Plan, Nantucket is within the area of lowest risk for earthquakes in the State. The highest risk lies in northeast Massachusetts. The potential for a damaging earthquake to occur in Nantucket in any given year is low.

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can amplify the shaking associated with an earthquake. In addition, artificial fill material has the potential for liquefaction. Increased shaking and liquefaction can cause greater damage to buildings and structures, and a greater loss of life.

Figure 2-5 depicts surficial geology of Nantucket. All of Nantucket is underlain by glacial silts, sand, and gravel. Bedrock is more than 1,000 feet below the surface. The areas of outwash deposits are slightly more susceptible to shaking than moraines. Nevertheless, according to the Massachusetts Hazard Mitigation Plan, the peak ground acceleration on Nantucket that could occur with a 2% probability in 50 years is on the order of 0.06 g (force of gravity), among the lowest in the State. Additionally, because none of the Town is built on fill material, structures are not at increased risk due to amplification of seismic energy and liquefaction.

Another factor that limits the vulnerability of Nantucket structures to earthquakes is that wood frame construction is preferred to masonry. Although some historic buildings in the downtown area are masonry, most of the structures in Nantucket are not. Interestingly, of all the critical facilities, the Fire Station, Police Station, and the municipal building at 16 Broad Street are most vulnerable due to their masonry construction. However, the low likelihood of earthquake occurrence and the anticipated low intensity reduce any cause for alarm that these facilities would not be available after an earthquake event.

Historic Resources

Historic resources may be particularly at risk from hurricane winds, relative to other assets, for the following reasons:

- ❑ **Construction:** Historic buildings constructed before modern building codes may not be as able to withstand earthquakes as those built more recently.
- ❑ **Material:** As noted above, masonry buildings are more susceptible to earthquake damage than wood-frame buildings. Many of the historic buildings in the downtown area are of masonry construction and therefore vulnerable. On the other hand, the majority of historic resources on Nantucket are wood frame and so at relatively low-risk of earthquake damage.

10.5.1 Loss Estimates

Given their infrequency, there are limited sources available to estimate losses due to earthquakes on Nantucket.

State Hazard Mitigation Plan

The State Hazard Mitigation Plan includes loss estimates for earthquakes, calculated using HAZUS-MH software. According to that plan, the annualized estimated loss for earthquake hazards on Nantucket is approximately $40,802. This is only source of loss estimates for earthquakes.

Annualized Loss Estimate: Earthquake (State HMP-based): ***$40,802***

10.6 Mitigation Strategies and Action

Because earthquakes cannot be predicted and can affect the entire Town of Nantucket, potential mitigation can only include adherence to building codes, education of residents, and adequate planning. The following potential mitigation measures have been identified:

- ❑ Continue to promote wood construction.
- ❑ Require adherence to the amended, updated Massachusetts Building Code.
- ❑ Ensure that employees of the Fire Department, Police Department, and 16 Broad Street building know how to evacuate in case of an earthquake.
- ❑ Ensure that municipal departments that are housed in masonry buildings have adequate backup facilities to utilize if damage occurs.
- ❑ Activities to build public awareness and education

10.7 Recommended Actions

10.7.1 Status of Previous Recommendations

A suite of mitigation actions for addressing earthquakes were proposed in the previous edition of this HMP. Each action is listed in the table below, along with its status and additional notes.

ACTION	STATUS	NOTES
Continue to promote wood construction.	Capability	
Require adherence to the amended, updated Massachusetts Building Code.	Capability	
Ensure that employees of the Fire Department, Police Department, and 16 Broad Street building know how to evacuate in case of an earthquake.	Carry Forward	Police Department has been relocated. This action has not been sufficiently addressed at this point, and will be carried forward.
Ensure that municipal departments that are housed in masonry buildings have adequate backup facilities to utilize if damage occurs.	Carry Forward	New facility at 4 Fairgrounds Road has improved capacity to maintain operations following a damaging earthquake event. Several additional departments would like to have the earthquake vulnerability of their offices addressed. Carry forward action as "perform study of critical facility structures to determine vulnerability to earthquakes." At a future date, this study can inform upgrades or relocations.

10.7.2 New Actions and Actions to Carry Forward

New actions were developed over the course of this Plan update; along with the actions being carried forward from the previous HMP, recommended earthquake mitigation actions to implement are listed below.

- ❑ Ensure that employees of the Fire Department, Police Department, and 16 Broad Street building know how to evacuate in case of an earthquake.
- ❑ Perform study of critical facility structures to determine vulnerability to earthquakes

Important recommendations that apply to all hazards are listed in Sections 2-14 and 11-1.

11 SUMMARY OF HAZARD MITIGATION ACTIONS

11.1 Hazard Mitigation Actions Applicable to Multiple Hazards

Some recommendations are applicable to all hazards, because they address improving public safety and planning for emergency response. Actions related to the institutional capabilities of the Town (such as municipal planning documents) are listed in Section 2.14. Other recommendations that apply to multiple hazards but have not been addressed in previous sections are listed below.

11.1.1 Status of Previous Recommendations

Mitigation actions applicable to all hazards that were proposed in the previous edition of this HMP are listed in the table below, along with their statuses and additional notes.

ACTION	STATUS	NOTES
Move forward with plans to develop the 2 Fairgrounds Road property such that it will include a combined Fire/Police facility with an emergency operations center (thus removing the Police facility from the coastal flood zone and providing additional space for the Fire Department).	Complete	New facility constructed at 4 Fairgrounds Road to serve as Police Station with EOC. Fire Station will be relocated to 4 Fairgrounds Road site sometime in 2019.
Move forward with plans to develop the 2 Fairgrounds Road property such that it will include a fully-equipped secondary shelter as a backup to the High School.	Complete	Achieved at 4 Fairgrounds Road facility; additionally, shelter reviews are conducted periodically.
While the improvements at the 2 Fairgrounds Road property are pending, study the feasibility and cost-effectiveness of central dispatching for fire and police services to increase the effectiveness of response and better coordinate provision of emergency services.	Complete	4 Fairgrounds Road Facility contains central dispatching for Island emergency services.
Establish central dispatching if found to be feasible and cost-effective.	Complete	4 Fairgrounds Road Facility contains central dispatching for Island emergency services.
Evaluate the equipment, training, and personnel needs of the Fire and Police Departments as Townwide population increases.	Capability	Ongoing effort as part of standard operations.
Seek more housing for seasonal police staff.	Drop	This action is not considered to be within the scope of this Plan
Evaluate private roads to determine where essential improvements are necessary to provide adequate access for emergency services.	Drop	The Town's approach to private roads Is to avoid maintenance and require private road owners to utilize the existing formal process for requesting that the Town accept private roads. The Master Plan's Area Plan annexes include actions to review, consolidate, and improve as necessary local "paper roads."

ACTION	STATUS	NOTES
Formalize agreements for roadway maintenance with private road owners.	Drop	The Town's approach to private roads Is to avoid maintenance and require private road owners to utilize the existing formal process for requesting that the Town accept private roads
Consider the dedication of some private roads as public roads or the formal negotiation of either public or private maintenance agreements.	Drop	The Town's approach to private roads Is to avoid maintenance and require private road owners to utilize the existing formal process for requesting that the Town accept private roads
Identify private roads to be acquired as public roads for safety of residents. These roads shall include private through roads that interconnect two or more public roads, and major collector roads that are principal or exclusive access roads to neighborhoods with substantial populations.	Drop	The Town's approach to private roads Is to avoid maintenance and require private road owners to utilize the existing formal process for requesting that the Town accept private roads. The Master Plan's Area Plan annexes include actions to review, consolidate, and improve as necessary local "paper roads."
Develop and adopt a minimum standard of road improvement to be utilized for public safety. This may be paved or unpaved depending on other objectives related to drainage and infiltration, but design should be consistent.	Complete	Planning Board and Fire Department review roadways
Enforce existing private road maintenance agreements that were required by the Town.	Drop	Enforcement is not needed
Ensure that new subdivisions with private roads have designated homeowners associations to provide maintenance that is adequate for public safety.	Capability	This is reclassified as a capability. The private roads of Tom Nevers serve as a good example.
Identify actions that 'Sconset and Madaket residents can take in advance to be prepared if a disaster should hit that would isolate either village. This may include training residents in first aid, ensuring that a local command center is designated, and providing for reliable communications.	Complete	This is now a capability
Develop village evacuation plans for 'Sconset, Madaket, and the downtown/Brant Point areas.	Drop	Townwide evacuation protocols are considered to be sufficient.
Conduct Emergency Preparedness Seminars for 'Sconset and Madaket residents.	Complete	This is now a capability
Develop an alternate access route to Madaket via Eel Point Road and Warren's Landing Road for emergency use.	Carry Forward	Town is aware of this route for emergency access. Revise action to "Develop maintenance plan to ensure Eel Point Road/Warren Road emergency access route is capable of passing emergency vehicles during an event."
Improvements in the Mid-Island Area should include enhancing traffic flow, increasing safety, and enhancing emergency access.	Complete	This is a requirement of the Mid-Island Area plan, and implemented as improvements are made.

ACTION	STATUS	NOTES
Reconstruct the Milestone Rotary as a modern roundabout.	Complete	This has been completed
Purchase additional portable emergency generators for use at any critical facilities.	Capability	The Town continually seeks to supplement and improve its emergency power generation capabilities. Since the previous HMP; - The Fire Department acquired 2 generators through a governments surplus program (operation is handled by NEMA) - Numerous generators were obtained for wastewater pumping stations - The new Nantucket Intermediate School has a generator - USACE pre-staged generator program allows for quick replacement in case of generator failure at a shelter

11.1.2 New Actions and actions to Carry Forward

Actions being carried forward from the list above are:

- ❑ Identify potential alternative access routes to Madaket via Eel Point Rd & Warren's Landing; and develop a maintenance plan to ensure Eel Point Road/Warren Road emergency access route is capable of passing emergency vehicles during an event.

New actions identified over the course of plan development, and not yet addressed in this plan, are:

- ❑ Obtain necessary radios and chargers for DPW staff and equipment to operate efficiently during town-wide emergencies
- ❑ Provide Incident Command System training to essential staff
- ❑ Develop a Nantucket Electric Supply Resilience Plan with National Grid that enhances information sharing, coordinates major projects and improvements, protects against major events, and integrates resilience into planning, investments and decision making.
- ❑ Develop and adopt a minimum standard of road improvements and maintenance that supports emergency use and public safety
- ❑ Improve the capabilities of personnel to search and obtain electronic project plans and records for major and critical infrastructure and systems. This includes completing the on-line GIS, deploying accurate location referencing, integrating files across departments, and implementing electronic document management along with scanning all project records. (Lesson learned from the emergency in 2018 and needs for information to locate and perform sewer force main repairs)
- ❑ Identify the needs for emergency materials (gravel, large blocks, pipe, etc.) that are essential to repair and reopen roadways damaged by flooding. Through cooperative

agreement with on-Island suppliers, and/or having inventory stocked at DPW, maintain this supply for emergency use.

- Develop a public outreach program that target public school teachers and students (K-12) and works to add appropriate climate science, sea level rise, hazard mitigation and coastal resilience planning to the curriculum.

11.2 Priority Recommendations

To prioritize recommended mitigation measures, it is necessary to determine how effective each measure will be in reducing or preventing damage. A set of criteria commonly used by public administration officials and planners was applied to each proposed strategy. The method, called STAPLEE, is outlined in FEMA planning documents such as Developing the Mitigation Plan (FEMA 386-3) and Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic, and Environmental" criteria for making planning decisions. The following questions were asked about the proposed mitigation strategies:

- **Social:**
  - Benefits: Is the proposed strategy socially acceptable to the community?
  - Costs: Are there any equity issues involved that would mean that one segment of Nantucket could be treated unfairly? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower-income people? Is the action compatible with present and future community values?
- **Technical:**
  - Benefits: Will the proposed strategy work? Will it reduce losses in the long term with minimal secondary impacts?
  - Costs: Is the action technically feasible? Will it create more problems than it will solve? Does it solve the problem or only a symptom?
- **Administrative:**
  - Benefits: Does the project make it easier for the community to administrate future mitigation or emergency response actions?
  - Costs: Does the community have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the community perform the necessary maintenance? Can the project be accomplished in a timely manner?
- **Political:**
  - Benefits: Is the strategy politically beneficial? Is there public support both to implement and maintain the project? Is there a local champion willing to see the project to completion? Can the mitigation objectives be accomplished at the lowest cost to the community (grants, etc.)?

- Costs: Have political leaders participated in the planning process? Do project stakeholders support the project enough to ensure success? Have the stakeholders been offered the opportunity to participate in the planning process?

- ❑ **Legal:**
  - Benefits: Is there a technical, scientific, or legal basis for the mitigation action? Are the proper laws, ordinances, and resolutions in place to implement the action?
  - Costs: Does the municipality have the authority to implement the proposed action? Are there any potential legal consequences? Will the municipality be liable for the actions or support of actions, or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

- ❑ **Economic:**
  - Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals, such as capital improvements or economic development?
  - Costs: Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? What proposed actions should be considered but be tabled for implementation until outside sources of funding are available?

- ❑ **Environmental:**
  - Benefits: Will this action beneficially affect the environment (land, water, endangered species)?
  - Costs: Will this action comply with local, state, and federal environmental laws and regulations? Is the action consistent with community environmental goals?

Each proposed mitigation strategy was evaluated and quantitatively assigned a score based on the above criteria, as outlined below:

- ❑ Benefits: a score of "1" was assigned if the project will have a beneficial effect for that particular criterion, or a "0" if the project would have a negligible effect or if the questions were not applicable to the strategy.

- ❑ Costs: a score of "-1" was assigned if the project would have an unfavorable impact for that particular criterion, or a "0" if the project would have a negligible impact or if the questions were not applicable to the strategy.

- ❑ Technical and Economic criteria were double weighted (multiplied by two) in the final sum of scores.

- ❑ The total benefit score and cost score for each mitigation strategy was summed to determine each strategy's final STAPLEE score.

An evaluation matrix with the total scores from each strategy can be found as Appendix A. After each strategy was evaluated[8], it was possible to prioritize them according to the final scores. Higher scores were determined to be of more importance economically, socially, environmentally and politically and were prioritized over those with lower scoring.

The following recommendations were identified by the project team as the highest priority projects and/or policies.

Action Code	Strategy	Hazards Mitigated						
		Inland Flood	Coastal Flood	Hurricane	Summer	Winter Storm	Wildfire	Earthquake
SC1	Complete the Community/Coastal Resilience Plan and Become an MVP Community	X	X	X	X	X	X	X
F10	Participate in a limited public-private partnership with Nantucket Engineering & Survey to complete a study of the Fulling Mill Brook watershed, in particular the hydrologic conditions at Polpis Road, to identify alternatives for improvements to this area.	X	X	X	X	X		
WF2	Complete mutual aid agreement with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.						X	
A5	Review the Nantucket Intermediate School and the Elementary School and determining their abilities to serve as emergency shelters.	X	X	X	X	X	X	X
A10	Conduct a targeted hazard vulnerability assessment of historic structures, and offer technical assistance to property owners.	X	X	X	X	X	X	X
F6	Develop a comprehensive storm water management plan that addresses needs and priorities to reduce flooding and improve drainage. Include a funding model and possible revenue sources to sustain ongoing maintenance and capital improvements. The Plan should review policy and regulations that govern the discharge of water into the Town's ROW and those that have direct connection to the Town's storm drainage system. The rising sea level and water table is leading to more sump pumps discharging into the drains or on the roadway.	X	X	X	X	X		
F19	Relocate important hard-copies of Town records (including Finance Department records and Health Department records) to a new storage location outside of the SFHA (currently located on Washington Street)	X	X					
F25	Develop a protocol or formal Standard Operating Procedure for opening and closing of the tide gate at Children's Beach boat ramp. Work with local citizens to make sure they are aware of the protocol.		X					
WS1	Develop local capacity for housing emergency equipment and personnel in Madaket village during a storm, in case of isolation due to road closure.			X	X	X		

[8] The STAPLEE evaluation was performed by the consultant (Milone & MacBroom, Inc) based on FEMA guidance (including FEMA-386-9, *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*, 2008, and FEMA 386-5, *Using Benefit-Cost Review in Mitigation Planning*, 2007) as well as information collected during meetings with Nantucket officials.

It is important to note that actions with higher STAPLEE priorities do not necessarily need to be completed before actions with lower STAPLEE priorities; additionally, as progress on a given project is made, the Town may find that the scores given to certain factors (such as estimated costs, or environmental impacts) may change.

Discussion of Benefit-Cost Ratio

Although a community may implement recommendations as prioritized by the STAPLEE method, an additional consideration is important for those recommendations that may be funded under the FEMA mitigation grant programs. To receive federal funding, the mitigation action must have a benefit-cost ratio (BCR) that exceeds a value of 1.0. Calculation of the BCR is conducted using FEMA's Benefit Cost Analysis (BCA) toolkit (https://www.fema.gov/benefit-cost-analysis). The calculation method may be complex and vary with the mitigation action of interest. Calculations are dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

Although it is beyond the scope of this Plan to develop precise BCRs for each recommendation, general cost ranges are estimated for each recommendation presented in Appendix A. When pursuing grants for selected projects, this information, along with the STAPLEE evaluation of benefits and costs, can be used to help select the projects that have the greatest chance of successfully navigating through the application review process.

11.3 Specific Sources of Funding

The following sources of funding and technical assistance may be available for the priority projects listed above. Funding requirements and contact information are provided in Section 12.0.

Beach Replenishment and Erosion Control

- ❑ U. S. Army Corps of Engineers – *funding for beach nourishment*.
- ❑ U.S. Department of Agriculture – *technical assistance for erosion control.*
- ❑ U.S. Fish and Wildlife National Coastal Wetlands Conservation Grant Program - *matching funds at the State level for projects that conserve, restore, and protect coastal wetlands. Nationally competitive.*
- ❑ North American Wetlands Conservation Act Grants Program – *funding for projects that support long term wetlands acquisition, restoration, and/or enhancement. Requires a 1-to-1 funds match.*

Flood Mitigation

- ❑ FEMA Flood Mitigation Assistance Program (FMA) – *grants for pre-disaster flood hazard mitigation planning and projects such as property acquisition, relocation of residents, and flood retrofitting.*
- ❑ U.S. Army Corps of Engineers – 50*/50 match funding for floodproofing and flood preparedness projects.*

- U.S. Department of Agriculture – *financial assistance to reduce flood damage in small watersheds and to improve water quality.*

Hurricane Mitigation

- FEMA State Hurricane Program - financial and technical assistance to local governments to support mitigation of hurricanes and coastal storms.
- FEMA Hurricane Program Property Protection – grants to hurricane prone states to implement hurricane mitigation projects.

Wildfire Mitigation

- Assistance to Firefighters Grant Program – pre-disaster grants to organizations such as fire departments that are recognized for expertise is fire prevention and safety programs.

General Hazard Mitigation

- FEMA Hazard Mitigation Grant Program (HMGP) – funding for hazard mitigation projects following a presidentially-declared disaster.
- FEMA Pre-Disaster Mitigation Grant Program (PDM) – funding for hazard mitigation projects on a nationally competitive basis.
- Massachusetts Land Acquisition & Conservation Program – funding for open space acquisition.
- Americorps – teams may be available to assist with landscaping projects such as surveying, tree planting, restoration, construction, and environmental education.

12 PLAN IMPLEMENTATION

12.1 Summary of Nantucket's Action Items

The HMP represents actions and priorities that should be considered for implementation in the following five years (2019 to 2023). When developing suite of hazard mitigation strategies and actions described in the previous sections of this Plan and summarized in Appendix A, the following specific concerns and interests were considered:

- **Access to the Mainland:** Ensuring continued access to the mainland following hazard event is a high priority for Nantucket
- **Isolation Within the Island:** Many roads on Nantucket are threatened by erosion or inundation, which would lead to isolation of neighborhoods.
- **Historic Resources:** Historic resources present unique challenges with regards to hazard mitigation due in part to the impacts that many mitigation actions would have on their historic characters.
- **Power Supply Resiliency:** The Town is pursuing a range of initiatives aimed at increasing the Island's capacity to generate and store electricity on-island using renewable energy technologies.
- **Water Supply Resiliency**: The water company uses resilience planning to address vulnerabilities. Additional resiliency measures are being planned to protect the aquifer and well head locations from contamination due to a hazardous material spill and pollution.
- **Climate Change:** As an island community, Nantucket recognizes the present and future effects that climate change will have on the Town, including sea level rise and the increased severity and frequency of coastal flooding, erosion, high wind events, precipitation events, and droughts.
- **Evaluation of the Storm Water Pump System:** Operational and performance issues have been recorded with the Children's Beach storm water system. In June 2018, DPW hired an engineering firm to review this system and provide recommendations for improvements.
- **Children's Beach Boat Ramp:** An improved protocol or formal Standard Operating Procedure should be considered for opening and closing of the tide gate at Children's Beach boat ramp.
- **Roadbed Construction Material for Emergency Use:** The Town may consider having selected types and quantities of construction materials stored at the DPW yard and reserved for emergency use.
- **Sanitary Sewer Collection System:** The Town of Nantucket is required to complete a Capacity, Management, Operation and Maintenance (CMOM) Program for its Sanitary Sewer Collection System for the Town Sewer District and Siasconset Sewer District.

Strategies have been developed to mitigate each of the natural hazards addressed in this plan, with additional strategies intended to improve the community's hazard mitigation capabilities without addressing any one specific hazard. Strategies were evaluated using the FEMA-developed

STAPLEE method, described in Section 11.2. A table summarizing all strategies and actions to be pursued in the next five years is included as Appendix A.

12.2 Implementation Strategy and Schedule

The Nantucket Planning & Land Use Services Office (PLUS) will be responsible for coordinating adoption of this HMP by the Town's Select Board. The Town understands that this plan will be considered current for five years from the date that it is adopted and may be updated as often as needed.

Individual mitigation actions will be implemented by the Town departments that oversee these activities. The STAPLEE matrix in Appendix A outlines current mitigation actions and responsible departments. An implementation schedule is also identified for each action; thus, both the responsible department and the anticipated time frame for completing each mitigation action, if funding is available, is listed in the STAPLEE matrix.

Upon adoption this HMP will be available as a planning tool to be used in conjunction with existing documents and regulations. It is expected that revisions to other community plans and regulations such as the Master Plan, department annual budgets, and Zoning and Subdivision Regulations may reference this plan and its updates. The local coordinator will be responsible for ensuring that the actions identified in each annex are incorporated into other planning activities.

12.3 Progress Monitoring and Public Participation

The Nantucket PLUS, with assistance from the Nantucket Emergency Management Agency, will administer this HMP under the authority of the Select Board. Holly Backus, Land Use Specialist at PLUS, will be the Local Coordinator of the Hazard Mitigation Plan, and the Chief of Police and Emergency Management Director (a single position) will be the deputy Local Coordinator. PLUS will coordinate with responsible departments and ensure that the recommendations of this HMP are considered or enacted.

The local coordinator and deputy local coordinator will be responsible for monitoring the successful implementation of this HMP, and will provide the linkage between the multiple departments involved in hazard mitigation at the local level relative to communication and participation. Coordination is expected to be able to occur without significant barriers.

Site reconnaissance for Specific Recommendations – The local coordinator, with the assistance of appropriate department personnel, will annually perform reconnaissance-level inspections of sites that are subject to specific recommendations. This will ensure that these recommendations remain viable and appropriate. Examples include home acquisitions or elevations, structural projects such as culvert replacements, roadway elevations in coastal areas, and water main extensions for increased fire suppression capabilities. The worksheet in Appendix E will be filled out for specific project-related recommendations.

The local coordinator will be responsible for obtaining a current list of repetitive loss properties (RLPs) in the community each year. The RLPs shall be subject to a windshield survey at least once every two years to ensure that the list is reasonably accurate relative to addresses and other basic information. Some of the reconnaissance-level inspections could occur incidentally during events such as flooding when response is underway.

Annual Reporting and Meeting – the local coordinator will be responsible for having an annual meeting to review the plan. Participants in this review should include officials or staff of the Department of Public Works, Building Department, Health Department, Planning Department, Conservation Commission, Selectman's Office, Marine & Coastal Resources Department, Wannacomet Water Company, and the Nantucket Airport.

Matters to be reviewed on an annual basis include the goals and objectives of the HMP, hazards or disasters that occurred during the preceding year, mitigation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and recommendations for new projects and revised activities. Results of site reconnaissance efforts will be reviewed also. A meeting should be conducted in spring each year, at least two months before the annual application cycle for pre-disaster grants under the HMA program[9]. This will enable a list of possible projects to be circulated to applicable local departments to review and provide sufficient time to develop a grant application. The local coordinator shall prepare and maintain documentation and minutes of this annual review meeting.

Post-Disaster Reporting and Metering – Subsequent to federally declared disasters in the Commonwealth of Massachusetts, a meeting shall be conducted by the local coordinator and representatives of appropriate departments to develop a list of possible projects for developing an HMGP application. The local coordinator shall prepare a report of the recent events and ongoing or recent mitigation activities for discussion and review at the HMGP meeting. Public outreach shall be solicited for HMGP applications at a *separate* public meeting.

Continued Public Involvement – Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the HMP. Public input can be solicited through community meetings, presentations on local cable access channels, and input to web-based information gathering tools. Public comment on changes to the HMP may be sought through posting of public notices and notifications posted on the Nantucket website.

12.4 Updating the Plan

Updates to this HMP will be coordinated by the Planning & Land Use Services (PLUS) Department. Nantucket will update this Plan if a consensus to do so is reached at any of the annual meetings, but not less frequently than every five years. The Town understands that this HMP will be considered current for a period of 5 years from the date of approval with the expiration date

[9] PDM and FMA applications are typically due to MEMA in October of any given year.

reported by FEMA via the approval letter. The local coordinator will be responsible for compiling the funding required to update the HMP in a timely manner such that the current Plan will not expire while the update is being developed.

Table 12-1: Schedule for Hazard Mitigation Plan Update

Month and Year	Tasks
October 2019	Annual Meeting to Review Plan Content & Progress
October 2020	Annual Meeting to Review Plan Content & Progress
October 2021	Annual Meeting to Review Plan Content & Progress
April 2022	Ensure that Funding for the Plan Update is included in the fiscal year 2022-2023 budget
October 2022	Annual Meeting to Review Plan Content & Progress
October 2022	Secure Consultant to Begin Updating the Plan, or Begin Updating in House
October 2023	Forward Draft Updated Plan to DEMHS for Review
July-September 2023	Process Edits from State and FEMA and Obtain the Approval Pending Adoption (APA)
October 2023	Adopt Updated Plan

To update the Plan, Local Hazard Mitigation Plan Coordinator and a supporting consultant will coordinate the appropriate group of local officials consisting of representatives of many of the same departments solicited for input to this HMP. In addition, local business leaders, community and neighborhood group leaders, and relevant private and nonprofit interest groups will be included in the update process.

The project recommendation worksheets prepared by the local coordinators and annual reports described above will be reviewed. In addition, the following questions will be asked:

- ❑ Do the mitigation goals and objectives still reflect the concerns of local residents, business owners, and officials?
- ❑ Have local conditions changed so that findings of the risk and vulnerability assessments should be updated?
- ❑ Are new sources of information available that will improve the risk assessment?
- ❑ If risks and vulnerabilities have changed, do the mitigation goals and objectives still reflect the risk assessment?
- ❑ What hazards have caused damage locally since the last edition of the HMP was developed? Were these anticipated and evaluated in the HMP or should these hazards be added to the plan?
- ❑ Are current personnel and financial resources at the local level sufficient for implementing mitigation actions?
- ❑ For each mitigation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles?
- ❑ For each mitigation action that has been completed, was the action effective in reducing risk?
- ❑ What mitigation recommendations should be added to the plan and proposed for implementation?

- ☐ If any proposed mitigation actions should be deleted from the plan, what is the rationale?

Updates may include deleting recommendations as projects are completed, adding recommendations as new hazard effects arise, or modifying hazard vulnerabilities as development patterns change. In addition, the list of shelters and critical facilities should be updated as necessary, or at least every three years.

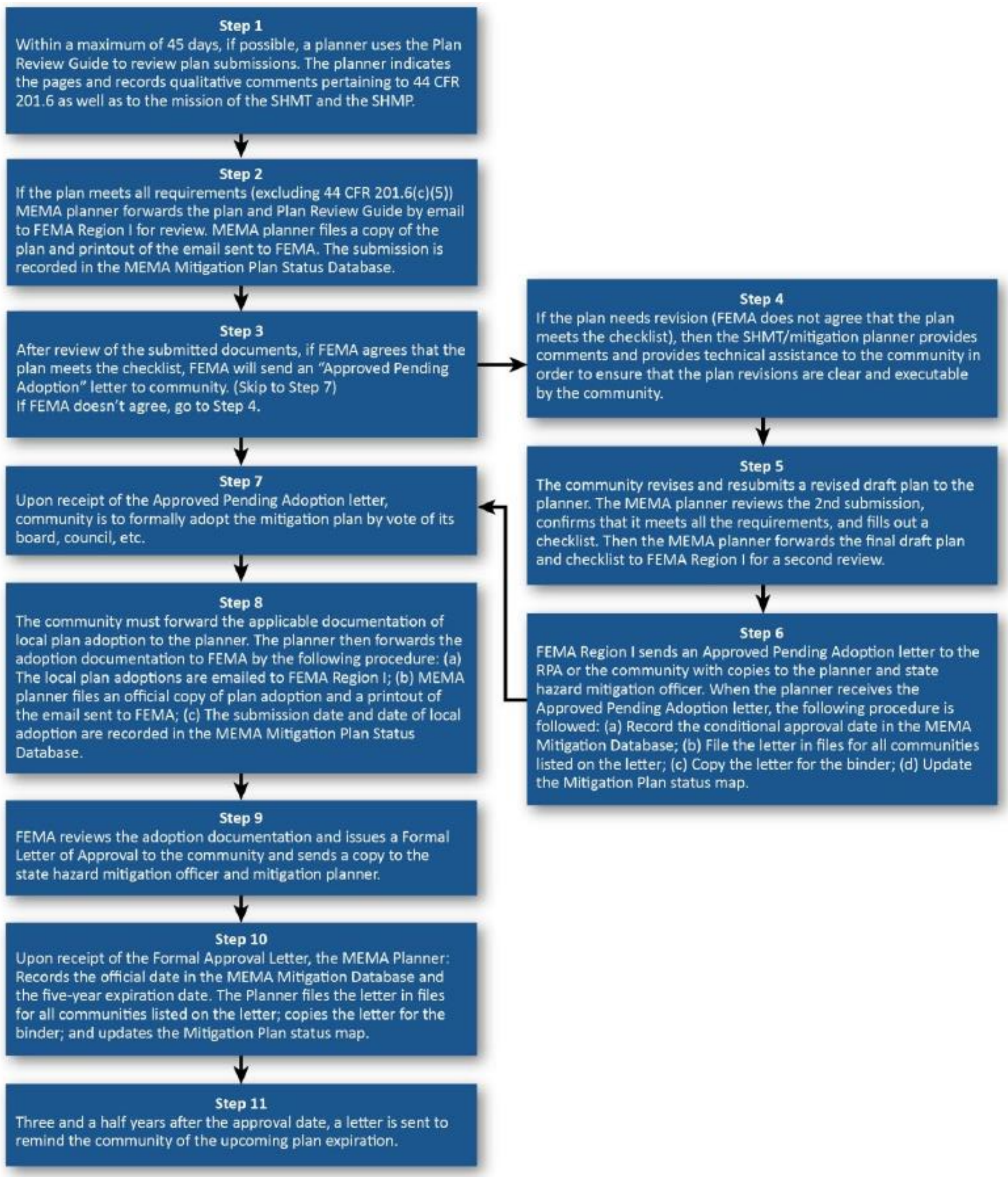

Figure 12-1: Steps in the MEMA and FEMA Plan Review Process

Massachusetts State Hazard Mitigation and Climate Adaptation Plan, September, 2018

12.5 Technical and Financial Resources

This subsection is comprised of a list of resources to be considered for technical assistance and potentially financial assistance for completion of the actions outlined in this plan. This list is not all-inclusive and is intended to be updated as necessary.

Federal Resources

Federal Emergency Management Agency
Region I
99 High Street, 6th floor
Boston, MA 02110-2320
(877) 336-2734

Mitigation Division

Administers all of FEMA's hazard mitigation programs, including: National Flood Insurance Program and Community Rating System; prepares and revises flood insurance studies and maps; information on past and current acquisition, relocation, and retrofitting programs; expertise in other natural and technological hazards, including hurricanes, earthquakes and hazardous materials. Financial assistance includes Hazard Mitigation Grant program (post-disaster); Flood Mitigation Assistance Program (pre-and post-flood), Pre-Disaster Mitigation (PDM) grant program; training for local officials at Emergency Management Institute in Emmitsburg, Maryland.

- ***Earthquake Hazards Reduction Assistant Program*:** As part of the National Earthquake Hazards Reduction Program (NRHRP), the purpose of the FEMA's State Earthquake Hazards Reduction Program is to provide funds for the development of comprehensive risk reduction programs at the State level and risk reduction measures at the local level to reduce future earthquake damages and losses. The fundamental goal of the program is to reduce earthquake impacts and the subsequent loss of lives, property damages, and economic losses. To accomplish these goals, technical assistance from State programs to local governments in the areas of structural and non-structural mitigation, building codes, and land-use planning ordinances is necessary.

- ***State Hurricane Program*:** This program is concerned with reducing the impacts of hurricanes and coastal storms on coastal areas of the United States and its territories as well as reducing the extent of subsequent losses. FEMA provides financial and technical assistance to State and local governments to support their efforts to mitigate the damaging effects of hurricane and coastal storms. State Hurricane Program funds are to be used for mitigation and preparedness activities related to hurricane hazards. Each participating State receives a Local Assistance allocation of $5,000 in addition to the State Assistance Grant.

- ❑ ***Hurricane Program Property Protection - Mitigation Grants*:** This element of the Hurricane Program provides grants to hurricane-prone States to implement mitigation projects. Each FEMA Region with States participating in the Hurricane Program receives funds for this activity. The Regional offices solicit the States to undertake projects that reduce the risk of loss of life or injury from damaged structures and reduce the overall cost of hurricane disasters due to property damage. This program is administered by the CT OEM.

- ❑ ***Multi-State Groups*:** There are three multi-state (regional) consortia that FEMA funds: the Western States Seismic Policy Council (WSSPC), the New England States Emergency Consortium (NESEC), and the Central United States Earthquake Consortium (CUSEC). The mission of all three consortia is to support the National Earthquake Hazard Program (Reduction) funded State earthquake programs. They provide support in areas such as coordination between the States in a region and public awareness and education, and they also reinforce interactions between all levels of government, academia, non-profit associations, and the private section.

- ❑ ***Technical Assistance Contracts*:** The Mitigation Directorate has in place several Technical Assistance Contracts (TAC) that support FEMA, States, territories, and local governments with activities to enhance the effectiveness of natural hazard reduction program efforts. The TACs support FEMA's responsibilities and legislative authorities for implementing the earthquake, hurricane, dam safety, and floodplain management programs. The range of technical assistance services provided through the TACs varies based on the needs of the eligible contract users and the natural hazard programs. Contracts and services include:

  - *The Hazard Mitigation Technical Assistance Program (HMTAP) Contract*- supporting post-disaster program needs in cases of large, unusual, or complex projects; situations where resources are not available; or where outside technical assistance is determined to be needed. Services include environmental and biological assessments, benefit/cost analyses, historic preservation assessments, hazard identification, community planning, training, and more.

  - *The Wind and Water Technical Assistance Contract (WAWTAC)*-supporting wind and flood hazards reduction program needs. Projects include recommending mitigation measures to reduce potential losses to post-FIRM structures, providing mitigation policy and practices expertise to States, incorporating mitigation into local hurricane program outreach materials, developing a Hurricane Mitigation and Recovery exercise, and assessing the hazard vulnerability of a hospital.

  - *The National Earthquake Technical Assistance Contract (NETAC)* – supporting earthquake program needs. Projects include economic impact analyses of various earthquakes, vulnerability analyses of hospitals and schools, identification of and training on non-structural mitigation measures, and evaluating the performance of seismically rehabilitated structures, post-earthquake.

- ❑ ***Hazard Mitigation Grant Program (HMGP)*:** HMGP is a post-disaster mitigation program that provides funding for hazard mitigation projects in affected counties following presidentially declared disasters. Available funds are based on a percentage of the total damages caused by the particular disaster. Grants from this program are limited to state and local governments and certain non-profit organizations. There is a need to demonstrate a positive cost/benefit analysis and a cost-share requirement of 25% to match the federal funds provided. Grants are competitive within the affected area. This program is administered by the state of Massachusetts, Massachusetts Emergency Management Agency (MEMA).

- ***Flood Mitigation Assistance Program (FMA*):** FMA is a pre-disaster mitigation program created by the National Flood Insurance Reform Act of 1994. This program provides both project and planning grants annually for flood hazard mitigation planning and projects with direct demonstrable benefits to the NFIP insurance fund. Administratively, this program is very similar to the HMGP described above.

- ***Pre-Disaster Mitigation Grant Program (PDM*):** PDM is a pre-disaster mitigation program that provides funding for hazard mitigation projects on a nationally-competitive basis. Projects are submitted by states and communities and rated by a national panel. Yearly funding for this grant is in the millions of dollars. There is a need to demonstrate a positive cost/benefit analysis and a cost-share requirement of 25% to match the federal funds provided. This program is administered by the state of Massachusetts, Massachusetts Emergency Management Agency (MEMA).

Response & Recovery Division

Information on dollar amounts of past disaster assistance including Public Assistance, Individual Assistance, and Temporary Housing; information on retrofitting and acquisition/relocation initiatives. Coordinates federal disaster assistance programs, including 75% grants for mitigation projects to protect eligible damaged public and private non-profit facilities from future damage through the Public Assistance Program, and 100% "minimization" grants through the Individuals and Family Grant Program.

Computer Sciences Corporation
New England Headquarters,
140 Wood Road, Suite 200,
Braintree, MA 02184
(617) 848-1908

A private company contracted by the Federal Insurance Administration as the National Flood Insurance Program Bureau and Statistical Agent, CSC provides information and assistance on flood insurance, including handling policy and claims questions, and providing workshops to leaders, insurance agents, and communities.

Small Business Administration
360 Rainbow Boulevard South, 3rd Floor
Niagara Falls, NY 14303

Disaster Program Director: Win Allred
(716) 282-4612 or 800-659-2955

SBA has the authority to "declare" disaster areas following disasters that affect a significant number of homes and businesses, but that would not need additional assistance through FEMA. (SBA is triggered by a FEMA declaration, however.) SBA can provide additional low-interest funds (up to 20% above what an eligible applicant would "normally" qualify for) to install mitigation measures. They can also loan the cost of bringing a damaged property up to state or local code requirements. Can be used in combination with the new "mitigation insurance" under the NFIP, or in lieu of that coverage.

Environmental Protection Agency
Region I - JFK Federal Building, Government Center,
Boston, MA 02203
(617) 565-3400

- ***Capitalization Grants for State Revolving Funds:*** Low interest loans to governments to repair, replace, or relocate wastewater treatment plans damaged in floods. Does not apply to drinking water or other utilities.
- ***Clean Water Act Section 319 Grants:*** Cost-share grants to state agencies that can be used for funding watershed resource restoration activities, including wetlands and other aquatic habitat (riparian zones). Only those activities that control non-point pollution are eligible. Grants are administered through the CT DEP, Bureau of Water Management, Planning and Standards Division.

U.S. Dept. of Housing and Urban Development
Thomas P. O'Neill, Jr. Federal Building
10 Causeway Street, 3rd Floor
Boston, MA 02222-1092
(617) 994-8200

- ***Community Development Block Grants (CDBG):*** Communities with populations greater than 50,000 contact HUD directly regarding CDGB. One program objective is to improve housing conditions for low and moderate income families. Projects can include acquiring flood prone homes or protecting them from flood damage. Funding is a 100% grant; can be used as a source of local matching funds for other funding programs, such as FEMA's "404" Hazard Mitigation Grant Program. Funds can also be applied toward "blighted" conditions, which is often the post-flood condition. A separate set of funds exists for conditions that create an "imminent threat." The funds have been used in the past to replace (and redesign) bridges where flood damage eliminates police and fire access to the other side of the waterway.

U.S. Army Corps of Engineers
Special Studies Branch
424 Trapelo Road
Waltham, MA 02254
(617) 647-8505

Provide 100% funding for floodplain management planning and technical assistance under the Floodplain Management Services Program (FPMS). Various flood protection measures such as beach re-nourishment, stream clearance and snagging projects, floodproofing, and flood preparedness funded on a 50/50 matching basis by Section 22 planning Assistance to States program. They are authorized to relocate homes out of the floodplain if it proves to be more cost effective than a structural flood control measure.

U.S. Department of Commerce
National Weather Service
445 Myles Standish Blvd.
Taunton, MA 02780
(508) 823-2266

Prepares and issues flood, severe weather, and coastal storm warnings. Staff hydrologists can work with communities on flood warning issues and can give technical assistance in preparing flood warning plans.

U.S. Department of the Interior
National Park Service
Rivers and Rails Conservation Program
Regional Office, 15 State Street
Boston, MA 02109
(617) 223-5203

Technical Assistance with open space preservation planning; can help facilitate meetings and identify non-structural options for floodplain development.

U.S. Fish and Wildlife Service
New England Field Office
22 Bridge Street, Unit #1
Concord, NH 03301

Can provide technical and financial assistance to restore wetlands and riparian habitats through the North American Wetland Conservation Fund and partners for Wildlife programs. Also administers the

- ***National Coastal Wetlands Conservation Grant Program**:* A nationally competitive fund matching program to preserve, restore, and protect coastal wetlands. Funds are administered at the State level.
- ***North American Wetlands Conservation Act Grants Program**:* Provides matching grants to organizations and individuals who have developed partnerships to carry out wetlands projects in the United States, Canada, and Mexico. Funds are available for projects focusing on protecting, restoring, and/or enhancing critical habitat. Projects must support long-term wetlands acquisition, restoration, and/or enhancement, and require a 1-to-1 match. The

program includes both Standard Grants (grant requests between $50,001 and $1,000,000) and Small Grants (funds not to exceed $50,000).

Contacts: *Standard Grants proposals*: David Buie (david_buie@fws.gov), (301) 497-5870; *Small Grants Program proposals*: Keith Morehouse (keith_morehouse@fws.gov), (703) 358-1888. *General office number*: (703) 358-1784.

U.S. Department of Agriculture
Natural Resources Conservation Service (formerly SCS)
West Wareham Service Center
15 Cranberry Highway
West Wareham MA, 02576
(508) 295-5151

Technical assistance to individual land owners, groups of landowners, communities, and soil and water conservation districts on land-use and conservation planning, resource development, storm water management, flood prevention, erosion control and sediment reduction, detailed soil surveys, watershed/river basin planning and recreation, fish and wildlife management. Financial assistance is available to reduce flood damage in small watersheds and to improve water quality. Financial assistance is available under the Emergency Watershed Protection Program; the Cooperative River Basin Program; and the Small Watershed Protection Program.

State Resources

Massachusetts Emergency Management Agency (MEMA)
400 Worcester Road
Framingham, MA 01702-5399
(508) 820-2000

The Massachusetts Emergency Management Agency (MEMA) is the state agency responsible for coordinating federal, state, local, voluntary and private resources during emergencies and disasters in the Commonwealth of Massachusetts. MEMA provides leadership to develop plans for effective response to all hazards, disasters or threats; train emergency personnel to protect the public; provide information to the citizenry; and assist individuals, families, businesses and communities to mitigate against, prepare for, and respond to and recover from emergencies, both natural and man made. MEMA administers FEMA's FMA, HMGP, and PDM programs with DCR.

Massachusetts Department of Conservation & Recreation (DCR)
251 Causeway Street
Boston, MA 02114
(617) 626-1250

- ***Flood Management Grants*** – DCR's Department of Flood Hazard Management, in coordination with the Massachusetts Emergency Management Agency, offers two grant programs to local government in order to reduce the risks and costs of natural disasters, especially floods, on homeowners and community infrastructure. These programs include pre-disaster grants through the annual Flood Hazard Mitigation Grant Program (FMA) and post-disaster grants through the Hazard Mitigation Grant Program (HMGP).
- ***Rivers and Harbors Grant Program*** – A statewide program of matching grants from DCR's Office of Waterways to towns and municipalities for design and construction to address problems on coastal and inland waterways, lakes and great ponds.

Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114-2138
(617 626-1200

The Massachusetts Office of Coastal Zone Management (CZM) is a part of the Executive Office of Environmental Affairs (EOEA). Its mission is to balance the impacts of human activity with the protection of coastal and marine resources. As a networked program, CZM was specifically established to work with other state agencies, federal agencies, local governments, academic institutions, nonprofit groups, and the general public to promote sound management of the Massachusetts coast. CZM is funded primarily through the Commonwealth of Massachusetts, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Environmental Protection Agency (EPA). CZM administers a number of grant and technical assistance programs aimed at wetland restoration.

MA Department of Public Safety
One Ashburton Place, Room 1301
Boston, MA 02108
(617) 727-3200

DPS is the lead agency responsible for emergency management. Specific responsibilities include emergency preparedness, response & recovery, homeland security, oversight of MEMA, and oversight of the Board of Building Regulations and Standards.

Private and Other Resources

The Association of State Floodplain Managers (ASFPM)
4233 W. Belittling Highway
Madison, WI 53711
(608) 274-0123

Professional association of state employees that assist communities with the NFIP with a membership of over 1,000. ASFMP has developed a series of technical and topical research papers, and a series of Proceedings from their annual conferences. Many "mitigation success stories" have been documented through these resources, and provide a good starting point for planning.

Natural Hazards Center
(303) 492-6818

Includes the Floodplain Management Resource Center, a free library and referral service of the ASFPM for floodplain management publications. The Natural Hazards Center is located at the University of Colorado in Boulder, staff can use keywords to identify useful publications from the more than 900 documents in the library.

New England Flood and Storm water Managers Association, Inc. (NEFSMA)
c/o MA DEM
100 Cambridge Street
Boston, MA 02202

NEFSMA is a non-profit organization made up of state agency staff, local officials, private consultants and citizens from across New England. NEFSMA sponsors seminars and workshops and publishes the NEFSMA News, three times per year to bring the latest flood and storm water management information from around the region to its members.

National Center for Earthquake Engineering and Research
(716) 645-3391

A source for earthquake statistics, research, engineering and planning advice.

National Emergency Managers Association (NEMA)
c/o Council of State Governments
3650 Iron Works Pike, P.O. Box 11910
Lexington, Kentucky 4057-1910
606-244-8000

A national association of state emergency management directors and other emergency management officials. The NEMA Mitigation Committee is a strong voice to FEMA in shaping all-hazard mitigation policy in the nation. NEMA is also an excellent source of technical assistance.

New England States Emergency Consortium (NESEC)
(800) 445-6332

A clearinghouse for mitigation and preparedness information with cooperation from all of the New England states. NESED presents a unique, non-governmental approach to aid. This agency could secure access to private sources of monetary and logistics support.

Insurance Institute for Property Loss Reduction (IIPLR)
73 Tremont Street, Suite 510
Boston, MA 012109-3910
(617) 722-0200

A non-profit organization put together by the insurance industry to research ways of lessening the impact of natural hazard. IIPLR advocates the development and implementation of building codes and standards nationwide and may be a good source of model code language.

Volunteer Organizations
Volunteer organizations, such as the American Red Cross, the Salvation Army, Habitat for Humanity, Interfaith, and the Mennonite Disaster Service are often available to help after disasters. Service Organizations, such as the Lions, Elks, and VFW are also. Habitat for Humanity and the Mennonite Disaster Service Provide skilled labor to help rebuild damaged buildings incorporating mitigation or floodproofing concepts. The office of individual organizations can be contacted directly, or the FEMA Regional Office may be able to assist.

AmeriCorps
AmeriCorps is the recently installed National Community Service Organization. Teams of works can assist with landscaping projects such as surveying, tree planting, restoration, construction and environmental education. Some states have trained AmeriCorps members to help during flood-fight situations, such as filling and placing sandbags.

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APPENDIX A: STAPLEE ACTION PRIORITIZATION

Action or Strategy #	Table 11-1: Mitigation Actions and Strategies for Nantucket	Status - Carried Forward - New	Responsible Department[1]	Fiscal Year					Cost Minimal <$10,000 Low < $50,000 Mod. < $100,000 High > $100,000	Potential Funding Sources[2]	Weighted STAPLEE Criteria[3]																Total STAPLEE Score
											Benefits								Costs								
				7/2018-6/2019	7/2019-6/2020	7/2020-6/2021	7/2021-6/2022	7/2022-6/2023			Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
	All Hazards																										
A1	Obtain necessary radios and chargers for DPW staff and equipment to operate efficiently during town-wide emergencies	New	DPW	X	X				Minimal	CIB	0	1	1	1	0	1	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
A2	Provide Incident Command System training to essential staff	New	EM	X	X	X	X	X	Minimal	OB	1	0	1	1	0	0	0	**3.0**	0	0	0	0	0	0	0	**0.0**	**3.0**
A3	Review NMP, and associated Area Plans, for consistency with this HMP, and revise as needed	New	PLUS	X	X				Low	OB	0	1	0	1	1	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A4	Add a 5-year review of natural hazard mitigation priorities, to coincide with updates of the HMP, to the NMP implementation schedule	New	PLUS					X	Minimal	OB	0	0	0	1	1	1	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A5	Review the Nantucket Intermediate School and the Elementary School and determining their abilities to serve as emergency shelters.	New	EM		X	X			Low	OB	1	1	0	1	1	1	0	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
A6	Develop a comprehensive checklist that cross-references bylaws, regulations, and codes related to natural hazard damage prevention that may be applicable to proposed development project.	Carried Forward	PLUS	X	X				Minimal	OB	0	1	0	1	1	1	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
A7	Identify potential locations and costs, in collaboration with the Steamship Authority, for development of an alternative shipping terminal and navigation channel capable of accepting high-capacity ferries and/or freight boats to maintain critical access to the mainland in case of blockage of the main channel. Outline steps to follow to develop such a terminal.	New	PLUS/SSA				X	X	Low	Grant	1	1	0	1	1	0	0	**5.0**	0	0	0	1	0	0	0	**1.0**	**4.0**
A8	Identify potential alternative access routes to Madaket via Eel Point Rd & Warren’s Landing; and develop a maintenance plan to ensure Eel Point Road/Warren Road emergency access route is capable of passing emergency vehicles during an event.	Carried Forward	DPW				X	X	Low	OB / Grant	1	1	0	1	1	1	0	**7.0**	0	0	0	1	0	0	1	**2.0**	**5.0**
A10	Conduct a targeted hazard vulnerability assessment of historic structures, and offer technical assistance to property owners.	New	PLUS		X	X			Moderate	OB / MHC	1	1	0	1	0	1	1	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
A11	Conduct a table-top exercise for a simulated tanker leak adjacent to a Town well head to improve emergency response capabilities and identify additional needs. Specifically consider how a natural hazard event may impact response capabilities.	New	PD/EM	X					Minimal	OB	0	0	1	1	1	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A12	Complete a study and develop recommendations to improve safety and control runoff on the roadways adjacent to Town water-supply wellheads.	New	DPW		X	X			Low	Grant	0	0	1	1	1	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A13	Explore development of one or more microgrid systems for core mid-island critical facilities to determine potential costs and benefits.	New	EC			X	X		Low	Grant	1	1	1	0	0	0	1	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**
A14	Develop a Nantucket Electric Supply Resilience Plan with National Grid that enhances information sharing, coordinates major projects and improvements, protects against major events, and integrates resilience into planning, investments and decision making.	New	EC				X	X	Low	Grant	0	1	1	1	0	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A15	Develop and adopt a minimum standard of road improvements and maintenance that supports emergency use and public safety	Carried Forward	DPW		X	X			Low	OB	0	1	1	0	1	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A16	Improve the capabilities of personnel to search and obtain electronic project plans and records for major and critical infrastructure and systems. This includes completing the on-line GIS, deploying accurate location referencing, integrating files across departments, and implementing electronic document management along with scanning all project records. (Lesson learned from the emergency in 2018 and needs for information to locate and perform sewer force main repairs)	New	Admin / IT	X					Minimal	OB	0	1	1	1	0	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
A17	Identify the needs for emergency materials (gravel, large blocks, pipe, etc.) that are essential to repair and reopen roadways damaged by flooding. Through cooperative agreement with on-Island suppliers, and/or having inventory stocked at DPW, maintain this supply for emergency use.	New	DPW	X					Low	OB	0	1	1	1	0	1	0	**6.0**	0	0	0	0	0	1	0	**2.0**	**4.0**
A18	Develop a public outreach program that target public school teachers and students (K-12) and works to add appropriate climate science, sea level rise, hazard mitigation and coastal resilience planning to the curriculum.	New	NPS			X	X		Low	OB	1	0	1	1	0	0	1	**4.0**	1	0	0	0	0	0	0	**1.0**	**3.0**
A19	The fuel tank farm is being relocated out of the coastal-flood-risk zone to a less at-risk area; however this relocation comes with the risk of fuel spillage during transport from the waterfront and contamination of the municipal water supply. This action is to design and construct roadway improvements that reduce the risk of contamination of the Town's water supply due to new fuel transport.	New	DPW				X	X	Minimal	OB	0	0	1	1	1	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**

Action or Strategy #	Table 11-1: Mitigation Actions and Strategies for Nantucket	Status - Carried Forward - New	Responsible Department[1]	Fiscal Year					Cost	Potential Funding Sources[2]	Weighted STAPLEE Criteria[3] Benefits								Costs								Total STAPLEE Score
				7/2018-6/2019	7/2019-6/2020	7/2020-6/2021	7/2021-6/2022	7/2022-6/2023	Minimal <$10,000 Low < $50,000 Mod. < $100,000 High > $100,000		Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
	Flooding																										
F1	Complete development of an Open Space Plan	New	PLUS	X					Low	OB / Grant	1	0	1	0	1	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
F2	Conduct Master Drainage Study for the Downtown area and its watershed. Identify needs for storm water drainage improvement, including backflow devices at outfalls at the harbor. Develop an operations & maintenance policy for retention/detention and water quality treatment (Stormceptors) systems for Town and privately owned facilities	Carried Forward	DPW	X	X	X			Low	Grant	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
F3	In the Downtown area (including Brant Point to Orange St.), complete CCTV inspection and Storm Water Management Program. Prioritize improvements to reduce flooding.	New	DPW	X					Low	Grant	0	1	1	0	0	1	0	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**
F4	Conduct master drainage studies for problematic inland areas, such as that between Madaket Road and Hummock Pond Road, to ensure that individual repairs and upgrades fit seamlessly with upstream and downstream drainage systems.	New	DPW			X	X	X	Moderate	Grant	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
F5	Complete Consue Springs project (including Orange St. and Pleasant St. systems) to improve drainage and outfall discharge in that area. The outfall serves a drainage area of 36 acres with several retention/detention systems. The project scope has been revised to address the restoration of the pond and creek to improve water quality.	New	DPW	X	X				Low	Grant	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
F6	Develop a comprehensive storm water management plan that addresses needs and priorities to reduce flooding and improve drainage. Include a funding model and possible revenue sources to sustain ongoing maintenance and capital improvements. The Plan should review policy and regulations that govern the discharge of water into the Town's ROW and those that have direct connection to the Town's storm drainage system. The rising sea level and water table is leading to more sump pumps discharging into the drains or on the roadway.	New	DPW			X	X	X	Moderate	Grant	0	1	1	0	1	1	1	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
F7	Document that the Milestone Road crossing of Phillips Run can convey the appropriate flood event. Identify the flood event that will overtop the road.	Carried Forward	DPW				X	X	Minimal	OB	0	1	0	0	0	1	0	**4.0**	0	0	0	0		0	0	**0.0**	**4.0**
F8	Adopt a set of design guidelines to encourage flood proofing and elevation of structures while maintaining their historic characters. The NFIP Floodplain Management Bulletin FEMA P-467-2, "Historic Structures," may be referenced.	New	PLUS	X	X				Minimal	OB / MHC	1	1	1	0	1	1	0	**7.0**	0	0	0	1	0	0	0	**1.0**	**6.0**
F9	Complete repairs to Children's Beach storm water pump and outfall to improve reliability, and reduce/eliminate backflow into the pump and drainage system during high tides. This system support a drainage area of more than 150 Acres.	New	DPW	X	X				Moderate	CIB	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
F10	Participate in a limited public-private partnership with Nantucket Engineering & Survey to complete a study of the Fulling Mill Brook watershed, in particular the hydrologic conditions at Polpis Road, to identify alternatives for improvements to this area.	New	DPW	X	X				Moderate	OB / CIB	0	1	1	1	1	1	1	**8.0**	0	0	0	0	0	0	0	**0.0**	**8.0**
F11	Educate residents, developers, and regulators about the zoning regulation allowing height limitations in "one-hundred-year" flood zones to be defined based on the first floor elevation as required by floodplain management regulations [updated 7/12/2016]. Target repetitive loss property owners for this education.	New	PLUS	X	X				Low	OB	0	1	1	1	1	1	0	**7.0**	0	0	0	1	0	0	0	**1.0**	**6.0**
F12	Extend the above height exception to any building elevating its first floor for flood mitigation purposes, even if outside current flood zone.	New	PLUS		X	X			Minimal	OB	0	0	1	1	1	1	0	**5.0**	1	0	0	1	0	0	0	**2.0**	**3.0**
F13	Adopt local freeboard standards that include AE zones when regulating development in flood zones.	Carried Forward	PLUS		X	X	X		Minimal	OB	1	1	1	0	1	1	0	**7.0**	0	0	0	1	0	0	0	**1.0**	**6.0**
F14	Increase the elevation of Madaket Road at Head of Long Pond and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise. Coordinate with culvert improvements or replacement.	Carried Forward	DPW			X	X	X	High	CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**

Action or Strategy #	Table 11-1: Mitigation Actions and Strategies for Nantucket	Status - Carried Forward - New	Responsible Department[1]	Fiscal Year					Cost Minimal <$10,000 Low < $50,000 Mod. < $100,000 High > $100,000	Potential Funding Sources[2]	Weighted STAPLEE Criteria[3]																Total STAPLEE Score
											Benefits								*Costs*								
				7/2018-6/2019	7/2019-6/2020	7/2020-6/2021	7/2021-6/2022	7/2022-6/2023			Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
F15	Increase the elevation of Madaket Road at Madaket Ditch and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise. Coordinate with culvert improvements or replacement.	New	DPW			X	X	X	High	CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
F16	Increase the elevation of Polpis Road at Fulling Mill Brook and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	New	DPW			X	X	X	High	CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
F17	Increase the elevation of Polpis Road at Sesachacha Pond and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	New	DPW			X	X	X	High	CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
F18	Increase the elevation of Wauwinet Road at Polpis Harbor and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	New	DPW			X	X	X	High	CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
F19	Relocate important hard-copies of Town records (including Finance Department records and Health Department records)to a new storage location outside of the SFHA (currently located on Washington Street)	New	Admin	X	X				Minimal	OB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
F20	Investigate and implement engineered flood protection solutions for the Finance Department Building (short-term) and develop options to relocate the office to a flood proof location (long-term).	New	Admin				X	X	Moderate	OB / CIB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
F21	Investigate and implement actions that mitigate the repetitive damage to the Harbormaster's facility on the Town Pier.	New	Admin		X	X			Moderate	OB	1	1	1	1	1	0	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
F22	Initiate development of plans for a long-term Harbormaster facility, incorporating sea level rise.	New	Admin			X	X		High	CIB	1	1	1	1	0	0	1	**6.0**	0	0	0	0	0	1	0	**2.0**	**4.0**
F23	Perform a network-level inventory and condition assessment of storm water infrastructure to drive development of a dedicated cleaning and maintenance program for the drainage systems. Current approach lacks the equipment and staffing in DPW. Use the same information to identify and plan for capital and improvement projects. Integrate the information with the Town's GIS and Work Order systems.	New	DPW					X	Moderate	Grant	0	1	1	0	1	1	0	**6.0**	0	0	0	0	0	1	0	**2.0**	**4.0**
F24	Install water tight sewer manholes in areas that experience regular street flooding.	New	DPW			X			Moderate	CIB	0	1	1	0	0	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
F25	Develop a protocol or formal Standard Operating Procedure for opening and closing of the tide gate at Children's Beach boat ramp. Work with local citizens to make sure they are aware of the protocol.	New	DPW		X	X			Minimal	OB	1	1	1	1	1	0	1	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
F26	Contact the owners of Repetitive Loss Properties and nearby properties at risk to inquire about mitigation undertaken and suggest options for mitigating flooding in those areas. This should be accomplished with a letter directly mailed to each property owner.	New	PLUS		X				Minimal	OB	1	0	1	1	1	1	0	**6.0**	1	0	0	0	0	0	0	**1.0**	**5.0**
	Hurricanes and Tropical Storms																										
TS1	Incorporate "code plus" wind-load requirements (more restrictive coding to make a building more resilient, specifically to wind hazards) into new critical and essential facility permitting, specifically, - The new fuel tank farm - The new Fire Department facility - The new hospital building - Any new or renovated pumping stations	New	EM	X	X				Minimal	OB	0	1	1	1	1	1	0	**7.0**	0	0	0	0	0	1	0	**2.0**	**5.0**
TS2	Perform an inventory and condition assessment of Town owned trees by a certified arborist that identifies a maintenance, pruning and removal schedules. Develop a risk rating model to identify trees and locations vulnerable to personal injury and property damage caused by storms.	New	DPW			X	X		Low	OB / Grant	0	1	1	0	0	0	1	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
TS3	Document the plan that identifies the haul-out capacity and timely removal of boats from the water in an emergency situation. The Town currently works with local businesses to coordinate the hauling of boats in the event of an imminent storm. This plan should be formalized in writing and the responsibilities of the Town and private providers should be defined.	New	PLUS		X				Minimal	OB / Grant	0	1	1	0	1	1	0	**6.0**	0	0	0	1	0	0	0	**1.0**	**5.0**
	Sea Level Rise, Shoreline Change, and Erosion																										
SC1	Complete the Community/Coastal Resilience Plan and Become an MVP Community	New	PLUS	X					Low	Grant	1	1	1	1	1	1	1	**9.0**	0	0	0	0	0	0	0	**0.0**	**9.0**
SC2	Update the Nantucket and Madaket Harbors Action Plan (HAP) to incorporate needs for Hazard Mitigation and Coastal Resilience	New	PLUS		X	X			Low	OB	1	1	1	0	1	0	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
SC3	Implement a project to map the near shore sand and sediment transport to develop a sand-budget model for monitoring island wide coastal erosion. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep. Mapping in high resolution monitors the movement of sand shoals and identifies location of marine habitat on the sea floor.	New	PLUS				X	X	High	Grant	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	1	0	**2.0**	**4.0**
SC4	Implement a project to map the harbor floors (Madaket, Polpis and Nantucket) to measure and monitor sediment transport. Information will be used to develop dredging and disposal plan, as well as the Harbor management Plan. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep.	New	PLUS				X	X	High	Grant	0	1	1	0	0	1	1	**6.0**	0	0	0	0	0	1	0	**2.0**	**4.0**

Table 11-1: Mitigation Actions and Strategies for Nantucket

Action or Strategy #	Table 11-1: Mitigation Actions and Strategies for Nantucket	Status (Carried Forward - New)	Responsible Department[1]	Fiscal Year 7/2018-6/2019	Fiscal Year 7/2019-6/2020	Fiscal Year 7/2020-6/2021	Fiscal Year 7/2021-6/2022	Fiscal Year 7/2022-6/2023	Cost (Minimal <$10,000; Low < $50,000; Mod. < $100,000; High > $100,000)	Potential Funding Sources[2]	Weighted STAPLE Criteria[3] Benefits: Social	Benefits: Technical (x2)	Benefits: Administrative	Benefits: Political	Benefits: Legal	Benefits: Economic (x2)	Benefits: Environmental	Benefits: STAPLE Subtotal	Costs: Social	Costs: Technical (x2)	Costs: Administrative	Costs: Political	Costs: Legal	Costs: Economic (x2)	Costs: Environmental	Costs: STAPLE Subtotal	Total STAPLE Score
	Summer Storms & Tornadoes																										
SS1	Ensure the Nantucket Building Department is fully educated on the 2017 building codes.	New	Building	X					Minimal	OB	0	1	0	1	1	1	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
SS2	Provide information on the benefits and applicability of lightning-rods to land-use and building permit applicants; in addition, make this information available on the Town website.	New	Building		X	X			Minimal	OB	0	0	1	1	1	1	0	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**
	Winter Storms																										
WS1	Develop local capacity for housing emergency equipment and personnel in Madaket village during a storm, in case of isolation due to road closure.	New	EM			**X**	**X**	**X**	Moderate	EOC / Grant	1	1	0	1	1	1	0	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
WS2	Develop local capacity for housing emergency equipment and personnel in 'Sconset village during a storm, in case of isolation due to road closure.	New	EM			**X**	**X**	**X**	Moderate	EOC / Grant	1	1	0	1	1	1	0	**7.0**	0	0	0	0	0	0	0	**0.0**	**7.0**
	Wildfire																										
WF1	Complete the Community Wildfire Protection Plan	New	Fire		**X**	**X**			Low	Grant	0	1	0	1	1	1	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
WF2	Complete mutual aid agreement with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.	Carried Forward	Fire	**X**					Minimal	OB	0	1	1	1	1	1	1	**8.0**	0	0	0	0	0	0	0	**0.0**	**8.0**
	Earthquake																										
EQ1	Ensure that employees of the Fire Department, Police Department, and 16 Broad Street building know how to evacuate in case of an earthquake.	Carried Forward	EM	**X**					Minimal	OB	0	0	1	1	1	1	0	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**
EQ2	Perform study of critical facility structures to determine vulnerability to earthquakes	New	EM				**X**	**X**	Low	Grant	0	1	1	1	1	0	0	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**

[1]**Notes**
DPW = Department of Public Works & Engineering
EM = Emergency Management
FS = First Selectman
PLUS = Planning and Land Use Services Department
PD = Police Department
EC = Energy Coordinator
IT = Information Technology & GIS
NPS = Nantucket Public Schools
SSA = Steamship Authority

[2]**Notes**
CIB = Capital Improvement Budget
EOC = EOC Grants
HMA = FEMA Grant Programs
OB = Operating Budget
Grants = Other Grant Programs
MHC = Massachusetts Historical Commission

[3]**Notes**
Beneficial or favorable ranking = 1
Neutral or Not Applicable ranking = 0
Unfavorable ranking = -1

Technical and Economic Factors have twice the weight of the remaining categories

(i.e. their values are counted twice in each subtotal).

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #SC1

Complete the Community/Coastal Resilience Plan and Become an MVP Community	
Total STAPLEE Score	Sea Level Rise, Shoreline Change, and Erosion
Primary Hazard	9
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2019
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Strategy #F10

Participate in a limited public-private partnership with Nantucket Engineering & Survey to complete a study of the Fulling Mill Brook watershed, in particular the hydrologic conditions at Polpis Road, to identify alternatives for improvements to this area.	
Total STAPLEE Score	Flooding
Primary Hazard	8
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2020
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Operating Budget / Capital Improvement Budget

Strategy #WF2

Complete mutual aid agreement with the NCF, Nantucket Land Council, Nantucket Land Bank, and/or Massachusetts Audubon Society for firefighting assistance.	
Total STAPLEE Score	Wildfire
Primary Hazard	8
Status	Carried Forward
Responsible Department	Fire Department
Timeframe	7/2018-6/2019
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A5

Review the Nantucket Intermediate School and the Elementary School and determining their abilities to serve as emergency shelters.	
Total STAPLEE Score	All
Primary Hazard	7
Status	New
Responsible Department	Emergency Management
Timeframe	7/2019-6/2021
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #A10

Conduct a targeted hazard vulnerability assessment of historic structures, and offer technical assistance to property owners.	
Total STAPLEE Score	All
Primary Hazard	7
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2021
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Operating Budget / Massachusetts Historical Commission

Strategy #F6

Develop a comprehensive storm water management plan that addresses needs and priorities to reduce flooding and improve drainage. Include a funding model and possible revenue sources to sustain ongoing maintenance and capital improvements. The Plan should review policy and regulations that govern the discharge of water into the Town's ROW and those that have direct connection to the Town's storm drainage system. The rising sea level and water table is leading to more sump pumps discharging into the drains or on the roadway.	
Total STAPLEE Score	Flooding
Primary Hazard	7
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F19

Relocate important hard-copies of Town records (including Finance Department records and Health Department records)to a new storage location outside of the SFHA (currently located on Washington Street)	
Total STAPLEE Score	Flooding
Primary Hazard	7
Status	New
Responsible Department	Administration
Timeframe	7/2018-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #F25

Develop a protocol or formal Standard Operating Procedure for opening and closing of the tide gate at Children's Beach boat ramp. Work with local citizens to make sure they are aware of the protocol.	
Total STAPLEE Score	Flooding
Primary Hazard	7
Status	New
Responsible Department	Public Works
Timeframe	7/2019-6/2021
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #WS1

Develop local capacity for housing emergency equipment and personnel in Madaket village during a storm, in case of isolation due to road closure.	
Total STAPLEE Score	Winter Storms
Primary Hazard	7
Status	New
Responsible Department	Emergency Management
Timeframe	7/2020-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Emergency Operations Center Grants / Grants

Strategy #WS2

Develop local capacity for housing emergency equipment and personnel in 'Sconset village during a storm, in case of isolation due to road closure.	
Total STAPLEE Score	Winter Storms
Primary Hazard	7
Status	New
Responsible Department	Emergency Management
Timeframe	7/2020-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Emergency Operations Center Grants / Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A1

Obtain necessary radios and chargers for DPW staff and equipment to operate efficiently during town-wide emergencies	
Total STAPLEE Score	All
Primary Hazard	6
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Capital Improvement Budget

Strategy #A6

Develop a comprehensive checklist that cross-references bylaws, regulations, and codes related to natural hazard damage prevention that may be applicable to proposed development project.	
Total STAPLEE Score	All
Primary Hazard	6
Status	Carried Forward
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #F2

Conduct Master Drainage Study for the Downtown area and its watershed. Identify needs for storm water drainage improvement, including backflow devices at outfalls at the harbor. Develop an operations & maintenance policy for retention/detention and water quality treatment (Stormceptors) systems for Town and privately owned facilities	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	Carried Forward
Responsible Department	Public Works
Timeframe	7/2018-6/2021
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F4

Conduct master drainage studies for problematic inland areas, such as that between Madaket Road and Hummock Pond Road, to ensure that individual repairs and upgrades fit seamlessly with upstream and downstream drainage systems.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Grants

Strategy #F5

Complete Consue Springs project (including Orange St. and Pleasant St. systems) to improve drainage and outfall discharge in that area. The outfall serves a drainage area of 36 acres with several retention/detention systems. The project scope has been revised to address the restoration of the pond and creek to improve water quality.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2020
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Strategy #F8

Adopt a set of design guidelines to encourage flood proofing and elevation of structures while maintaining their historic characters. The NFIP Floodplain Management Bulletin FEMA P-467-2, "Historic Structures," may be referenced.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget / Massachusetts Historical Commission

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F9

Complete repairs to Children's Beach storm water pump and outfall to improve reliability, and reduce/eliminate backflow into the pump and drainage system during high tides. This system support a drainage area of more than 150 Acres.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2020
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F11

Educate residents, developers, and regulators about the zoning regulation allowing height limitations in "one-hundred-year" flood zones to be defined based on the first floor elevation as required by floodplain management regulations [updated 7/12/2016]. Target repetitive loss property owners for this education.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2020
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #F13

Adopt local freeboard standards that include AE zones when regulating development in flood zones.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	Carried Forward
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2022
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F21

Investigate and implement actions that mitigate the repetitive damage to the Harbormaster's facility on the Town Pier.	
Total STAPLEE Score	Flooding
Primary Hazard	6
Status	New
Responsible Department	Administration
Timeframe	7/2019-6/2021
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Operating Budget

Strategy #SC2

Update the Nantucket and Madaket Harbors Action Plan (HAP) to incorporate needs for Hazard Mitigation and Coastal Resilience	
Total STAPLEE Score	Sea Level Rise, Shoreline Change, and Erosion
Primary Hazard	6
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2021
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #SS1

Ensure the Nantucket Building Department is fully educated on the 2017 building codes.	
Total STAPLEE Score	Summer Storms & Tornadoes
Primary Hazard	6
Status	New
Responsible Department	Building Department
Timeframe	7/2018-6/2019
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #WF1

Complete the Community Wildfire Protection Plan	
Total STAPLEE Score	Wildfire
Primary Hazard	6
Status	New
Responsible Department	Fire Department
Timeframe	7/2019-6/2021
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A8

Identify potential alternative access routes to Madaket via Eel Point Rd & Warren's Landing; and develop a maintenance plan to ensure Eel Point Road/Warren Road emergency access route is capable of passing emergency vehicles during an event.	
Total STAPLEE Score	All
Primary Hazard	5
Status	Carried Forward
Responsible Department	Public Works
Timeframe	7/2021-6/2023
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget / Grants

Strategy #A13

Explore development of one or more microgrid systems for core mid-island critical facilities to determine potential costs and benefits.	
Total STAPLEE Score	All
Primary Hazard	5
Status	New
Responsible Department	Energy Coordinator
Timeframe	7/2020-6/2022
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Strategy #F3

In the Downtown area (including Brant Point to Orange St.), complete CCTV inspection and Storm Water Management Program. Prioritize improvements to reduce flooding.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2019
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F14

Increase the elevation of Madaket Road at Head of Long Pond and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise. Coordinate with culvert improvements or replacement.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	Carried Forward
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F15

Increase the elevation of Madaket Road at Madaket Ditch and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise. Coordinate with culvert improvements or replacement.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F16

Increase the elevation of Polpis Road at Fulling Mill Brook and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F17

Increase the elevation of Polpis Road at Sesachacha Pond and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F18

Increase the elevation of Wauwinet Road at Polpis Harbor and harden the embankment for wave action. Final elevation to be examined and analyzed considering sea-level rise.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F20

Investigate and implement engineered flood protection solutions for the Finance Department Building (short-term) and develop options to relocate the office to a flood proof location (long-term).	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Administration
Timeframe	7/2021-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Operating Budget / Capital Improvement Budget

Strategy #F26

Contact the owners of Repetitive Loss Properties and nearby properties at risk to inquire about mitigation undertaken and suggest options for mitigating flooding in those areas. This should be accomplished with a letter directly mailed to each property owner.	
Total STAPLEE Score	Flooding
Primary Hazard	5
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #TS1

Incorporate "code plus" wind-load requirements (more restrictive coding to make a building more resilient, specifically to wind hazards) into new critical and essential facility permitting, specifically, - The new fuel tank farm - The new Fire Department facility - The new hospital building - Any new or renovated pumping stations	
Total STAPLEE Score	Hurricanes and Tropical Storms
Primary Hazard	5
Status	New
Responsible Department	Emergency Management
Timeframe	7/2018-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #TS3

Document the plan that identifies the haul-out capacity and timely removal of boats from the water in an emergency situation. The Town currently works with local businesses to coordinate the hauling of boats in the event of an imminent storm. This plan should be formalized in writing and the responsibilities of the Town and private providers should be defined.	
Total STAPLEE Score	Hurricanes and Tropical Storms
Primary Hazard	5
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2020
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget / Grants

Strategy #SS2

Provide information on the benefits and applicability of lightning-rods to land-use and building permit applicants; in addition, make this information available on the Town website.	
Total STAPLEE Score	Summer Storms & Tornadoes
Primary Hazard	5
Status	New
Responsible Department	Building Department
Timeframe	7/2019-6/2021
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #EQ1

Ensure that employees of the Fire Department, Police Department, and 16 Broad Street building know how to evacuate in case of an earthquake.	
Total STAPLEE Score	Earthquake
Primary Hazard	5
Status	Carried Forward
Responsible Department	Emergency Management
Timeframe	7/2018-6/2019
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #EQ2

Perform study of critical facility structures to determine vulnerability to earthquakes	
Total STAPLEE Score	Earthquake
Primary Hazard	5
Status	New
Responsible Department	Emergency Management
Timeframe	7/2021-6/2023
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Strategy #A3

Review NMP, and associated Area Plans, for consistency with this HMP, and revise as needed	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2020
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #A4

Add a 5-year review of natural hazard mitigation priorities, to coincide with updates of the HMP, to the NMP implementation schedule	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2022-6/2023
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A7

Identify potential locations and costs, in collaboration with the Steamship Authority, for development of an alternative shipping terminal and navigation channel capable of accepting high-capacity ferries and/or freight boats to maintain critical access to the mainland in case of blockage of the main channel. Outline steps to follow to develop such a terminal.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services/Steamship Authority
Timeframe	7/2021-6/2023
Estimated Cost	\$10,000 - \$50,000
Potential Funding Sources	Grants

Strategy #A11

Conduct a table-top exercise for a simulated tanker leak adjacent to a Town well head to improve emergency response capabilities and identify additional needs. Specifically consider how a natural hazard event may impact response capabilities.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Police Department/Emergency Management
Timeframe	7/2018-6/2019
Estimated Cost	Less than \$10,000
Potential Funding Sources	Operating Budget

Strategy #A12

Complete a study and develop recommendations to improve safety and control runoff on the roadways adjacent to Town water-supply wellheads.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2019-6/2021
Estimated Cost	\$10,000 - \$50,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A14

Develop a Nantucket Electric Supply Resilience Plan with National Grid that enhances information sharing, coordinates major projects and improvements, protects against major events, and integrates resilience into planning, investments and decision making.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Energy Coordinator
Timeframe	7/2021-6/2023
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Grants

Strategy #A15

Develop and adopt a minimum standard of road improvements and maintenance that supports emergency use and public safety	
Total STAPLEE Score	All
Primary Hazard	4
Status	Carried Forward
Responsible Department	Public Works
Timeframe	7/2019-6/2021
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #A16

Improve the capabilities of personnel to search and obtain electronic project plans and records for major and critical infrastructure and systems. This includes completing the on-line GIS, deploying accurate location referencing, integrating files across departments, and implementing electronic document management along with scanning all project records. (Lesson learned from the emergency in 2018 and needs for information to locate and perform sewer force main repairs)	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Administration / Information Technology & GIS
Timeframe	7/2018-6/2019
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A17

Identify the needs for emergency materials (gravel, large blocks, pipe, etc.) that are essential to repair and reopen roadways damaged by flooding. Through cooperative agreement with on-Island suppliers, and/or having inventory stocked at DPW, maintain this supply for emergency use.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2018-6/2019
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #A19

The fuel tank farm is being relocated out of the coastal-flood-risk zone to a less at-risk area; however this relocation comes with the risk of fuel spillage during transport from the waterfront and contamination of the municipal water supply. This action is to design and construct roadway improvements that reduce the risk of contamination of the Town's water supply due to new fuel transport.	
Total STAPLEE Score	All
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2021-6/2023
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #F1

Complete development of an Open Space Plan	
Total STAPLEE Score	Flooding
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2018-6/2019
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget / Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #F7

Document that the Milestone Road crossing of Phillips Run can convey the appropriate flood event. Identify the flood event that will overtop the road.	
Total STAPLEE Score	Flooding
Primary Hazard	4
Status	Carried Forward
Responsible Department	Public Works
Timeframe	7/2021-6/2023
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #F22

Initiate development of plans for a long-term Harbormaster facility, incorporating sea level rise.	
Total STAPLEE Score	Flooding
Primary Hazard	4
Status	New
Responsible Department	Administration
Timeframe	7/2020-6/2022
Estimated Cost	More than $100,000
Potential Funding Sources	Capital Improvement Budget

Strategy #F23

Perform a network-level inventory and condition assessment of storm water infrastructure to drive development of a dedicated cleaning and maintenance program for the drainage systems. Current approach lacks the equipment and staffing in DPW. Use the same information to identify and plan for capital and improvement projects. Integrate the information with the Town's GIS and Work Order systems.	
Total STAPLEE Score	Flooding
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2022-6/2023
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Grants

Strategy #F24

Install water tight sewer manholes in areas that experience regular street flooding.	
Total STAPLEE Score	Flooding
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2021
Estimated Cost	$50,000 - $100,000
Potential Funding Sources	Capital Improvement Budget

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #TS2

Perform an inventory and condition assessment of Town owned trees by a certified arborist that identifies a maintenance, pruning and removal schedules. Develop a risk rating model to identify trees and locations vulnerable to personal injury and property damage caused by storms.	
Total STAPLEE Score	Hurricanes and Tropical Storms
Primary Hazard	4
Status	New
Responsible Department	Public Works
Timeframe	7/2020-6/2022
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget / Grants

Strategy #SC3

Implement a project to map the near shore sand and sediment transport to develop a sand-budget model for monitoring island wide coastal erosion. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep. Mapping in high resolution monitors the movement of sand shoals and identifies location of marine habitat on the sea floor.	
Total STAPLEE Score	Sea Level Rise, Shoreline Change, and Erosion
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2021-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Grants

Strategy #SC4

Implement a project to map the harbor floors (Madaket, Polpis and Nantucket) to measure and monitor sediment transport. Information will be used to develop dredging and disposal plan, as well as the Harbor management Plan. Side scan sonar will be used to measure bathymetry in extremely shallow water, between 0 and 20 ft. deep.	
Total STAPLEE Score	Sea Level Rise, Shoreline Change, and Erosion
Primary Hazard	4
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2021-6/2023
Estimated Cost	More than $100,000
Potential Funding Sources	Grants

Town of Nantucket Prioritized Hazard Mitigation Strategies

Strategy #A2

Provide Incident Command System training to essential staff	
Total STAPLEE Score	All
Primary Hazard	3
Status	New
Responsible Department	Emergency Management
Timeframe	7/2018-6/2023
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

Strategy #A18

Develop a public outreach program that target public school teachers and students (K-12) and works to add appropriate climate science, sea level rise, hazard mitigation and coastal resilience planning to the curriculum.	
Total STAPLEE Score	All
Primary Hazard	3
Status	New
Responsible Department	Nantucket Public Schools
Timeframe	7/2020-6/2022
Estimated Cost	$10,000 - $50,000
Potential Funding Sources	Operating Budget

Strategy #F12

Extend the above height exception to any building elevating its first floor for flood mitigation purposes, even if outside current flood zone.	
Total STAPLEE Score	Flooding
Primary Hazard	3
Status	New
Responsible Department	Planning & Land Use Services
Timeframe	7/2019-6/2021
Estimated Cost	Less than $10,000
Potential Funding Sources	Operating Budget

APPENDIX B: DOCUMENTATION OF PLAN DEVELOPMENT

Meeting Agenda

HAZARD MITIGATION PLAN UPDATE FOR NANTUCKET

September 18, 2017

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1. Purpose and Need for Hazard Mitigation Plan
2. Long Term Goals of Hazard Mitigation
3. Update on Hazard Mitigation Grant Programs
4. How Can the Plan be Used?
5. Hazards to Include in the Plan
6. Hazard Mitigation Strategies and Actions
7. Components of the Planning Process
8. Data Collection and Discussion
9. Update Mitigation Goals, Strategies, and Actions
10. Next Steps

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Update of Hazard Mitigation Plan for the Town of Nantucket

Presented by:
David Murphy, P.E., CFM
Noah Slovin, CFM
Milone & MacBroom, Inc.

September 18, 2017

Agenda

- Purpose and Need for Hazard Mitigation Plan
  - Long Term Goals of Hazard Mitigation
- Update on Hazard Mitigation Grant Programs
  - How Can the Plan be Used?
- Hazards to Include in the Plan
- Hazard Mitigation Strategies and Actions
- Components of the Planning Process
- Data Collection and Discussion
- Update Mitigation Goals, Strategies, and Actions
- Next Steps

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Purpose and Need for Hazard Mitigation Plan

- **Authority**
  - o Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)
- **Goal of Disaster Mitigation Act**
  - o Encourage disaster *preparedness*
  - o Encourage hazard mitigation *actions* to reduce losses of life and property
- **Status of Plans in Massachusetts**
  - o Most initial plans developed 2005-2011
  - o Local plans are updated every five years
  - o Nantucket HMP was adopted in 2007
  - o The State HMP is being updated now

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Purpose and Need for Hazard Mitigation Plan

- What is a Natural Hazard?
  - ✓ An extreme natural event that poses a risk to people, infrastructure, and resources

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Purpose and Need for Hazard Mitigation Plan

- **What is Hazard Mitigation?**
  - ✓ **Actions we take now that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects**

Elevation in Madaket

Removal of Structures in Codfish Park

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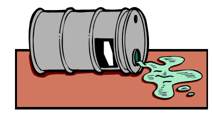
Purpose and Need for Hazard Mitigation Plan

- **Hazard Mitigation Plan does not *directly* address:**
  - ✓ **Disaster Response and Recovery**
  - ✓ **Terrorism and Sabotage**
  - ✓ **Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc**



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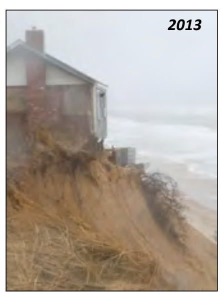
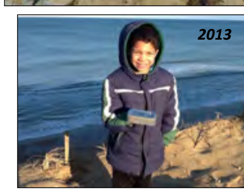
Purpose and Need for Hazard Mitigation Plan

- **But WHY should we plan?**
  - ✓ Lost residents and neighborhoods, eroded social fabric
  - ✓ Lost tax base and decreased economic activity nearby



Some towns are not able to easily delete a parcel from their grand list!



7

Long-Term Goals of Hazard Mitigation

- **Reduce**
  - **loss** of life
  - **damage** to property and infrastructure
  - **costs** to residents and businesses (taxes, insurance, repair costs, etc.)
  - municipal service costs (**long-term**, e.g. emergency response, infrastructure maintenance)
- **Educate**
  - residents
  - policy-makers
- **Connect**
  - hazard mitigation planning to other community planning efforts
- **Enhance**
  - and preserve natural resource systems in the community

Nantucket Harbor

Drainage Berm along Lovers Lane

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Update on Hazard Mitigation Grant Programs

- Local communities must have a FEMA-approved Hazard Mitigation Plan in place to receive Federal Grant Funds for Hazard Mitigation Projects
  - o PDM (Pre-Disaster Mitigation)
  - o HMGP (Hazard Mitigation Grant Program)
  - o FMA (Flood Mitigation Assistance)
- Massachusetts has allocated its HMGP funds from Hurricane Sandy, Winter Storm Nemo in 2013, and the winter storm of early 2015
- Next opportunity for grant applications will be PDM in 2018

HAZARD MITIGATION GRANT PROGRAM

PRE-DISASTER MITIGATION

FLOOD MITIGATION ASSISTANCE

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How Can the Plan be Used?

- Grants can be used for:
  - o Building acquisitions or elevations
  - o Culvert replacements
  - o Drainage projects
  - o Bank stabilization
  - o Landslide stabilization
  - o Wind retrofits
  - o Seismic retrofits
  - o Snow load retrofits
  - o Standby power supplies for critical facilities

This home was acquired and demolished using a FEMA grant

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How Can the Plan be Used?

Culvert Replacement funded by HMGP in Buckland, MA

Floyd 1999

Irene 2011

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How Can the Plan be Used?

Riverbank Stabilization funded by HMGP in Hawley, MA

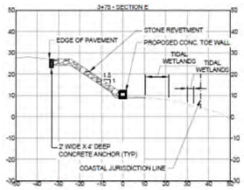
Irene 8/2011

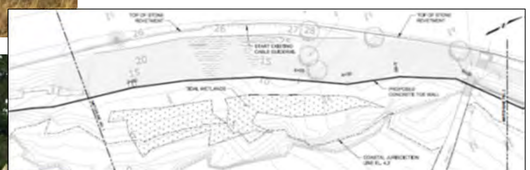
Post-Irene 9/2011

Construction August 2017

How Can the Plan be Used?

Coastal Bank Stabilization funded by HMGP in Branford, CT





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Hazards to Include in the Plan

- Non-Coastal Floods
- Coastal Floods
- Coastal and Erosion Hazards
- Hurricanes and Tropical Storms
- Summer Storms and Tornadoes
- Winter Storms and Nor'easters
- Wildfires
- Earthquakes

Climate Change

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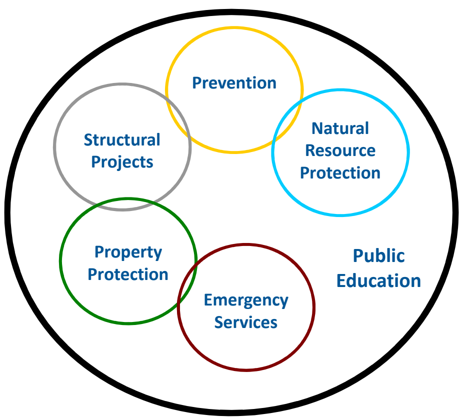
Hazard Mitigation Strategies and Actions



Structural Project

Property Protection

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Flood Mitigation Strategies

Flood Mitigation

Structural Projects

- Replace Bridges and Culverts
- Remove In-Stream Dams
- Remove Obstructions
- Upstream Detention
- Install Stormwater Systems
- Create Floodways
- Enlarge Channels
- Reduce Flow Resistance
- Install Levees
- Install Flood Walls

Property Protection

- Wet Floodproofing
- Dry Floodproofing
- Elevate Buildings
- Relocate Buildings
- Secure Utilities
- Anchor Floatables
- Remove Hazardous Materials
- Re-Grade Properties
- Purchase Flood Insurance
- Join the Community Rating System (CRS)

Prevention

- Modify Zoning
- Modify Comp Plan
- Stormwater Management Regulations
- Increase Flood Damage Prevention Standards
- Freeboard
- Low Impact Development
- Minimize Impervious Cover

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Flood Mitigation Strategies

Flood Mitigation

Natural Resources

- Acquire or Preserve Floodplain Land
- Acquire and Remove Structures from Floodplains and Convert to Open Space
- Acquire or Preserve Other Lands
- Increase Wetland Storage
- Re-Connect Streams to Floodplains

Emergency Services

- Build Local Capacities to Respond
- Move Critical Facilities from Flood Risk Areas
- Establish Emergency Shelters
- Elevate Roads or Bridges to Ensure Egress
- Develop Community Evacuation Plans
- Develop Site-Specific Evacuation Plans
- Establish Satellite Facilities in Areas Subject to Isolation

Public Education

- Newsletters
- Community Meetings
- Information Kiosks
- Web Site with Flood Risk Maps
- Education of Municipal Staff
- Leverage State and FEMA Education Programs
- Establish a Standing Committee or Board to Oversee Outreach

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Other Hazard Mitigation Strategies

- Strengthen or reinforce shelters and critical facilities
- Create backup critical facilities
- Bury utilities
- Harden utilities
- Expand and fund tree maintenance programs
- Snow removal plans and programs
- Shutters, load path, and roof projects
- Enhance fire suppression capabilities with dry hydrants, cisterns, etc.
- Bracing for potential earthquake damage
- Public education programs and resources

Hurricane Shutters

Dry Hydrants

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Components of the Planning Process

- Review and confirm natural hazards that could occur
- Identify critical facilities and areas of concern
- Update the vulnerability and risk assessments for structures and populations
- In 2007, *narratives* of the above were sufficient. Presently, the following are required:
  - ✓ HAZUS analysis for floods, hurricane winds, and earthquakes
  - ✓ Loss estimates for all hazards, based on the State HMP at a minimum but supplemented by local sources of information and FEMA Public Assistance reimbursements

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Components of the Planning Process

- Review Locations of Repetitive Loss (RL) Properties

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Components of the Planning Process

- **Review Locations of Repetitive Loss (RL) Properties**




Downtown and Brant Point

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Components of the Planning Process

- **Review Locations of Repetitive Loss (RL) Properties**




Madaket and Sheep Pond Road

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Components of the Planning Process

- **Incorporate effects of the ten federally declared disasters that have occurred since the 2007 HMP was adopted:**

Incident	Year	#
Nor'easter of April 2007	2007	DR-1701
Winter Storm of December 2008	2008	DR-1813
Flooding of March 2010	2010	DR-1895
Winter Storm of January 2011	2011	DR-1959
Springfield tornadoes of June 2011	2011	DR-1994
Tropical Storm Irene of August 2011	2011	DR-4028
Winter Storm Alfred of October 2011	2011	DR-4051
Hurricane Sandy in October 2012	2012	DR-4097
Winter Storm Nemo in February 2013	2013	DR-4110
Winter Storm of January 2015	2014	DR-4214

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Components of the Planning Process

- **Outreach to "neighboring communities"**
- **Public participation**
- **Assess adequacy of mitigation measures currently in place**
- **Update mitigation goals, strategies, and actions**
- **Develop plan document**
- **State (MEMA) and FEMA reviews**
- **Plan adoption**
- **Annual plan maintenance and reporting**

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Data Collection and Discussion

- Have the critical facilities changed?
- Have shelters and evacuation routes changed?
- Any new standby power supplies?
- Discussion of recent storms
- Development and redevelopment trends
- Update on areas of flooding
- How are drainage and flooding complaints received and tracked?
- Have any bridges, culverts, tide gates, or stormwater systems been replaced or upgraded?

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Data Collection and Discussion

- Update on areas prone to wind damage or increased wind damage risk
- Tree maintenance and tree warden budget
- Update on snow and ice removal routes and capabilities
- Update on areas prone to icing or drifts in winter
- Areas prone to wildfires, fire department capabilities, coordination with nearby municipalities
- Areas without fire protection and use of dry hydrants and cisterns

Milestone Road Wind Breaks

MILONE & MACBROOM

Data Collection and Discussion

- Loss Estimates
  - ✓ Public Assistance reimbursements needed (2007-2017)
  - ✓ Typical costs to recover from a severe thunderstorm
  - ✓ Typical costs to recover from a severe winter storm
  - ✓ Typical costs to address a wildfire or brush fire

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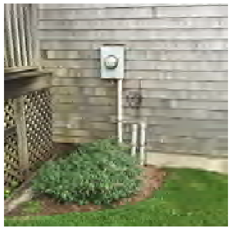
Update Mitigation Goals, Strategies, Actions

- **Think about mitigation that's already happening**
  - ✓ Home elevation, wet floodproof garage, and elevate utilities



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Update Mitigation Goals, Strategies, Actions

- **Think about mitigation that's already happening**
  - ✓ Home relocation or acquisition/demolition

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Update Mitigation Goals, Strategies, Actions

- **Think about mitigation that's already happening**
  - ✓ Erosion mitigation projects

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Update Mitigation Goals, Strategies, Actions

EXAMPLES

- **What is the Town's vision for hazard mitigation?** → *Continue to mitigate losses from natural hazards while maintaining a high quality of life for residents and visitors*
- **What are some goals for hazard mitigation?** → *Reduce loss of property. Reduce flood insurance claims. Protect Town infrastructure. Maintain response capabilities.*
- **What are some objectives for hazard mitigation?** → *Continue some erosion control projects while incorporating green infrastructure. Elevate additional homes. Maintain adequate egress/access. Further reduce drifting snow.*

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Update Mitigation Goals, Strategies, Actions

- **Review prior actions**
  - ✓ "Ongoing" and "continue" are not allowed anymore
- **New mitigation actions**
  - ✓ Should be achievable within five years (i.e. "design" rather than "construct")
  - ✓ What one or two things can be done with current budgets?
  - ✓ What one or two things would be done if funding was not a concern?

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Next Steps
Provide information requested today
Outreach and public involvement
Public information meeting
Stakeholder meeting
MILONE & MACBROOM

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
9/18/17

Nantucket Hazard Mitigation Plan Update Kickoff Meeting

9/18/2017

Attendees:

Name	Role
Dave Fronzuto	Emergency Management Coordinator
Brendan Coakley	Nantucket Police
Stephen Murphy	Fire Department / Chief
Martha Lake-Greenfield	Nantucket Cottage Hospital
Nathan Porter	GIS (nporter@nantucket-ma.gov)
Lauren Sinatra	Energy
Jeff Carlson	Natural Resources
Michael Cozort	Nantucket Public Schools
Diane ONeil	Nantucket Public Schools
Holly Backus	Planning and Land Use Services (PLUS) – Landuse Specialist
Bill Pittman	Chief of Police / EMD
Chuck Larson	Deputy Director DPW
Rob McNeil	DPW Direction
Mike Burns	Transportation Planner / Planning
Robert Santamaria	Health Director
David Gray Sr.	Sewer Director

David Murphy began the meeting by running through a presentation outlining basic concepts of hazard mitigation, the hazard mitigation planning process, and the benefits of developing and maintaining a hazard mitigation plan. The presentation included information about hazard mitigation funding opportunities available through the federal government.

The Emergency Manager (EM) noted that the week previous to this meeting the Town had held an emergency training drill that included walking through the steps of an emergency event being declared a disaster by the local emergency manager and eventually by the federal government. Different funding pools that become available once emergencies are declared were reviewed at that drill.

A meeting attendee asked who at the Town level was responsible for final plan adoption. Mr. Murphy answered that the board of selectmen adopted the plan.

Mr. Murphy noted that having the Town's records of reimbursements through the PA grant program was important for estimating hazard costs in the plan. The Emergency Manager will provide this information for each of the declared disasters since and including Tropical Storm Irene [which hazards were to be included was clarified at the end of the meeting].

Vision, Goals, and Objectives

Mr. Murphy introduced the concept of creating a Vision, a set of Goals, and a set of Objectives to guide the Plan and its implementation. He presented some sample language for each, and asked for comments and suggestions.

Mr. Kozart suggested adding a line to the vision that conveyed "not adversely affecting other aspects of the Island." This idea was noted for being applicable to debate around the Baxter Road project, where protecting Baxter Road had to be done without adversely affecting the aesthetic and habitat quality of the beach below.

The Emergency Manager suggested including preservation of the Island's historic quality in the vision. There is a strong advocacy from the environmental and historic preservation groups on the Island.

Resiliency

Lauren asked about including concepts of "Resiliency" in the plan Vision, or in the plan generally. Mr. Murphy agreed that resiliency is an important concept that should inform plan development, but observed that it is not practical to combine resilience plans and Hazard Mitigation Plans (by, for example, making the HMP into a resilience plan, or vice versa).

Lauren pointed out that there are many grants available supporting development of microgrids, power islands, and backup power. She believes that including such actions in the HMP will increase the Island's ability to secure such grants.

Holly Backus noted that the Island is separately looking into resiliency and development of resiliency plans through the Massachusetts Coastal Zone Management program (CZM). She asked if there is any overlap between MEMA and CZM. A public meeting about improving the Island's coastal resiliency is scheduled for September 25, 2017.

Dave Murphy said that other municipalities that Milone and MacBroom has worked with have appended a Coastal Resiliency Plan to their HMP, or have used the HMP to apply for grants while using the CRP as a guiding document creating a municipal vision and supplying project ideas.

Update Process

David Graham asked about the update process. David Murphy walked through the steps of updating the plan, how the update schedule affects the Town's ability to secure grants, and some of the changes that will be seen in the updated plan.

David Graham noted that the sewer department is currently working on a $6 million project to update the Island's main pumping station in the downtown neighborhood. He also noted that the sewer department has many generators, but could use more. He wondered whether the pumping station update project or the acquisition of more generators should be included in the HMP, and whether they might be eligible for funding through FEMA.

Attendees asked why the previous HMP had expired before being updated.

Nantucket, MA Hazard Mitigation Plan Update
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Chief Pittman suggested that poor coordination between departments had led to the Town losing track of the HMP status.

David Graham noted that there has been a great deal of staff turnover, which has likely contributed to the Town losing track of the HMP status.

Floodplains and Elevation

The Emergency Manager informed meeting attendees that the FEMA Flood Insurance Rate Map for Nantucket had been updated in 2014. In 2014 and 2015 five letters of map amendment (LOMA) were submitted to FEMA; all five have been approved. He clarified that LOMAs allow a building to considered outside of the floodplain if it has been sufficiently elevated.

Meeting attendees shared that elevating buildings had been discussed, but some issues had arisen:

- Building elevations come up against building height restrictions in many areas.
- Building elevations that include grade alterations can direct water onto adjacent properties.
- Many of the buildings on Nantucket are historic, and pose additional complications with regards to elevating or performing other flood mitigation activities.

Energy Reliability

Lauren noted that her department is working on a couple of alternative backup power projects:

- With TESLA, she is working on distributing powerwall batteries to residents, providing backup power in individual homes
- She is also exploring installation of solar PV panels on the island to allow for local power generation.

Open Space:

LandBank acquires and preserves open space on Nantucket. Two ongoing acquisition projects are:

- Washington Street: LandBank is working to acquire all of the waterfront parcels
- Easy Street: Acquisitions are ongoing

Bank Protection and Beach Nourishment

Three ongoing bank protection and beach nourishment projects were listed:

- Hummock Pond
- Matackut Road
- Quaise Road

Drainage

A study of the downtown area's stormwater drainage system is being completed.

The Consue Springs project is being rebooted; this project includes a number of drainage upgrades, and overlaps with conservation and open space preservation goals.

David Graham reiterated that the sewer department has four portable generators, which can be used to maintain pumping station operation during power outages.

Critical Facilities

A new school (Nantucket Intermediate School) has been constructed recently and includes a generator. It has not been designated as a shelter, but the Town is interested in reviewing the property and determining its ability to serve as a shelter.

The backup generator at the elementary school has been replaced. This building is also not a shelter, but the Town is interested in reviewing the property and determining its ability to serve as a shelter.

The backup generator at the Town's existing shelter is "pre-staged" through a USACE program. If the generator were to fail, the USACE can bring in a replacement that is "pre-staged" and would be able to be hooked up and used immediately. The Town would consider doing this for the school generators as well were those sites to be used as emergency shelters.

Additional sheltering space for emergency personnel would be helpful. For example, National Grid sent workers down to restore power after previous storms, and it was difficult to house those workers and residents in shelters.

It was noted that the State is providing grants for development of clean energy sources for critical facilities. It was suggested that these grants could be pursued in order to install solar panels on the roofs of shelters or other critical facilities to provide clean energy and an additional source of backup power. It was noted that solar panels and wind turbines would likely be inoperable during storm events, and so any additional power provided by those sources would not be available until the hazard event had passed.

Snow

New protocols have been implemented for mitigating snow drifting on Milestone Road. Snow fences are deployed farther from the road than in the past, and have helped significantly. The Town is now able to keep up with plowing requirements on that road during events.

The DPW plows, and in recent years has used private contractors as well to supplement their force. This has been effective at keeping Town roads clear, however it has led to a backlog of private roads that would have otherwise used those private contractors. There is a limited pool of plowing resources on the island. Outside help is not feasible. The Airport will also help the Town with their plows when possible.

New Actions

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
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Dave Murphy opened the meeting up to a conversation about new actions that attendees might want to add to the plan. Suggestions were as follows:

- Relocate the Town's records to a new location outside of the floodplain.
- Mitigate the repetitive damage to the Harbormaster's facility on the Town Pier
- Validate the Repetitive Loss list
- Address flood and storm vulnerabilities at the Finance Department and Harbormaster Building along Washington Street (34-38 Washington Street).
- Relocate Finance Department records outside of the floodplain.
- Relocate Health Department records (septic system plans, drinking water plans, etc., on mylar) outside of the floodplain.
- Protect the critical facilities of the Ferry Terminal and Airport
- Develop Alternate Shelters for Matakut and 'Sconset in case of isolation – perhaps at the local fire or police departments.
- Address the risk posed by failure of Millies Bridge: if it is washed out, access and utilities to the neighborhood on the far side [Smith Point?] would be cut off. Actions may be to elevate or harden the bridge.

On the following pages, the status of previously recommended actions is summarized, based on information collected during the meeting:

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
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	Action	Dept.	Complete	Drop	Carry	Notes
	PLANNING AND REGULATIONS					
1	Increase cooperation between Conservation Commission, Planning Board, Building Dept., and Health Dept.	Various	yes	X	no	This is now a capability
2	Implement a development checklist that lists all required permits	Various	no	X	no	This is not believed necessary
3	Petition FEMA to more critically evaluate LOMA applications	Various	yes	X	no	The Town spent considerable time after the current FEMA maps were issued, working with property owners to review questions related to potential LOMAs. At the present time, the Town does not believe that many LOMAs are pending, and feels that current capabilities are appropriate to handle future LOMA requests.
4	Adopt freeboard standards (two feet for dwellings and one foot for roadways) in Wetland, Zoning, and Bldg. Regulations	Various	no		yes	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones.
5	Adopt V zone standards in coastal A zones	Various	no		yes	This would be challenging given the configurations of coastal A zones in the Town. A better approach is to adopt freeboard in AE zones.
6	Revise the setback clause in the Wetlands Regulations (20 times the erosion rate or 100 feet) to be more stringent	Conservation	yes	X	no	This is now a capability
7	Enforce Building codes for earthquakes	Building	yes	X	no	This is now a capability
	DWELLING RELOCATION AND ELEVATION					

Nantucket, MA Hazard Mitigation Plan Update
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	Action	Dept.	Complete	Drop	Carry	Notes
8	Offer to assist in the application for FEMA funds to relocate homes if owners agree to cease hard solutions	Conservation	yes	x	no	The Town has assisted in two cases, and can assist in the future if needed. This is now a capability.
9	Encourage home elevation in Codfish Park residential area to the coastal base flood (9') plus two feet	Health	No	X	no	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Codfish Park.
10	Encourage home elevation in Madaket flood zones to the coastal base flood (8') plus two feet	Health	No	X	no	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Madaket.
	MISCELLANEOUS					

Nantucket, MA Hazard Mitigation Plan Update
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	Action	Dept.	Complete	Drop	Carry	Notes
11	Replace overhead utilities with underground utilities	Public Works	No		yes	The Town does not believe this will be cost effective in large areas, but would like to pursue a pilot project. A new actions is suggested.
12	Increase tree limb inspections and maintenance in Sconset and downtown	Public Works	yes		No	This is now a capability
13	Promote wood construction of buildings	Building	yes		No	This is now a capability
14	Continue Sesachacha Pond drawdown twice each year to prevent high water	Public Works	yes		No	This is now a capability
15	Continue to make sandbags available to protect sewer pumping station downtown	Public Works	yes		No	This is now a capability. In addition, a $6 million upgrade to the downtown pumping station includes floodproofing and replacement of the pump with a submersible pump.
	FUEL TANK FARM					
16	Ensure that pre-disaster hazard mitigation is a primary consideration/factor in analysis of fuel storage/delivery alternatives	Selectman	yes	x	no	Tank farm being relocated to an area with minimal flood risk.
17	If tank farm should remain, floodproofing should be inspected/upgraded; freeboard standards should be applied to flood-proofing	Selectman	no	X	no	Tank farm being relocated to an area with minimal flood risk.
18	If tank farm should be relocated, relocate outside flood and hurricane storm surge zones to area accessible during disasters	Public Works	yes	X	no	Tank farm being relocated to an area with minimal flood risk.
	CONSERVATION AND OPEN SPACE					

Nantucket, MA Hazard Mitigation Plan Update
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	Action	Dept.	Complete	Drop	Carry	Notes
19	Focus open space and conservation acquisitions on coastal properties	Land Bank, Private	yes		Yes	This is an ongoing action. Suggested revision to specify the number of acres to be acquired within five years. Check with Nantucket Land Bank.
20	Pursue conservation objectives in the Madaket Area Plan	Land Bank, Private	?			Need to check the plan
21	Purchase the development rights to the 270-acre Loring Property	Land Bank, Private	yes	X	no	Complete
22	Pursue conservation objectives in the Sconset Area Plan	Land Bank, Private	?			Need to check the plan
23	Implement open space zoning	Planning	no			Need to review the open space plan to see what it says about this
	BEACH NOURISHMENT AND DEWATERING					
24	Support privately-funded beach nourishment projects that have minimal environmental impacts	Various	yes	X	no	This is now a capability
25	Develop a list of potential Town-funded and/or FEMA-funded beach nourishment demonstration projects	Conservation	yes		yes	Several have been identified, but more are desired. For example, the Town is completing projects at the ends of Madaket Road and Hummock Pond Road; and the Town was a participant with the Baxter Road project. Suggested action is to list those that could be pursued within five years.
26	Urge State regulators to make a determination relative to beach dewatering effectiveness	Public Works	no	x	no	The Town no longer supports this potential method of beach accretion, and it will not be approved for use.

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
9/18/17

	Action	Dept.	Complete	Drop	Carry	Notes
	DRAINAGE AND ROADWAY FLOODING					
27	Conduct master drainage studies for problem areas to ensure that each repair is individually and cumulatively adequate	Public Works	no		Yes	Revise to focus on the downtown area, where a master drainage study is desired.
28	Complete the Orange Street drainage system upgrade	Public Works	yes	x	no	Complete; however, a project in the Consue Springs area is being planned. An action should reflect this.
29	Improve Pleasant Street storm drainage system	Public Works	yes	x	no	Complete
30	Ensure that the Milestone Road crossing of Phillips Run can convey the 100-year flood	Public Works	no	?	?	Check the new FIRM and FIS; this will be noted
31	Increase the elevation of Polpis Road at Sesachacha Pond to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years
32	Increase the elevation of Wauwinet Road at Polpis Harbor to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years
33	Increase the elevation of Polpis Road at Fulling Mill Brook to the base flood (8') plus one foot	Public Works	No		Yes	Revise for achievable action within five years. Resiliency planning will include this road. The condition of the culvert will require action in the near term.
34	Increase the elevation of Madaket Road at Head of Long Pond to the base flood (8') plus one foot	Public Works	No		Yes	Revise for achievable action within five years. Resiliency planning will include this road.
35	Increase the elevation of Madaket Road at Madaket Ditch to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years. Resiliency planning will include this road.
	EMERGENCY SERVICES AND PREPAREDNESS					

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
9/18/17

	Action	Dept.	Complete	Drop	Carry	Notes
36	Develop the 2 Fairgrounds Road property to include a combined Fire/Police facility with an emergency operations center	Emergency	yes	X	no	This was achieved at 4 Fairgrounds Road
37	Upgrade the 2 Fairgrounds Road facility for sheltering capacity	Emergency	no	X	no	This was achieved at 4 Fairgrounds Road. Additionally, shelter reviews are conducted periodically.
38	Purchase additional emergency generators as needed	Emergency	Yes	X	no	FD acquired two generators through Government Surplus; operational use being handled by Emergency Management. Numerous generators were obtained for wastewater pumping stations. The new school (Nantucket Intermediate) has a generator. If a generator located at a shelter fails, a pre-staged generator is available to deploy to that location.
39	Study the feasibility and cost-effectiveness of central dispatching if the combined Fire/Police facility does not move ahead	Emergency	Yes	x	no	This was achieved at 4 Fairgrounds Road
40	Implement central dispatching if feasible and cost-effective	Emergency	Yes	x	no	This was achieved at 4 Fairgrounds Road
41	Seek more housing for seasonal police staff	Emergency	?	?	?	?
42	Evaluate the equipment, training, and personnel needs of the Fire and Police Departments as Townwide population increases	Emergency	yes	x	no	This is now a capability
43	Begin using the Reverse 911 system	Emergency	no	x	no	Ping 4 is used, and Nantucket is a StormReady community.

Nantucket, MA Hazard Mitigation Plan Update
Public Meeting Notes
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	Action	Dept.	Complete	Drop	Carry	Notes
44	Mobilize emergency equipment and personnel to Madaket village in advance of predicted nor'easters and tropical storms	Emergency	No		Yes	No, Structure does not allow staffing
45	Mobilize emergency equipment and personnel to Sconset village in advance of predicted nor'easters and tropical storms	Emergency	No		Yes	No, Structure is not ideal for staffing
46	Provide evacuation plans for masonry critical facilities	Emergency	?	?	?	?
47	Provide alternative locations for municipal departments housed in masonry buildings	Emergency	Partially complete		yes	Several municipal departments would like their office locations to be addressed due to vulnerabilities that are present. Suggested new actions include: Need to fill in
48	Develop mutual aid agreements with conservation groups to fight wildland fires	Fire	Underway	x	no	FD & Land Bank do have an informal agreement that is being developed into a formal MOU for their help in large area wildland fires. This will be completed soon and does not need to be listed as a mitigation action.
49	Pursue funding for water main extensions where additional fire protection is needed	Water	yes		yes	Additional extensions are desired. Suggested revision to list specific segments.
50	Identify and upgrade lines that are substandard for fire protection	Water	yes	x	no	This is a capability
51	Explore alternate solutions to fire protection where it is not feasible to extend a conventional water system.	Fire	Partially complete		Yes	Two of the Tanker's water capacity increased. Still issues in certain areas due to access and water sources. Suggested revision to list specific actions.

	Action	Dept.	Complete	Drop	Carry	Notes
52	Develop fire ponds in vulnerable areas without public water systems	Fire	Partially complete		Yes	Water sources are available in some locations, upkeep and development of Ponds is difficulty and can be costly to maintain. Suggested revision to list specific actions.
53	Provide funding for additional Marine Dept. staff to assist with boat removal before storms	Marine	yes	x	no	This is now a capability
54	Designate sites for boat storage during storm events	Marine	yes	x	no	This is now a capability
55	Identify actions that Sconset and Madaket residents can take in advance to be prepared	Emergency	yes	x	no	This is now a capability
56	Conduct Emergency Preparedness Seminars for Sconset and Madaket residents	Emergency	yes	x	no	This is now a capability
57	Wildfire booklet should be made available at Health & Building Departments	Emergency	yes	x	no	This is now a capability
	TRANSPORTATION, EVACUATION, AND EMERGENCY ACCESS					
58	Urge conservation groups to restore windbreaks along Milestone Road	Public Works	yes	x	no	This is now a capability. Specifically, snow fencing is deployed each winter, and plowing capabilities have been increased. Tree planting has been also used.
59	Continue to use two rows of snow fencing along Milestone Road	Public Works	yes	x	no	This is a capability
60	Improvements in the Mid-Island Area should include enhancing traffic flow, increasing safety, and emergency access	Public Works	yes	x	no	Complete
61	Reconstruct the Milestone Rotary as a modern roundabout	Public Works	yes	x	no	Complete
62	Ensure that new subdivisions with private roads have designated homeowners associations to provide maintenance	Planning	yes	x	no	This is a capability

	Action	Dept.	Complete	Drop	Carry	Notes
63	Evaluate private roads to determine where essential improvements are necessary	Public Works	No	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
64	Formalize agreements for roadway maintenance with private road owners	Public Works	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
65	Consider the dedication of some private roads as public, or negotiation of either public or private maintenance agreements	Selectman	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
66	Enforce existing private road maintenance agreements that were required by the Town	Selectman	no	x	no	Enforcement is not needed.

Nantucket, MA Hazard Mitigation Plan Update
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	Action	Dept.	Complete	Drop	Carry	Notes
67	Identify private roads to be acquired as public roads for safety of residents	Selectman	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
68	Increase plowing of Milestone Road in snow drift areas	Public Works	yes	x	no	This is a capability.
69	Develop an alternate access route to Madaket via Eel Point Road and Warren's Landing Road	Public Works	no		yes	Suggest more specific action.
70	Develop and adopt a minimum standard of road improvement to be utilized for public safety	Selectman	yes	x	no	The Planning Board and Fire Department review roadways.
71	Utilize available technology and warning systems to ensure that adequate equipment is available to keep Harbor open	Town	yes	x	no	This is a capability.
72	Develop detailed evacuation plans for downtown and Brant Point residents	Emergency	no	x	no	Addressed in townwide evacuation protocols.
73	Develop village evacuation plan for Sconset	Emergency	no	x	no	Addressed in townwide evacuation protocols.
74	Develop village evacuation plan for Madaket	Emergency	no	x	no	Addressed in townwide evacuation protocols.

	Action	Department	Has Item Been Completed?	Action is No Longer Needed	Should Item Be Carried Forward?	Comments
	PLANNING AND REGULATIONS					
1	Increase cooperation between Conservation Commission, Planning Board, Building Dept., and Health Dept.	Various	yes	X	no	This is now a capability
2	Implement a development checklist that lists all required permits	Various	no	X	no	This is not believed necessary
3	Petition FEMA to more critically evaluate LOMA applications	Various	yes	X	no	The Town spent considerable time after the current FEMA maps were issued, working with property owners to review questions related to potential LOMAs. At the present time, the Town does not believe that many LOMAs are pending, and feels that current capabilities are appropriate to handle future LOMA requests.
4	Adopt freeboard standards (two feet for dwellings and one foot for roadways) in Wetland, Zoning, and Bldg. Regulations	Various	no		yes	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones.
5	Adopt V zone standards in coastal A zones	Various	no		yes	This would be challenging given the configurations of coastal A zones in the Town. A better approach is to adopt freeboard in AE zones.
6	Revise the setback clause in the Wetlands Regulations (20 times the erosion rate or 100 feet) to be more stringent	Conservation	yes	X	no	This is now a capability
7	Enforce Building codes for earthquakes	Building	yes	X	no	This is now a capability
	DWELLING RELOCATION AND ELEVATION					
8	Offer to assist in the application for FEMA funds to relocate homes if owners agree to cease hard solutions	Conservation	yes	x	no	The Town has assisted in two cases, and can assist in the future if needed. This is now a capability.
9	Encourage home elevation in Codfish Park residential area to the coastal base flood (9') plus two feet	Health	No	X	no	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Codfish Park.
10	Encourage home elevation in Madaket flood zones to the coastal base flood (8') plus two feet	Health	No	X	no	The State Building Code requires 2' freeboard for VE zones. The Town has not adopted a local freeboard requirement for AE zones. A townwide freeboard requirement would be more appropriate than encouraging voluntary use of freeboard in Madaket.
	MISCELLANEOUS					
11	Replace overhead utilities with underground utilities	Public Works	No		yes	The Town does not believe this will be cost effective in large areas, but would like to pursue a pilot project. A new actions is suggested.
12	Increase tree limb inspections and maintenance in Sconset and downtown	Public Works	yes		No	This is now a capability
13	Promote wood construction of buildings	Building	yes		No	This is now a capability
14	Continue Sesachacha Pond drawdown twice each year to prevent high water	Public Works	yes		No	This is now a capability
15	Continue to make sandbags available to protect sewer pumping station downtown	Public Works	yes		No	This is now a capability. In addition, a $6 million upgrade to the downtown pumping

						station includes floodproofing and replacement of the pump with a submersible pump.
	FUEL TANK FARM					
16	Ensure that pre-disaster hazard mitigation is a primary consideration/factor in analysis of fuel storage/delivery alternatives	Selectman	yes	x	no	Tank farm being relocated to an area with minimal flood risk.
17	If tank farm should remain, floodproofing should be inspected/upgraded; freeboard standards should be applied to flood-proofing	Selectman	no	X	no	Tank farm being relocated to an area with minimal flood risk.
18	If tank farm should be relocated, relocate outside flood and hurricane storm surge zones to area accessible during disasters	Public Works	yes	X	no	Tank farm being relocated to an area with minimal flood risk.
	CONSERVATION AND OPEN SPACE					
19	Focus open space and conservation acquisitions on coastal properties	Land Bank, Private	yes		Yes	This is an ongoing action. Suggested revision to specify the number of acres to be acquired within five years. Check with Nantucket Land Bank.
20	Pursue conservation objectives in the Madaket Area Plan	Land Bank, Private	?			Need to check the plan
21	Purchase the development rights to the 270-acre Loring Property	Land Bank, Private	yes	X	no	Complete
22	Pursue conservation objectives in the Sconset Area Plan	Land Bank, Private	?			Need to check the plan
23	Implement open space zoning	Planning	no			Need to review the open space plan to see what it says about this
	BEACH NOURISHMENT AND DEWATERING					
24	Support privately-funded beach nourishment projects that have minimal environmental impacts	Various	yes	X	no	This is now a capability
25	Develop a list of potential Town-funded and/or FEMA-funded beach nourishment demonstration projects	Conservation	yes		yes	Several have been identified, but more are desired. For example, the Town is completing projects at the ends of Madaket Road and Hummock Pond Road; and the Town was a participant with the Baxter Road project. Suggested action is to list those that could be pursued within five years.
26	Urge State regulators to make a determination relative to beach dewatering effectiveness	Public Works	no	x	no	The Town no longer supports this potential method of beach accretion, and it will not be approved for use.
	DRAINAGE AND ROADWAY FLOODING					
27	Conduct master drainage studies for problem areas to ensure that each repair is individually and cumulatively adequate	Public Works	no		Yes	Revise to focus on the downtown area, where a master drainage study is desired.
28	Complete the Orange Street drainage system upgrade	Public Works	yes	x	no	Complete; however, a project in the Consue Springs area is being planned. An action should reflect this.
29	Improve Pleasant Street storm drainage system	Public Works	yes	x	no	Complete
30	Ensure that the Milestone Road crossing of Phillips Run can convey the 100-year flood	Public Works	no	?	?	Check the new FIRM and FIS; this will be noted
31	Increase the elevation of Polpis Road at Sesachacha Pond to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years
32	Increase the elevation of Wauwinet Road at Polpis Harbor to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years

33	Increase the elevation of Polpis Road at Fulling Mill Brook to the base flood (8') plus one foot	Public Works	No		Yes	Revise for achievable action within five years. Resiliency planning will include this road. The condition of the culvert will require action in the near term.
34	Increase the elevation of Madaket Road at Head of Long Pond to the base flood (8') plus one foot	Public Works	No		Yes	Revise for achievable action within five years. Resiliency planning will include this road.
35	Increase the elevation of Madaket Road at Madaket Ditch to the base flood (8') plus one foot	Public Works	No		yes	Revise for achievable action within five years. Resiliency planning will include this road.
	EMERGENCY SERVICES AND PREPAREDNESS					
36	Develop the 2 Fairgrounds Road property to include a combined Fire/Police facility with an emergency operations center	Emergency	yes	X	no	This was achieved at 4 Fairgrounds Road
37	Upgrade the 2 Fairgrounds Road facility for sheltering capacity	Emergency	no	X	no	This was achieved at 4 Fairgrounds Road. Additionally, shelter reviews are conducted periodically.
38	Purchase additional emergency generators as needed	Emergency	Yes	X	no	FD acquired two generators through Government Surplus; operational use being handled by Emergency Management. Numerous generators were obtained for wastewater pumping stations. The new school (Nantucket Intermediate) has a generator. If a generator located at a shelter fails, a pre-staged generator is available to deploy to that location.
39	Study the feasibility and cost-effectiveness of central dispatching if the combined Fire/Police facility does not move ahead	Emergency	Yes	x	no	This was achieved at 4 Fairgrounds Road
40	Implement central dispatching if feasible and cost-effective	Emergency	Yes	x	no	This was achieved at 4 Fairgrounds Road
41	Seek more housing for seasonal police staff	Emergency	?	?	?	?
42	Evaluate the equipment, training, and personnel needs of the Fire and Police Departments as Townwide population increases	Emergency	yes	x	no	This is now a capability
43	Begin using the Reverse 911 system	Emergency	no	x	no	Ping 4 is used, and Nantucket is a StormReady community.
44	Mobilize emergency equipment and personnel to Madaket village in advance of predicted nor'easters and tropical storms	Emergency	No		Yes	No, Structure does not allow staffing
45	Mobilize emergency equipment and personnel to Sconset village in advance of predicted nor'easters and tropical storms	Emergency	No		Yes	No, Structure is not ideal for staffing
46	Provide evacuation plans for masonry critical facilities	Emergency	?	?	?	?
47	Provide alternative locations for municipal departments housed in masonry buildings	Emergency	Partially complete		yes	Several municipal departments would like their office locations to be addressed due to vulnerabilities that are present. Suggested new actions include: Need to fill in
48	Develop mutual aid agreements with conservation groups to fight wildland fires	Fire	Underway	x	no	FD & Land Bank do have an informal agreement that is being developed into a formal MOU for their help in large area wildland fires. This will be completed soon and does not need to be listed as a mitigation action.
49	Pursue funding for water main extensions where additional fire protection is needed	Water	yes		yes	Additional extensions are desired. Suggested revision to list specific segments.
50	Identify and upgrade lines that are substandard for fire protection	Water	yes	x	no	This is a capability

51	Explore alternate solutions to fire protection where it is not feasible to extend a conventional water system.	Fire	Partially complete		Yes	Two of the Tanker's water capacity increased. Still issues in certain areas due to access and water sources. Suggested revision to list specific actions.
52	Develop fire ponds in vulnerable areas without public water systems	Fire	Partially complete		Yes	Water sources are available in some locations, upkeep and development of Ponds is difficulty and can be costly to maintain. Suggested revision to list specific actions.
53	Provide funding for additional Marine Dept. staff to assist with boat removal before storms	Marine	yes	x	no	This is now a capability
54	Designate sites for boat storage during storm events	Marine	yes	x	no	This is now a capability
55	Identify actions that Sconset and Madaket residents can take in advance to be prepared	Emergency	yes	x	no	This is now a capability
56	Conduct Emergency Preparedness Seminars for Sconset and Madaket residents	Emergency	yes	x	no	This is now a capability
57	Wildfire booklet should be made available at Health & Building Departments	Emergency	yes	x	no	This is now a capability
	TRANSPORTATION, EVACUATION, AND EMERGENCY ACCESS					
58	Urge conservation groups to restore windbreaks along Milestone Road	Public Works	yes	x	no	This is now a capability. Specifically, snow fencing is deployed each winter, and plowing capabilities have been increased. Tree planting has been also used.
59	Continue to use two rows of snow fencing along Milestone Road	Public Works	yes	x	no	This is a capability
60	Improvements in the Mid-Island Area should include enhancing traffic flow, increasing safety, and emergency access	Public Works	yes	x	no	Complete
61	Reconstruct the Milestone Rotary as a modern roundabout	Public Works	yes	x	no	Complete
62	Ensure that new subdivisions with private roads have designated homeowners associations to provide maintenance	Planning	yes	x	no	This is a capability
63	Evaluate private roads to determine where essential improvements are necessary	Public Works	No	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
64	Formalize agreements for roadway maintenance with private road owners	Public Works	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
65	Consider the dedication of some private roads as public, or negotiation of either public or private maintenance agreements	Selectman	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
66	Enforce existing private road maintenance agreements that were required by the Town	Selectman	no	x	no	Enforcement is not needed.
67	Identify private roads to be acquired as public roads for safety of residents	Selectman	no	x	no	The Town's approach to private roads is to avoid maintenance; and require private road owners to utilize the existing formal process for requesting that the Town accept private roads.
68	Increase plowing of Milestone Road in snow drift areas	Public Works	yes	x	no	This is a capability.
69	Develop an alternate access route to Madaket via Eel Point Road and Warren's Landing Road	Public Works	no		yes	Suggest more specific action.
70	Develop and adopt a minimum standard of road improvement to be utilized for public safety	Selectman	yes	x	no	The Planning Board and Fire Department review roadways.

71	Utilize available technology and warning systems to ensure that adequate equipment is available to keep Harbor open	Town	yes	x	no	This is a capability.
72	Develop detailed evacuation plans for downtown and Brant Point residents	Emergency	no	x	no	Addressed in townwide evacuation protocols.
73	Develop village evacuation plan for Sconset	Emergency	no	x	no	Addressed in townwide evacuation protocols.
74	Develop village evacuation plan for Madaket	Emergency	no	x	no	Addressed in townwide evacuation protocols.

From: Nathan Porter
To: Noah Slovin
Subject: Nantucket Critical Facilities
Date: Thursday, October 5, 2017 10:56:30 AM

Hi Noah,

I had a chance to go through the locations in my data and compare them to the table you handed out for the Nantucket Critical Facilities, and I have a few notes. Hopefully I'll just be repeating things that others have already brought up.

Emergency Services –

- Renaming the Police Station (in Downtown) to the Sheriff's Office?
- Adding the Public Safety Facility at 4 Fairgrounds

Municipal Facilities –

- Remove 22 Federal St (sold)
- Add Park & Rec at Bathing Beach
- Add Department of Culture and Tourism at S Water St/Federal St?
- Add Health Department at S Water St/E Chestnut St?
- Add Land Bank at Center St?
- Add Former DPW Paint Shop at Orange St?
- Add the Atheneum (Library) at India St?

Schools –

- Add Private schools (not including pre-k)?

Water and Wastewater –

- Add Wannacomet Office?

Transportation –

- Add NRTA Greenhound (Seasonal Information Office)?

Communications –

- There were 2 Cell Towers on the list. I only have one in my data, at 215 Cliff Road. Do you have an address for the second?

I can't say that I have the definitive list of facilities, but these were things that I noticed that I have in my layers that didn't make the list and might need to be on there. If you check with the higher ups in these areas and they disagree, I will bow to their expertise. And if you would like or need copies of these layers (or any others that you are interested in) just let me know.

Nathan Porter
GIS Coordinator
Town Of Nantucket
508-325-4131

The Inquirer and Mirror

Town plans for natural disasters by updating hazard-mitigation plan

By Elizabeth Clemente
I&M Staff Writer
Follow

Posted Oct 30, 2017 at 12:16 PM
Updated Oct 30, 2017 at 12:19 PM

(*Oct. 26, 2017*) The Town of Nantucket is working to ensure the island is more prepared in the face of severe weather. Monday the town held its first public-outreach meeting for its Hazard Mitigation Plan update.

The federal Disaster Mitigation Act of 2000 requires each community in the United States to have an individualized plan approved by the Federal Emergency Management Agency (FEMA), designed to identify what natural risks a community might be prone to and how it can minimize the amount of damage, safety threats and cost to residents in the event of an emergency.

Updating the plan every five years is also necessary in order for towns to be eligible for federal funding to help with http://www.nantucket-ma.gov/

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Popular Links

- *Massachusetts Marijuana Legalization Initiative*
- *New Fire Station Project*
- *Agendas & Minutes*
- *Budget Information*
- *Code of the Town of Nantucket*
- *Licensing & Permitting*

Latest News & Events

View News *View Calendar*

Sewer System Evaluation

The Nantucket Sewer Department is conducting a sewer system evaluation to identify and locate sources of groundwater infiltration and stormwater inflow within the Siasconset and Town Sewer Districts.

Read on...

Town of Nantucket Hazard Mitigation Plan Update

What can be done to minimize our vulnerabilities to natural hazards? Please fill out the survey and let us know!

Read on...

View

Select Language

8:44 AM
11/13/2017

- Intranet
- General Questions & Comments
- New Fire Station Project
- OpenGov Financial Transparency Portal
- Notify Me
- Awards

You Are Here: Home › News Flash

New & Noteworthy

Posted on: October 16, 2017

Town of Nantucket Hazard Mitigation Plan Update

What can be done to minimize our vulnerabilities to natural hazards? Please fill out the survey and let us know!

Hurricanes Sandy, Jose, and Irma are reminders that Nantucket is at risk to significant natural hazards.

What can be done to minimize our vulnerabilities to natural hazards? The Town of Nantucket is updating its hazard mitigation plan to make sure it continues to be relevant and useful. This plan discusses the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan identifies activities that communities can perform before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. This update will identify significant changes in risks, vulnerabilities, capabilities, and mitigation actions that have developed since adoption of the previous plan in 2007.

Please fill out the survey and let us know:

· What Hazards Concern You?

· Where Have You Seen Losses and Risks?

· What Actions Interest You?

Click HERE to take our survey.

The original 2007 plan is available to review on the Town's website. For more information, please email hbackus@nantucket-ma.gov.

Hazard Mitigation Plan Site

Previous
Sewer System Evaluation

Other News in New & Noteworthy

Sewer System Evaluation

Search
All categories
Tools
RSS
Notify Me®
Categories
All Categories
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New & Noteworthy

Posted on: November 15, 2017

Hazard Mitigation Plan Public Meeting

On Monday, November 27th at 6:00 PM at the PSF Community Room, 4 Fairgrounds Road, the Town of Nantucket will host an informational meeting where regional residents can learn about the plan, ask questions, and provide input.

Hurricanes Sandy, Jose, and Irma are reminders that Nantucket is at risk to significant natural hazards.What can be done to minimize our vulnerabilities to natural hazards?

The Town of Nantucket is updating its hazard mitigation plan to make sure it continues to be relevant and useful. This plan discusses the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan identifies activities that communities can perform before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. This update will identify significant changes in risks, vulnerabilities, capabilities, and mitigation actions that have developed since adoption of the previous plan in 2007.

Click HERE for the original 2007 plan. For more information, please email hbackus@nantucket-ma.gov.

Next
Sewer System Evaluation

Other News in New & Noteworthy

4 4

Town of Nantucket @TownofNantucket · Nov 14

SOON #ACKPublicForum The Town invites all to an open meeting where residents & stakeholders can learn about the updated Hazard Mitigation Plan, ask questions, and provide input.

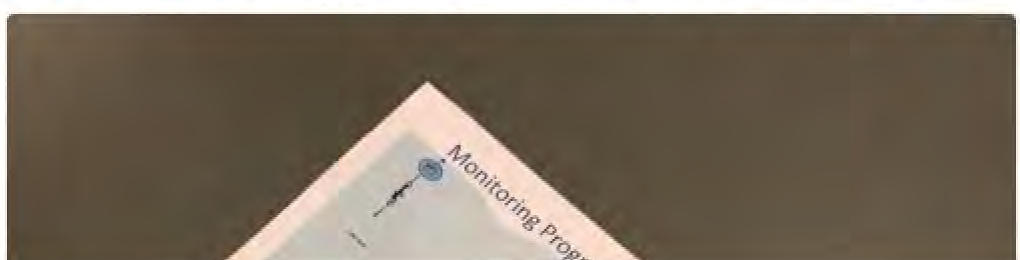
Monday, 11/27, 6 PM @ PSF Community Room, 4 Fairgrounds Road.

ACK Energy Office, Nantucket Health Dpt, Nantucket Police and 3 others

3 2

Town of Nantucket @TownofNantucket · Nov 9

#ACKDPW #ACKPublicForum on Landfill Groundwater Monitoring Program @ 4 Fairgrounds Rd. STARTING NOW. If you aren't here, watch it on NCTV18



Input Needed for Town of Nantucket Hazard Mitigation Plan Update Public Meeting #2

Hurricanes Sandy, Jose, and Irma are reminders that Nantucket is at risk to significant natural hazards. What can be done to minimize our vulnerabilities to natural hazards? The Town of Nantucket is updating its hazard mitigation plan to make sure it continues to be relevant and useful. This plan discusses the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan identifies activities that communities can perform before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. This update will identify significant changes in risks, vulnerabilities, capabilities, and mitigation actions that have developed since adoption of the previous plan in 2007. The Town of Nantucket is offering a second opportunity for the public and the island's stakeholders to attend an informational meeting where regional residents can learn about the plan, ask questions, and provide input:

- **Monday, November 27, 2017 at 6:00PM at the Public Safety Facility Community Room 1st Floor (4 Fairgrounds Road)**

The original 2007 plan is available to review on the Town's website: http://www.nantucket-ma.gov/1126/Hazard-Mitigation-Plan . For more information, please email hbackus@nantucket-ma.gov.

Input Needed for Town of Nantucket Hazard Mitigation Plan Update

Hurricanes Sandy, Jose, and Irma are reminders that Nantucket is at risk to significant natural hazards.

What can be done to minimize our vulnerabilities to natural hazards? The Town of Nantucket is updating its hazard mitigation plan to make sure it continues to be relevant and useful. This plan discusses the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan identifies activities that communities can perform before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. This update will identify significant changes in risks, vulnerabilities, capabilities, and mitigation actions that have developed since adoption of the previous plan in 2007.

The Town of Nantucket is offering an opportunity for the public to attend an informational meeting where regional residents can learn about the plan, ask questions, and provide input:

- Monday, October 23, 2017 at 6:00PM at the Public Safety Facility Community Room 1st Floor (4 Fairgrounds Road)

The original 2007 plan is available to review on the Town's website: http://www.nantucket-ma.gov/1126/Hazard-Mitigation-Plan . For more information, please email hbackus@nantucket-ma.gov.

Hazard Mitigation Plan Update For Nantucket

Hurricane Sandy Town Pier Flooding
Photo: Nicole Harnishfeger / The Inquirer and Mirror

Presented by: David Murphy, P.E., CFM, Milone & MacBroom, Inc.
October 23, 2017

Milone & MacBroom

Agenda

- Hazard Mitigation Planning
- Benefits of Having Plan
- Developing a Plan
- Natural Hazards Facing the Region
- Mitigation Alternatives
- Plan Update
- Discussion

Milone & MacBroom

Hazard Mitigation Planning

Tropical Storm Jose, 2017
Image: NASA

Milone & MacBroom

Hazard Mitigation Planning

Overview

- Authority
  - Disaster Mitigation Act of 2000
- Goals
  - Disaster preparedness
  - Hazard mitigation measures to reduce losses of life and property
- Status of Plans in Massachusetts
  - Most initial plans developed 2005 - 2011
  - Local plans updated every 5 years
  - Nantucket plan adopted in 20017
  - State plan being updated now

Milone & MacBroom

Hazard Mitigation Planning

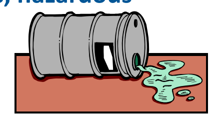
What is a Natural Hazard?

- Extreme natural event that poses a risk to people, infrastructure, and resources

Hazard Mitigation Planning

What Plans DON'T Address:

- Terrorism and Sabotage
- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



Hazard Mitigation Planning

What is Hazard *Mitigation*?

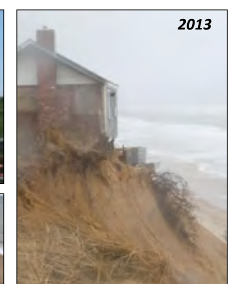
- Actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

Elevation in Madaket

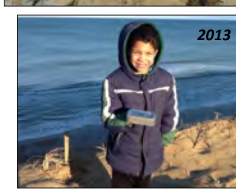
Removal of Structures in Codfish Park

Hazard Mitigation Planning

- But WHY should we plan?
  - ✓ Lost residents and neighborhoods, eroded social fabric
  - ✓ Lost tax base and decreased economic activity nearby



Some towns are not able to easily delete a parcel from their grand list!



Hazard Mitigation Planning

- **Reduce**
  - **loss** of life
  - **damage** to property and infrastructure
  - **costs** to residents and businesses (taxes, insurance, repair costs, etc.)
  - municipal service costs (**long-term**, e.g. emergency response, infrastructure maintenance)
- **Educate**
  - residents
  - policy-makers
- **Connect**
  - hazard mitigation planning to other community planning efforts
- **Enhance**
  - and preserve natural resource systems in the community

Nantucket Harbor

Drainage Berm along Lovers Lane

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Benefits of Having A Plan

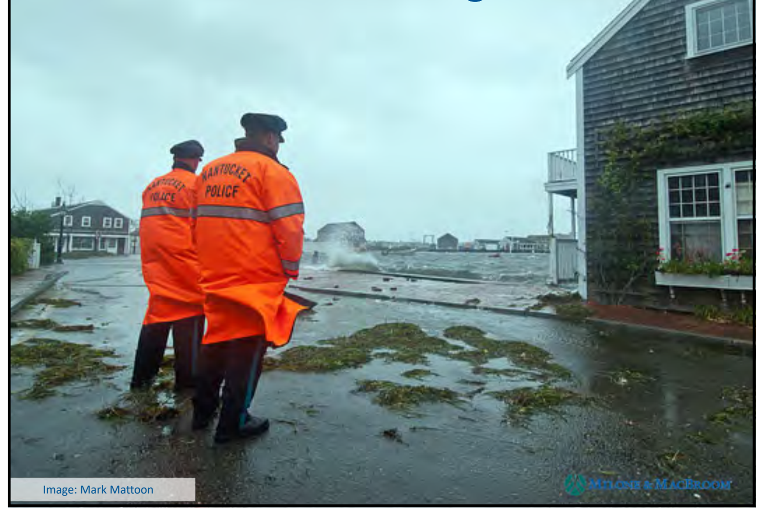

Image: Mark Mattoon

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Benefits of Having a Plan

A Hazard Mitigation Plan Provides:

- **Comprehensive <u>risk assessment</u> to support proposed strategies**
- **Detailed <u>action plan</u> that the community may implement to reduce risk**
- **<u>Coordination</u> with local, regional, State, and Federal entities**
- **Provide State and FEMA with <u>information</u> to guide emergency response and post-event assistance**

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Benefits of Having a Plan

Municipalities <u>must</u> have a FEMA-approved Hazard Mitigation Plan in place to receive Federal Grant Funds for Hazard Mitigation Projects under three grant programs

- *PDM (Pre-Disaster Mitigation)*
- *HMGP (Hazard Mitigation Grant Program)*
- *FMA (Flood Mitigation Assistance)*

- Projects must be cost-effective to be eligible
- Grant funding typically covers 75% of project costs
- Eligible projects may already be identified in local plans and budgets
- Projects often provide long-term reductions in municipal service costs (e.g. emergency response, infrastructure maintenance)
- Can fund post-disaster mitigation of damaged structures and infrastructure

MILONE & MACBROOM

Benefits of Having a Plan

- Massachusetts has allocated its HMGP funds from Hurricane Sandy, Winter Storm Nemo in 2013, and the winter storm of early 2015
- Next opportunity for grant applications will be PDM in 2018

Benefits of Having a Plan

- **Grants can be used for:**
  - Building acquisitions or elevations
  - Culvert replacements
  - Drainage projects
  - Bank stabilization
  - Landslide stabilization
  - Wind retrofits
  - Seismic retrofits
  - Snow load retrofits
  - Standby power supplies for critical facilities

This home was acquired and demolished using a FEMA grant

Benefits of Having a Plan

Culvert Replacement funded by HMGP in Buckland, MA

Floyd 1999

Irene 2011

Benefits of Having a Plan

Riverbank Stabilization funded by HMGP in Hawley, MA

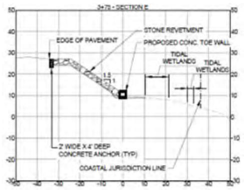
Irene 8/2011

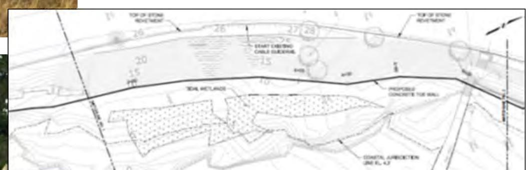
Post-Irene 9/2011

Construction August 2017

Benefits of Having a Plan

Coastal Bank Stabilization funded by HMGP in Branford, CT





Developing A Plan

Nantucket Conservation Commission Public Meeting, 2015
Van Lieu Photograph

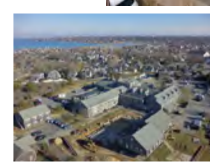
Developing a Plan

- **Identify hazards that could occur in the region**
- **Assess Vulnerabilities and Risks**
  - What's Vulnerable? What is at Risk?
  - How bad would a disaster be? What losses could be expected?
- **Assess Capabilities**
  - What measures are in place to avoid or reduce losses?
  - Where is there room for improvement?
- **Outreach and Collaboration**
  - Public, Neighboring Communities
- **Recommendations**
- **Paperwork**
  - Develop plan document
  - State and FEMA approvals
  - Local adoption

Developing a Plan

Critical Facilities

- **Shelters**
- **Emergency Operations Centers**
- **Municipal facilities such as Town Hall**
- **Fire and Police Departments**
- **Public Works and Highway Garages**
- **Hospitals**
- **Assisted Living and Nursing Homes**
- **Schools – when used as shelters**
- **Airport and Ferry Terminals**
- **Police & Coast Guard Barracks**



Developing a Plan

Historical and Cultural Resources

- Often particularly vulnerable
- Mitigation and adaptation options limited
- Play an important role in anchoring community, building neighborhood cohesion, creating local identity
- Economic value through tourism, preservation and restoration work

Natural Hazards Facing the Island

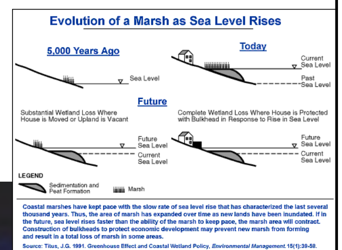
Inland Flooding

- **Riverine/Overbank**
- **Shallow**
- **Nuisance**
- **Poor Drainage**
- **Erosion**
- ***Limited in Nantucket***

(Phillips Run is only inland flood zone)

Coastal Flooding

- **Storm surge**
- **Sea level rise causes**
  - Accelerated coastal erosion
  - Inundation
  - Increased incidence of flooding



What Could Sea Level Rise Look Like?

- **Unlike storm surges or wave action**
- **Over time, flooding gets a little bit worse**

Area-Specific Flooding Problems

Inland Flooding

- **Phillips Run**
- **Sesachacha Pond**
- **Polpis Road**
- **Miacomet Pond**
- **Nuisance Flooding**
  - Easy Street
  - Orange Street
  - Pleasant Street near Post Office
  - Lovers Lane
  - Old South Road near Airport
  - Madacket Road – Hummock Pond Road

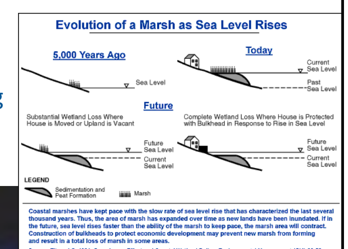
Area-Specific Flooding Problems

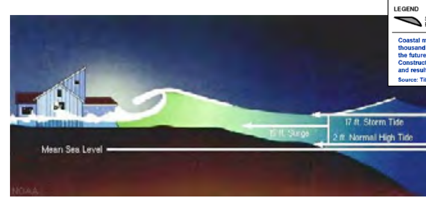
Coastal Flooding

- **Downtown & Brant Point**
- **Madaket Village**
- **Codfish Park**
- **Isolation:**
  - Madaket
  - Smith Point
  - Polpis
  - Wauwinet

Coastal Erosion

- **Storm surge**
- **Sea level rise causes**
  - Accelerated coastal erosion
  - Inundation
  - Increased incidence of flooding





Hurricanes and Tropical Storms

- Strong winds
- Heavy rain
- Floods

1955 Flood Images

Coastal Erosion

Area-Specific Erosion Problems

<u>Coastal Flooding</u>

- Codfish Park
- Sconset Beach
- Low Beach
- Pwbble Beach
- Cisco Beach
- Sheep Pond Road
- Madaket Beach
- Smith Point
- Cliff Beach

Thunderstorms and Tornadoes

- Tornadoes
- Downbursts
- Lightning
- Heavy rain
- Hail

Tornado photos courtesy of the Hartford Courant

Winter Storms and Nor'easters

- Blizzards and nor'easters
- Coastal Flooding
- Heavy snow and drifts
- Freezing rain and ice
- Downed trees

Mitigation > Benefits > Development > Hazards > Alternatives > Update > Discussion

Winter Storms and Nor'easters

- Collapsed Buildings

Photos courtesy of the Hartford Courant

MILONE & MACBROOM

Mitigation > Benefits > Development > Hazards > Alternatives > Update > Discussion

Earthquakes

- Connecticut is prone to very low-energy earthquakes
  - Plainfield earthquakes of 2015 (mag. 3.3)
- Can cause dam failure, shaking, liquefaction, slides/slumps

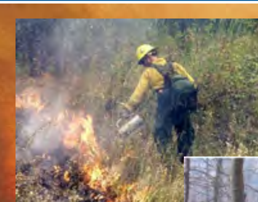
Photos courtesy of FEMA

MILONE & MACBROOM

Mitigation > Benefits > Development > Hazards > Alternatives > Update > Discussion

Wildfires

- Fire
- Heat
- Smoke
- April is the month of maximum risk in Connecticut
- The 2016 drought has elevated risks throughout the state



Photos courtesy of FEMA and the Middlebury Fire Department

MILONE & MACBROOM

Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life and millions of dollars in damage
- Numerous registered high-hazard dams in the region

1963 Spaulding Pond dam failure in Norwich, CT

Recent dam failure in Sherman, CT

Mitigation Alternatives

Temporary Berm in Westport, 2012
Spencer Platt/Getty Images

Hazard Mitigation Categories

Structural Projects

- What can we construct or reconstruct to reduce the occurrence of the hazard or impacts from the hazard?

Prevention

- How can losses be prevented through codes, regulations, etc.?

Natural Resources

- Can we set aside land or preserve natural resources to avoid losses that could occur, or to allow these resources to protect us?

Property Protection

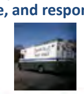
- Can our property be protected to reduce losses?

Public Education

- Can we help educate the public about hazard risks and encourage them to take action?

Emergency Services

- Can we strengthen our capacity to evacuate, shelter people, and respond?



Hazard Mitigation Options

Applied to Floods

Flood Risks

Structural Projects

- Bridges and Culverts
- Levees and Walls
- Detention and Drainage

Prevention

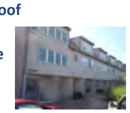
- Zoning
- Codes
- Regulations
- Plan of Conservation & Development

Natural Resources

- Acquire & Preserve Land
- Wetland Storage
- Reconnect Floodplains

Property Protection

- Floodproof
- Elevate
- Relocate



Public Education

- Newsletters & Meetings
- Web Site with Risk Maps
- Educate Municipal Staff

Emergency Services

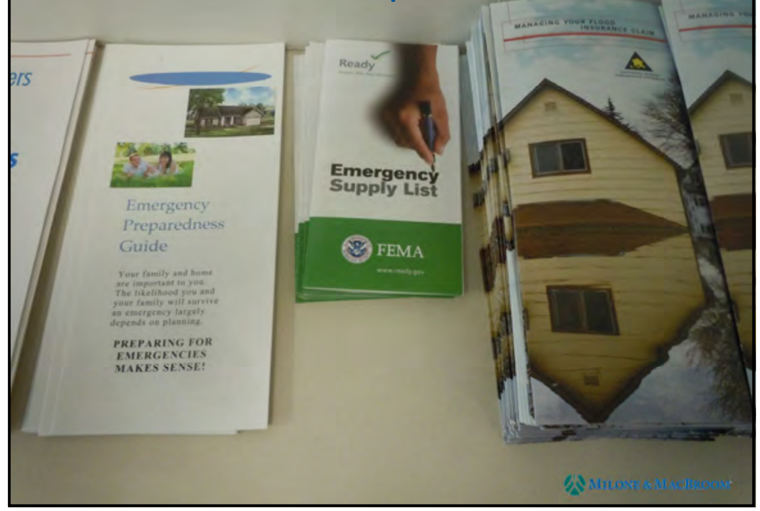
- Improve Response Capacity
- Establish Shelters
- Evacuation Plans

Hazard Mitigation Options

Other Typical Strategies

- Strengthen or reinforce shelters and critical facilities
- Create backup critical facilities
- Place overhead utilities underground
- Harden utilities and buildings
- Localized power grids ("microgrids")
- Expand tree maintenance programs
- Snow load removal and response plans
- Shutters, load path, and roof projects
- Backup systems and equipment
- Enhance fire suppression capabilities with dry hydrants, cisterns, etc.
- Bracing for potential earthquake damage
- Public education programs and resources

Plan Update



Plan Update

Organization

- **One regional multi-jurisdiction plan**
  - Describe planning process
  - Address Hazards – what has changed?
  - Present Vulnerability and Risk Analysis – what has changed?
  - Present Possible Mitigation Strategies
- **Community-Specific "Annexes"**
  - Describe Community Risks – what has changed?
  - Present Specific Mitigation Actions
- **Appendices – Supporting Documentation**
  - Meeting Minutes
  - Survey Results
  - Press Releases and Public Meeting Presentations
  - HAZUS Output

Plan Update

Next Steps

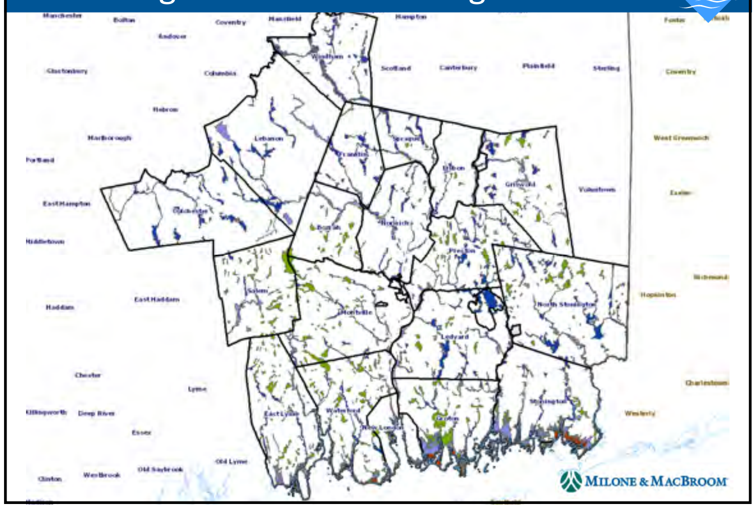
- Incorporate input from residents, business owners, and public officials
- Internet survey available – *see link on the next slide*
- Characterize hazard risks and potential losses
- Develop mitigation strategies and actions
- Prepare draft plans for review by the municipalities and the public
- Adopt and implement the plan
- Seek hazard mitigation funds

Discussion

- What Hazards Concern You?
- Where Have You Seen Losses and Risks?
- What Actions Interest You?

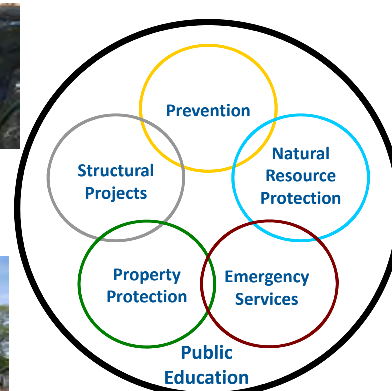
www.surveymonkey.com/r/SCCOGHazard

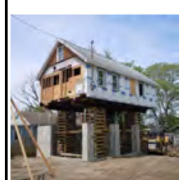
Flooding Concerns in the Region



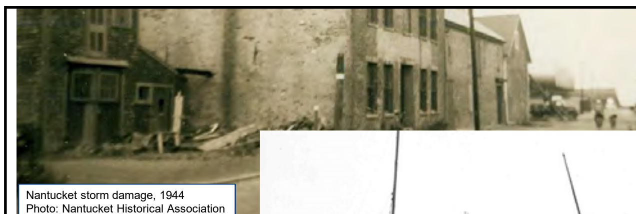
Mitigation Alternatives

Categories of Strategies





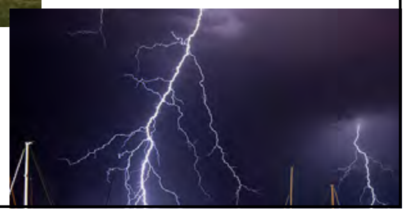
ndy Impacts
Harnishfeger / The Inquirer and Mirror



Nantucket storm damage, 1944
Photo: Nantucket Historical Association

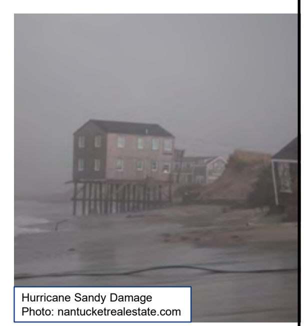
Hurricane Carol, 1954
Photo: Nantucket Historical Association

Damage from January 2015 Blizzard
Photo: NBC News



Middle Moors Firebreak

Mutual Aid arrives from the mainland during the "April Fools Day Fire" 2007
Photo: Fire Dirstrict 1



Hurricane Sandy Damage
Photo: nantucketrealestate.com

Nantucket Hazard Mitigation Plan 2017 Update
October 23, 2017 Public Meeting Notes
Noah Slovin

Meeting Attendees:

Noah Slovin, CFM	Milone & MacBroom	(Presenter)
Holly Backus	Nantucket Planning & Zoning Office	Land Use Specialist
Elizabeth Clemente	The Inquirer and Mirror	Reporter / Staff Writer
Chuck Larson	Nantucket DPW	Deputy Director
Jack Weinhold	Resident	
Larry LeCain	Resident	

Presentation:

Noah gave a presentation in which he explained the regulatory context for community Hazard Mitigation Planning, the benefits of having a Hazard Mitigation Plan, and the steps that the consultant and the Town will take to develop the current update. He also discussed the types of hazards faced by Nantucket and the areas susceptible to different hazards. Finally, he reviewed possible hazard mitigation alternatives that could be pursued on the island.

Noah then opened the floor to discussion and questions.

Discussion

- One resident asked in Nantucket has applied for any of the FEMA hazard mitigation grants discussed in the presentation (Pre-Disaster Mitigation, Hazard Mitigation Grant Program, or Flood Mitigation Assistance grants).
    - Holly confirmed that the Town has applied for grants to implement hazard mitigation projects, but noted that many of the grants have been from entities other than FEMA. She specifically pointed to grants available through the State, that Nantucket has taken advantage of. She affirmed that the existence of the Hazard Mitigation Plan has helped guide the Town's grant applications and secure grant funds; however she also felt that the previous edition of the HMP was not used to its full potential.
- A resident wondered why the plan had been allowed to expire, and why it took so long to update.
    - Holly agreed that it was frustrating, and pointed to the historically high turnover rate of municipal employees, especially within the hazard-relevant departments. The Planning & Zoning office and DPW leadership have both changed multiple times since the previous plan was adopted.
- A resident shared some specific at-risk areas he thought should be addressed in the plan update:
    - Ames Road [Avenue?] in Madaket: work that was slated to be completed has never been finished, and that road is susceptible to flooding.
        - Specifically, the Ames Avenue and Madaket Road intersection is threatened by erosion of the bluff to the south. The bluff has been eroded by 30 feet in the last

two storms. The Resident has tried to get the USACE to help, and they have expressed interest, but they can only act if the Town requests assistance.

    - Additionally, there is a spit of sand on “the other side of the bridge” [Ames Avenue Bridge?] there is a spit of sand that is indicative of high velocity water / erosion / potential bridge failure.

- Beach access improvements must be made
- The bulkhead on Easy Street requires improvement

End of Meeting

Nantucket HMP Update Phone Interview Notes
12/21/17
David Gray Sr.
Director, Sewer Department
MMI #2967-09

- 6.6 million dollar to sea street pumping station
    - Currently underway
    - 4 brand new pumps, brand new electronics, kw-generator
    - New fema maps: existing 1st floor is elevation 5. - raising everything to BFE
        - Submersible pumps. All electronics above flood level
    - Building flood retention wall around entire facility to BFE
    - Doorways will have stoplogs to dry floodproof
    - Serves 85% of island, 2 million gallons a day
- Priority list: surfside road pumping station
- Adding 2 new stations during sewer construction project (up to 17 total)
- Towable generators: **5,** receiving 2 more Jan 2.
    - Surfside has a generator
    - South valley has a generator
    - Sachem's path has a generator
    - Two new pump stations will have generators
    - Sconset has generator, runs whole treatment plant
    - 1.5 MW unit at (southside) facility

If there's a big storm coming, we turn all facilities onto generators before storms so they can run without interruptions. SOP for generator deployment.

2-way radios for all staff, intercommunications with all departments

Nantucket HMP Update Phone Interview Notes
12/4/17
Diane O'Neil
Director of Facilities, Nantucket Public Schools
MMI #2967-09

General Feedback

- Public School is shelter
- Several issues in the past with American Red Cross - has been worked out through MOU (memorandum of understanding) that school signed with Red Cross - next time hopefully bugs will be worked out
    - Last time shelter opened was 2 years ago, MOU signed
-

Nantucket HMP Update Phone Interview Notes
12/7/17
Holly Backus
Land Use Planner
MMI #2967-09

- Historic/Cultural resources component - **extremely important to have that**
    - Parts of downtown, Brant point area (and other neighborhoods) that would like to have some sort of direction - can we elevate? What can we do? Pinpoint something that the Town can adopt, whether through planning board or HDC. Don't have to reinvent the wheel.
    - Entire island is a national historic landmark (second after Charleston SC)
    - 2 historic districts (local) - Downtown and Sconset
    - Historic structures registered through state
    - A few registered through feds
    - How can we help people prepare historic homes for disasters
- Make sure we have better communication between planning board and concom, instead of pingponging people back and forth
    - We're seeing lots of redevelopment, residential prop. Downtown that have conservation requirements, they have to go through both land use and concom, lots of back and forth. For HMP purposes it would be good to have something going forward. There was a specific subdivision that came through and had some issues…..?
    - People are going to be buying up property downtown and subdividing - they have to go through concom.
    - COMPREHENSIVE Checklist would be beneficial! Addressed all boards and requirements.
- 2015 High Water and High Stakes - read that
- Sewer department working on elevating pumping stations - some are historic structures
- Sewer system can be flooded just by regular rain
- * look at mass historic resources report….?
- * DAVID GRAY
-

Nantucket HMP Update Phone Interview Notes
12/4/17
Jeff Carlson
Natural Resources Coordinator
MMI #2967-09

- Biggest issue: being on an island!
    - Isolation
    - No mutual aid / aid "in-kind"
    - Planning with finite resources
- Critical Infrastructure in vulnerable areas
    - Sewage Treatment Plant
    - Downtown flooding can shut down ferry lines
        - Town needs to work better with Steamship authority
        - Create a more adaptable facility
        - Return to service as soon as possible after a storm
- Vulnerable areas
    - Core downtown district
    - Affluent neighborhood downtown is in 1% annual-chance floodplain
        - Key tax base
        - There is a lot of land that is vulnerable to relatively small events
- Mitigation:
    - Building a wall is not doable
- Limited land:
    - Cost is very high
        - Buyouts are not feasible

Nantucket HMP Update Phone Interview Notes
12/7/17
Lauren Sinatra
Energy Coordinator
MMI #2967-09

- Mass is leading country in energy storage and resiliency
- Clean energy resiliency
- Hard to get internal buy-in
- Microgridding, islanding, advanced inverters, etc., if they get brought into plan
- Especially at emergency shelters
    - Solar-plus storage
- ACES grant will help build in resiliency
- Just applied for a grant for wastewater treatment plant solar power
    - If there's funding for a battery later they'd integrate that
- There are proposals for deep offshore wind sites in federal waters off ACK - she's in touch about communities benefits agreement - Nantucket will have some visual impacts, what can they get in return? Mutual benefits
    - Contributions toward community improvement fund for HMP and resilience upgrades
    - Would need to know what those projects are
    - In touch with the developers bidding on specific sites
    - Looked into direct power feed from windfarms, but very expensive, not worth undertaking.
- National Grid is upgrading 2 aging diesel generators
    - Phase 1 approved: new 10 MW diesel generator
    - Phase 2: 10 MW tesla battery
    - Benefits
        - Backup power
        - Reduce peak load
- Energy storage for multiple benefits locally
    - Town looking to deploy creative solutions

Nantucket HMP Update Phone Interview Notes
12/12/17
Libby Gibson, Town Manager
Gregg Tivnan, Assistant Town Manager
Brian Turbitt, Director of Municipal Finance
MMI #2967-09

- Capabilities
    - Community support for actions
    - Community groups
        - Coastal conservancy
        - Land council
        - Conservation commission
            - Some regulatory power in floodplains
        - Sustainable Nantucket
    - Also have groups of people who *don't* believe in climate change, sea level rise, etc.
        - This is a problem
    - Internal discussion about budget recommendations - tomorrow night!
        - Put coastal resiliency into budget!
        - Andrew sent article about ice melting, rising seas
        - We *really* want to pay attention to this.
        - GROWING realization within Town government
        - Starting coastal resilience plan
    - We're NOT overly strong with resources
        - EMC retired, not being replaced with standalone coordinator -being replaced with police sergeant.
            - We may need a standalone at some point
            - Not his dedicated job
        - Weak with capabilities
    - Hardening Easy Street Bulkhead
    - New sewer stormwater system somewhere
    - Children's Beach
- Harbor Master - Town Pier is safe refuge, Harbor Master Building we want to elevate
- Big project on Town Land

Vulnerabilities:

- Waterfront
    - South shore
    - East
    - Downtown subject to flooding
- Great Ponds flood - we have to open them and manage them - $10K to open
- Wildfires
    - ACK Conservation Foundation (largest conservation land landowner) - was working on wildfire prevention program
        - Jim Lantowski - been there 40 years, knows lots about all of these things
        - Fire Breaks, controlled burns
- New Jetty helps keep channel open

    - Reconstructed, raised a little, by army corps, completed 2016-2017, paid for by Fed money
- Town infrastructure in coastal areas
    - Street lights
    - Municipal buildings that tend to flood
    - Project in works L: public concession beach area starts flooding when rain is predicted
        - Sewer dept putting in design to control stormwater
        - Jetty's Beach
        - Very low, parking lot floods, Town area down there can become inaccessible
        - Two public buildings, parking, project in works (temp : install pumps)

Installed warning sirens

Town nursing home vulnerability:
- Near water, not in area that floods
- Army corps SLOSH maps show flooding there
- Our Island Home - east creek road, town run
- Isolated

Actions moving forward
- Millie's Bridge - fix that problem → number 1 priority
    - Concern about buouyancy
- Massassoit - only connection to ____
    - Not so close to the water, but only access to an area
- Downtown municipal buildings in vulnerable areas. Concessions.
- Stormwater management projects
    - Get approval for stormwater management plan in upcoming town meeting
    - Will need money after that to actually implement plan
- Airport:
    - Runway gets closer and closer to ocean - erosion
    - Eventually will need to be figured out
- Sewer Treatment Plant:
    - Erosion, getting closer to ocean
- Baxter Road - relocate? Erosion? Bluff.
- Sheep Pond Road
    - Had to deal with rerouting, becomes our problem
    - Only accessible by Massasoit bridge
    - Fell into the ocean, in Madaket

Nantucket HMP Update Phone Interview Notes
12/7/17
Martha Lake-Greenfield
MMI #2967-09

New Building:

- We will have a command center in new building
- Fuel storage, utilities, etc taken into consideration
- Hospital has an internal response plan to an incident
    - Joint commission requirement
    - Cms requirement
    - Very robust
    - Emergency operations, communication, sheltering
    - Staff all has incident command training
        - NIMS minimum 100
- Monitor power levels, use 96 hour tool to monitor internal sustainability
- 12 rooms
    - A couple rooms able to manage multiple patients should emergency arise

Storms fall high on hva, along with flooding

Will coordinate

Nantucket HMP Update Phone Interview Notes
12/6/17
Nathan Porter
GIS Coordinator
MMI #2967-09

- Off-island
- Departments don't realize capabilities of what they can do
- We have a lot of stuff, in good shape
- Public was interested in recent floodzone update
- D Fronzuto coordinated research with town and another group to map stormtide pathways to model where storms would impact
    - On online website
    - Will email
    - https://nantucketma.mapgeo.io/?latlng=41.282868%2C-70.119118&panel=themes&themes=%5B%22storm-tide-pathways%22%5D&zoom=12
    -

From: Nathan Porter [mailto:NPorter@nantucket-ma.gov]
Sent: Thursday, October 05, 2017 10:57 AM
To: Noah Slovin <noahs@miloneandmacbroom.com>
Subject: Nantucket Critical Facilities

Hi Noah,

I had a chance to go through the locations in my data and compare them to the table you handed out for the Nantucket Critical Facilities, and I have a few notes. Hopefully I'll just be repeating things that others have already brought up.

Emergency Services –

- Renaming the Police Station (in Downtown) to the Sheriff's Office?
- Adding the Public Safety Facility at 4 Fairgrounds

Municipal Facilities –

- Remove 22 Federal St (sold)
- Add Park & Rec at Bathing Beach
- Add Department of Culture and Tourism at S Water St/Federal St?
- Add Health Department at S Water St/E Chestnut St?
- Add Land Bank at Center St?
- Add Former DPW Paint Shop at Orange St?
- Add the Atheneum (Library) at India St?

Schools –

- Add Private schools (not including pre-k)?

Water and Wastewater –

- Add Wannacomet Office?

Transportation –

- Add NRTA Greenhound (Seasonal Information Office)?

Communications –

- There were 2 Cell Towers on the list. I only have one in my data, at 215 Cliff Road. Do you have an address for the second?

I can't say that I have the definitive list of facilities, but these were things that I noticed that I have in my layers that didn't make the list and might need to be on there. If you check with the higher ups in these areas and they disagree, I will bow to their expertise. And if you would like or need copies of these layers (or any others that you are interested in) just let me know.

Nathan Porter

GIS Coordinator

Town Of Nantucket

508-325-4131

Nantucket HMP Update Phone Interview Notes
12/7/17
Robert McNeill III
Chuck Larson
Director, Public Works Department
MMI #2967-09

- Mitigation - what is that?
- My understanding:
    - Identify low hanging fruit areas that will normally be challenged during weather events
    - Mostly flooding, etc
    - FEMA will fund to make resilient

- Tree Trimming
    - We do not have a lot of information about tree inspection
    - Utility is doing a lot work right now with trimming and hardening
    - Town is working on determining inventory of shade trees, working on getting baseline, developing tree trimming program
    - We have lots of mature trees downtown that are probably approaching end of life
    - We don't have any information to inform decision
    - Townwide public shade trees
    - Lower priority?

Conduct master drainage studies for problem areas to ensure that each repair is individually and cumulatively adequate	We're working on it now, it would be helpful for this to show up as a priority, maybe get some funding to supplement or offset costs. Refer to an index. Problem areas could be prioritized, are they an evacuation route, high traffic?
Complete the Orange Street drainage system upgrade	Still work that needs to be done. NOT completed. Any project that was completed did not fully address problem.
Improve Pleasant Street storm drainage system	Silver street area.
Maybe list above two sites into general master drainage study Top ten list they'll send	
Ensure that the Milestone Road crossing of Phillips Run can convey the 100-year flood	Single this out as an action (#2 priority)
Increase sensitive roads to 1 ft above flood elevation with list below Consolidate asks into more manageable program	
Increase the elevation of Polpis Road at Sesachacha Pond to the base flood (8') plus one foot	
Increase the elevation of Wauwinet Road at Polpis Harbor to the base flood (8') plus one foot	
Increase the elevation of Polpis Road at Fulling Mill Brook to the base flood (8') plus one foot	

Increase the elevation of Madaket Road at Head of Long Pond to the base flood (8') plus one foot	
Increase the elevation of Madaket Road at Madaket Ditch to the base flood (8') plus one foot #5 Add alternative access route to madaket	
Develop an alternate access route to Madaket via Eel Point Road and Warren's Landing Road	Something we can do as a plan. This is #4 in list (see above)

← good list of roadways in that order

Roadway improvement projects, standard operations and maintenance, not necessarily hazard mitigation

Urge conservation groups to restore windbreaks along Milestone Road	Pipe dream, never going to happen. To mitigate we're putting up snow fence.
Continue to use two rows of snow fencing along Milestone Road	Part of operations and maintenance
Improvements in the Mid-Island Area should include enhancing traffic flow, increasing safety, and emergency access	
Reconstruct the Milestone Rotary as a modern roundabout	

Evaluate private roads to determine where essential improvements are necessary	
Formalize agreements for roadway maintenance with private road owners	

Increase plowing of Milestone Road in snow drift areas	

- Facility-related
    - #4 - Do an analysis to make sure floor elevations are above 1% flood plus foot, including fuel station, garage spaces, generators, etc
    - Generally analyze critical municipal facilities to make sure they're at this level

Follow up on drainage list of priorities

Nantucket DPW
Hazard Mitigation Plan Project List
12/7/2017

Project Description

1 Conduct master drainage studies for problem areas
   a. Bartlett/Somerset/Raceway Area
   b. Bear/Pleasant/Sparks Avenue Area
   c. Broad Street
   d. Codfish Park
   e. Easton/Willard Street Area
   f. Lily Pond Area
   g. Lover's Lane
   h. Main Street Area
   i. Orange Street
   j. South Water Street
   k. Sparks Avenue @ Tashama/McClean
   l. Straight Wharf
   m. Washington Street

2 Design & Construct Roadway Improvements in flood prone areas
(Raise roadway elevations to minimum one foot above the 100-year base flood)
   a. Madaket Road @ Long Pond
   b. Madaket Road @ Madaket Ditch
   c. Polpis Road @ Fulling Mill Brook
   d. Polpis Road @ Sesachacha Pond
   e. Wauwinet Road @ Polpis Harbor

3 Flood analysis - Milestone Road culvert crossing @ Phillips Run

4 Flood Analysis of Critical Municipal Facilities (versus the 100-year base flood)

5 Develop alternative access route(s) to Madaket & Smith's Point

Nantucket HMP Update Phone Interview Notes
12/6/17
Stephen Murphy
Chief, Nantucket Fire Department
MMI #2967-09

- Sconset and Madaket
    - Shelters = garages
- Make sure generators can hook up to shelters as backup - ongoing effort
- 2 shelters they got from NASA are on trailers - not yet been used
- Mobilize emergency equipment to “shelters”:
    - looking to upgrade shelter to allow staffing during critical times
    - especially sconset
- Upgrading water lines for firefighting still a priority
- Alternate water sources are in place.
- New station will make building much better, better basic infrastructure
- Mutual aid agreement with land bank still underway, moving along
- Pretty well stocked equipment-wise
- Ready equipment to deploy at large gatherings or mass casualty incidents
    - Trailer to roll up and have equipment
        - Equipment and supplies
        - Mass Casualty Incident
        - UTV to use at events
        - Trailer to put UTV in
        - Have trailer capable to serve MCI
            - Just starting to look into it.
    - Have to a smaller extent but it’s a couple things instead of one

Nantucket HMP Update Phone Interview Notes
12/7/17
William Pittman
Brendan Coakley - EM Coordinator
Chief of Police, EMD
MMI #2967-09

- Primary vulnerabilities
    - Erosion (especially madaket - endangerment to smith's point access)
        - THIS SHOULD BE A PROJECT AREA
    - Secondary: **town pier** continual damage
        - Million dollar structure, has suffered significant damage in storms
        - Nobody thinks about it until it's not available
        - Vulnerable to surge, or winds out of east. Floating part seems to have been built NOT to withstand ocean conditions
            - Talk about barrier wall, more robust structure
        - We already have a program to do some things
            - Doing some dredging now - just got permits or currently seeking permits
        - Next big loss will be the Town Pier
    - Third: continual flooding downtown, during any astronomical tide and northeast wind
        - Easy street
        - Easton street
            - At north beach
        - Washington street
        - Sometimes because of backed-up freshwater, sometimes seawater coming over the bulkheads
        - KEY access routes - all others are secondary
- Others
    - Polpis road - redoing culvert and raising road, near lifesaving museum
        - Loss makes access very difficult
    - Concerned about access through Orange Street to nursing home and elder care facilities
        - Island Home is in part in flood zone
        - Big debate about building new facility, probably will end up staying there
        - Make sure we have access OR has adequate capacity to keep running in isolation
    - We only have one access to ferry terminals (even though there are two wharfs) - only one channel coming in. There's been talk about exploring alternative ferry terminal outside jetties - down by jetties beach or something like that
        - Steamship terminal - two gates, can still use secondary if entire facility isn't damaged
            - Only freight boat location
            - Passengers can come in at straight wharf
        - One narrow channel in jetties coming into harbor - one boat sinking in that channel would block everything off. Exists a couple times a year that a boat is close to sinking in a critical location. Emergency plan is to get salvage from New Bedford.
        - Outside access for freight boat.
    - Lots more wind during past few years
    - FIRE

        - Whole place is just dry scrub - wildfires is a problem. If we really had a good fire going we don't have enough staff to deal with it. Backup is 3 hours away, if it's perfect.

Good things

- Emergency Alert
    - Installed 3-siren alert system, E-W and midpoint. Need 2 more to make truly effective.
        - Hopefully will help visitors
    - Ping-4
        - Need to download app. At ferry terminals have info. But not many people download. Battery Hog.
    - Social Media platforms
    - 105.5 FM low power fm station for emergency information
    - Pretty robust
    - Challenge - so many visitors. Traditional reverse-911 systems don't work. Visitors tend not to sign up to emergency alerts.
- Established and regularly drill EOC procedure
    - And implement/exercise a few times a year, real time.
- Formalized emergency shelter agreement with red cross
- Need more shelter supplies
    - Hold 1500
    - Have equipment for 100
        - Cots, etc.
- IN process : upgrade to radio system on digital spectrum - outside interference with other frequencies
    - Entire island on common-use frequency 800-trunked system from 2006
    - Revision will make it more robust
    - Radio system has always worked
- Building a new hospital - don't know how that will impact, but should make things better
    - Emergency management and mass casualties are included
    - Call Martha-Lake Greenfield
        - → try again

No discussion about Tuckernuck

- 30 houses or so over there
- Every building has own power source
- Access is a problem
- There's a lagoon with a dock - shoaling occurred, had to buy a new boat
- People over there don't like us coming over
- They have a fire house with a pickup truck with a tank in the back
- They DO have good communication
- All private land

APPENDIX C: PUBLIC ONLINE SURVEY RESULTS

Q1 Where do you live?

Answered: 10 Skipped: 1

ANSWER CHOICES	RESPONSES	
Street	100.00%	10
Nearest Cross Street	100.00%	10
Town/City (if not Meriden)	20.00%	2

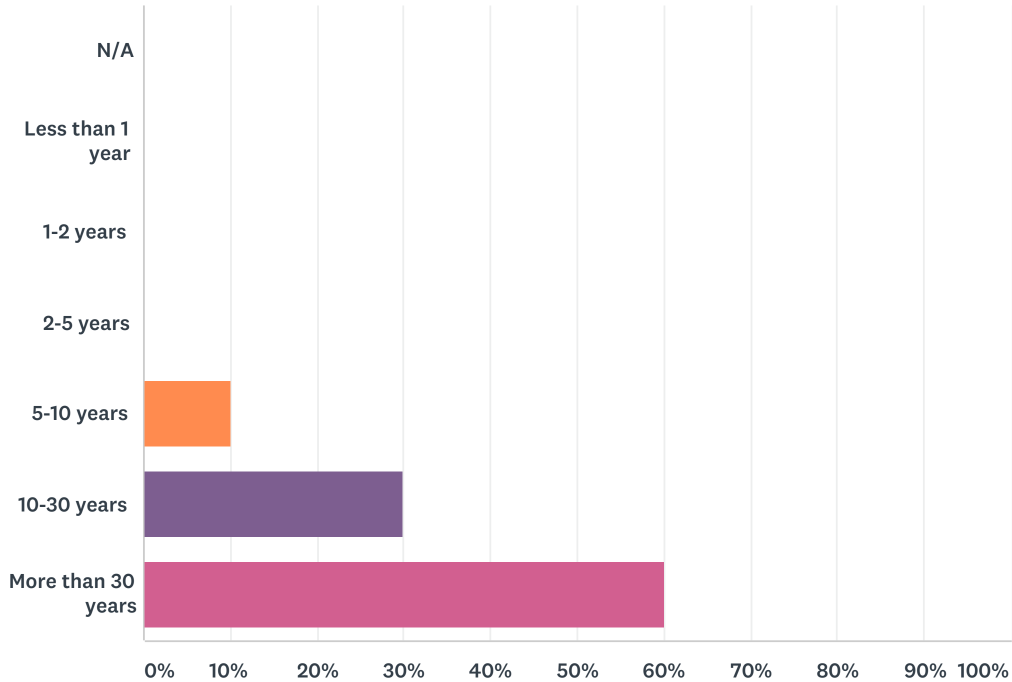
Q2 Where do you work?

Answered: 9 Skipped: 2

ANSWER CHOICES	RESPONSES	
Street	88.89%	8
Nearest Cross Street	66.67%	6
Town/City (if not Meriden)	55.56%	5

Q3 How long have you lived or worked in Meriden?

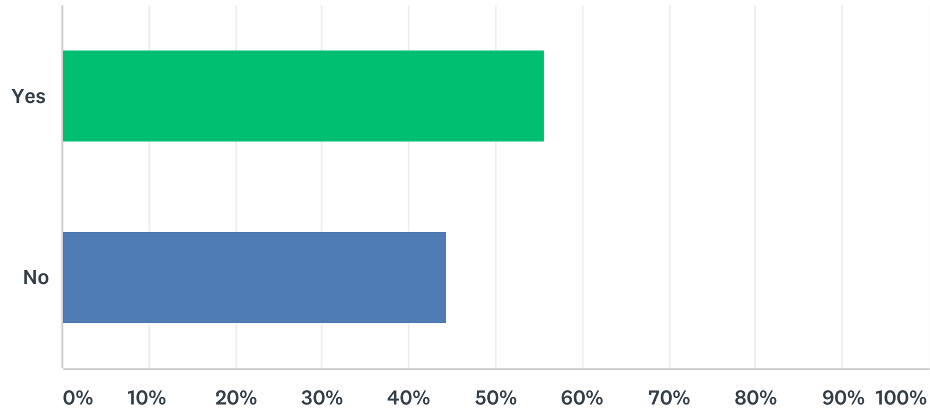
Answered: 10 Skipped: 1



ANSWER CHOICES	RESPONSES	
N/A	0.00%	0
Less than 1 year	0.00%	0
1-2 years	0.00%	0
2-5 years	0.00%	0
5-10 years	10.00%	1
10-30 years	30.00%	3
More than 30 years	60.00%	6
TOTAL		10

Q4 Did you know that Meriden maintains a Hazard Mitigation Plan?

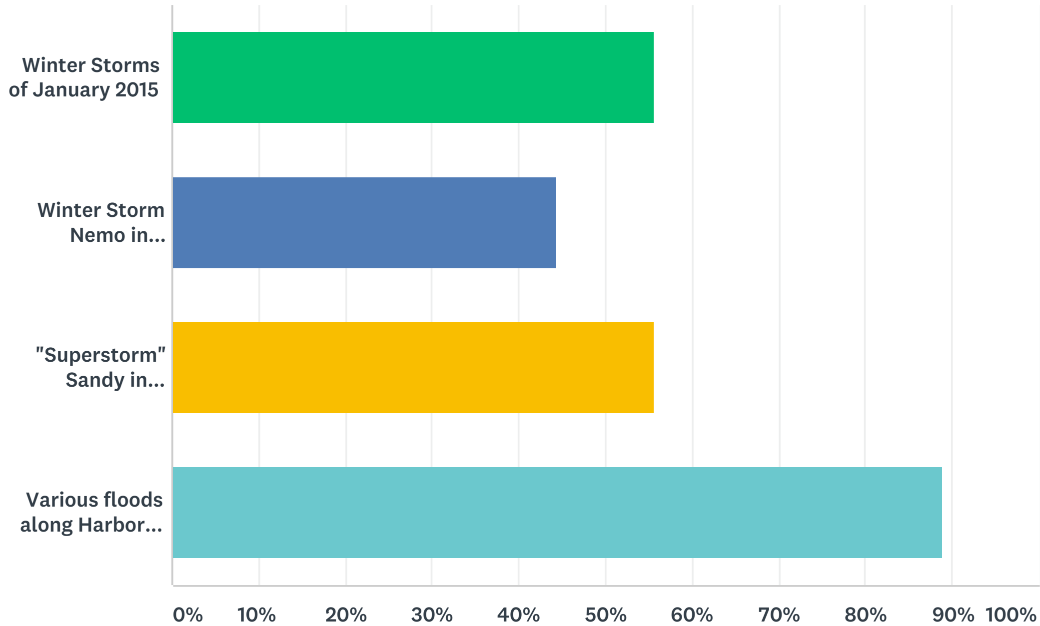
Answered: 9 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	55.56%	5
No	44.44%	4
TOTAL		9

Q5 Which recent events have made you more aware of the danger of natural hazards?

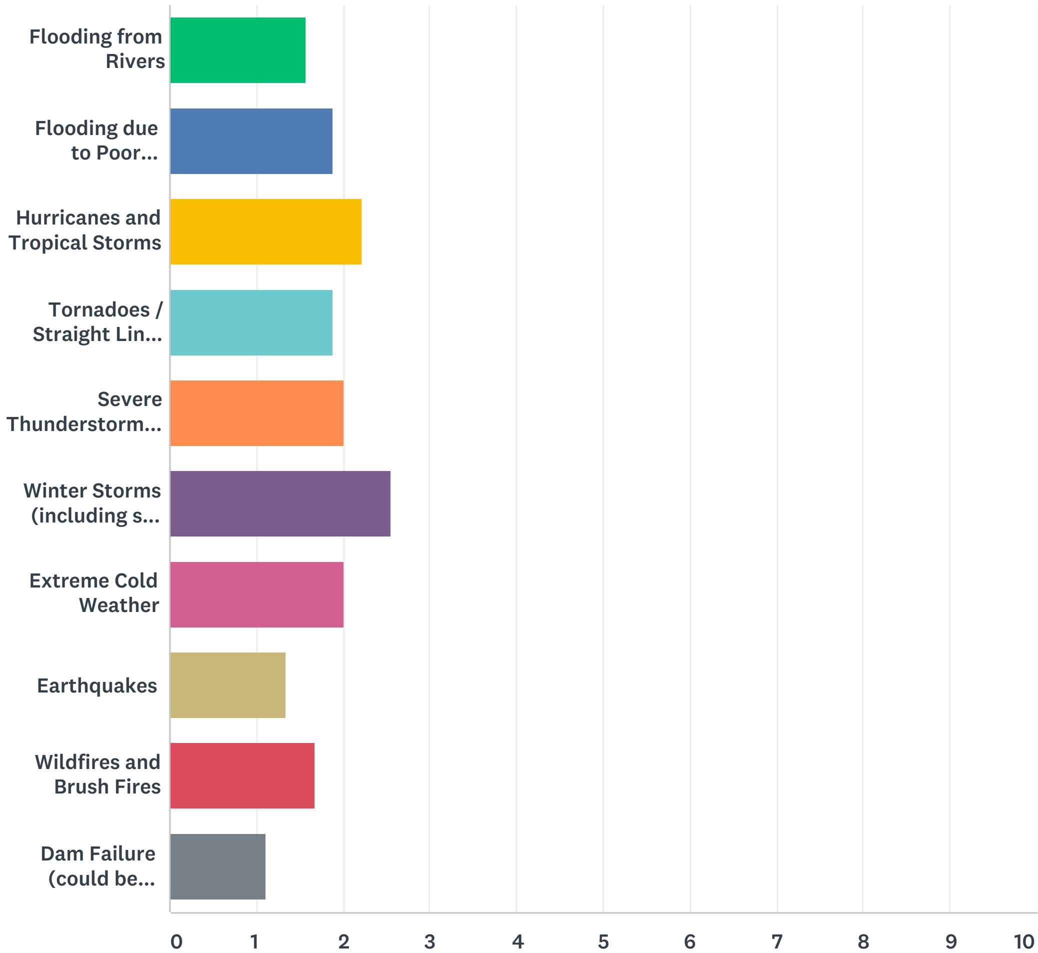
Answered: 9 Skipped: 2



ANSWER CHOICES	RESPONSES	
Winter Storms of January 2015	55.56%	5
Winter Storm Nemo in February 2013	44.44%	4
"Superstorm" Sandy in October 2012	55.56%	5
Various floods along Harbor Brook	88.89%	8
Total Respondents: 9		

Q6 How concerned are you about each of the following Hazards impacting your home or business?

Answered: 9 Skipped: 2

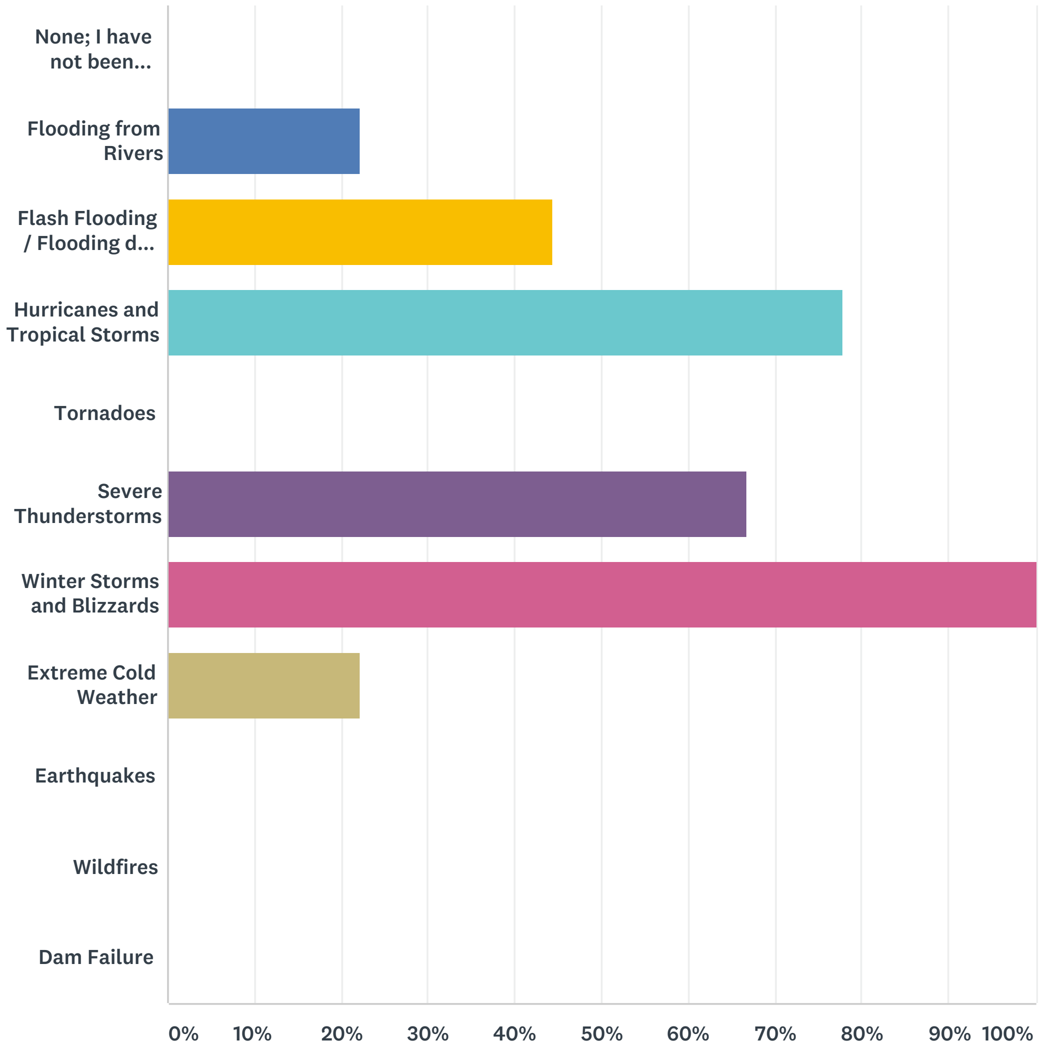


	LOW CONCERN	MODERATE CONCERN	HIGH CONCERN	TOTAL	WEIGHTED AVERAGE
Flooding from Rivers	66.67% 6	11.11% 1	22.22% 2	9	1.56
Flooding due to Poor Drainage	33.33% 3	44.44% 4	22.22% 2	9	1.89
Hurricanes and Tropical Storms	11.11% 1	55.56% 5	33.33% 3	9	2.22
Tornadoes / Straight Line Winds	44.44% 4	22.22% 2	33.33% 3	9	1.89
Severe Thunderstorms (including hail and lightning)	33.33% 3	33.33% 3	33.33% 3	9	2.00
Winter Storms (including snow or ice) and Blizzards	11.11% 1	22.22% 2	66.67% 6	9	2.56
Extreme Cold Weather	33.33% 3	33.33% 3	33.33% 3	9	2.00

Earthquakes	77.78% 7	11.11% 1	11.11% 1	9	1.33
Wildfires and Brush Fires	44.44% 4	44.44% 4	11.11% 1	9	1.67
Dam Failure (could be caused by other hazards)	88.89% 8	11.11% 1	0.00% 0	9	1.11

Q7 Which hazards have impacted you?

Answered: 9 Skipped: 2



ANSWER CHOICES	RESPONSES	
None; I have not been impacted	0.00%	0
Flooding from Rivers	22.22%	2
Flash Flooding / Flooding due to Poor Drainage	44.44%	4
Hurricanes and Tropical Storms	77.78%	7
Tornadoes	0.00%	0
Severe Thunderstorms	66.67%	6
Winter Storms and Blizzards	100.00%	9
Extreme Cold Weather	22.22%	2
Earthquakes	0.00%	0
Wildfires	0.00%	0

Dam Failure	0.00%	0
Total Respondents: 9		

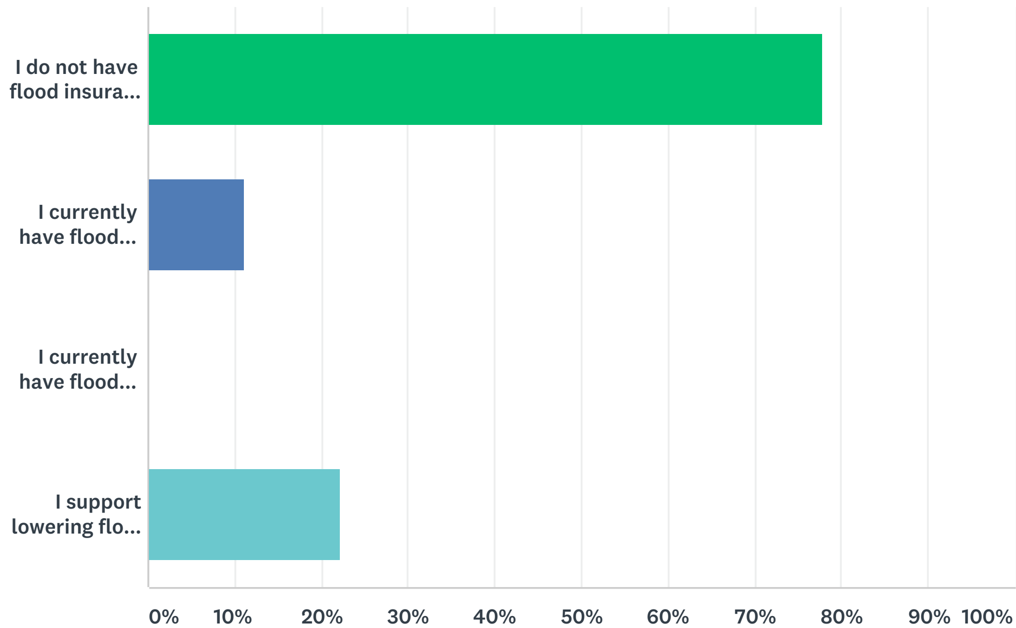
Q8 Are any specific areas of Meriden vulnerable to any of the above hazards? If so, please list them by location. Please use street intersections or landmarks to describe locations.

Answered: 5 Skipped: 6

ANSWER CHOICES	RESPONSES	
Location 1	100.00%	5
Location 2	60.00%	3
Location 3	20.00%	1
Location 4	0.00%	0
Additional Locations	0.00%	0

Q9 Flood insurance premiums nationwide are increasing. What are your thoughts about flood insurance?

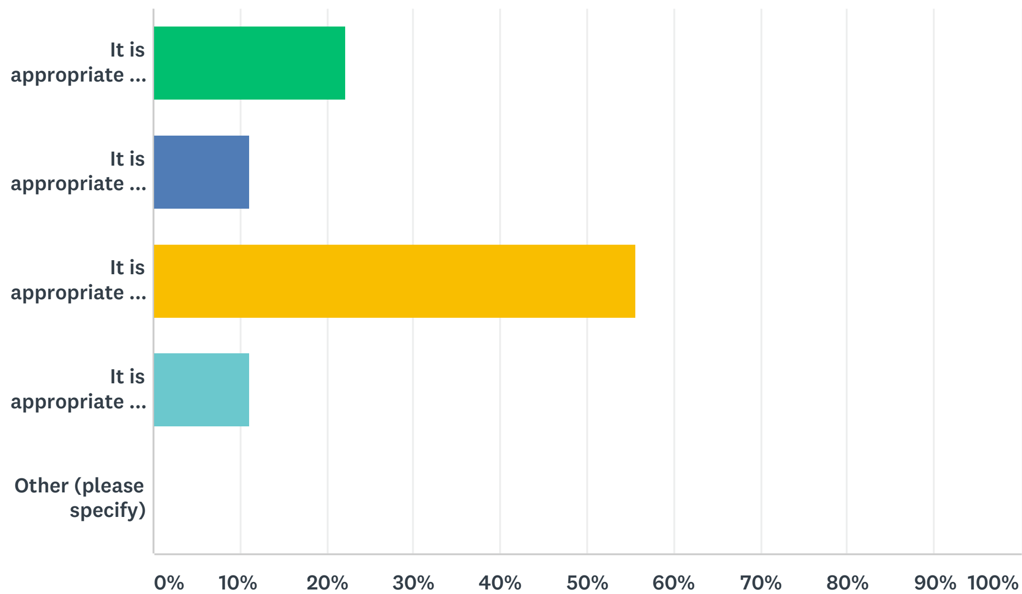
Answered: 9 Skipped: 2



ANSWER CHOICES	RESPONSES	
I do not have flood insurance and have no opinions about it	77.78%	7
I currently have flood insurance and am not concerned about increasing premiums	11.11%	1
I currently have flood insurance and will be looking for ways to lower my premiums	0.00%	0
I support lowering flood insurance premiums for all policyholders	22.22%	2
Total Respondents: 9		

Q10 Scientists expect that rain and storm events may become more frequent and more intense due to climate change. Which of the following statements do you most agree with?

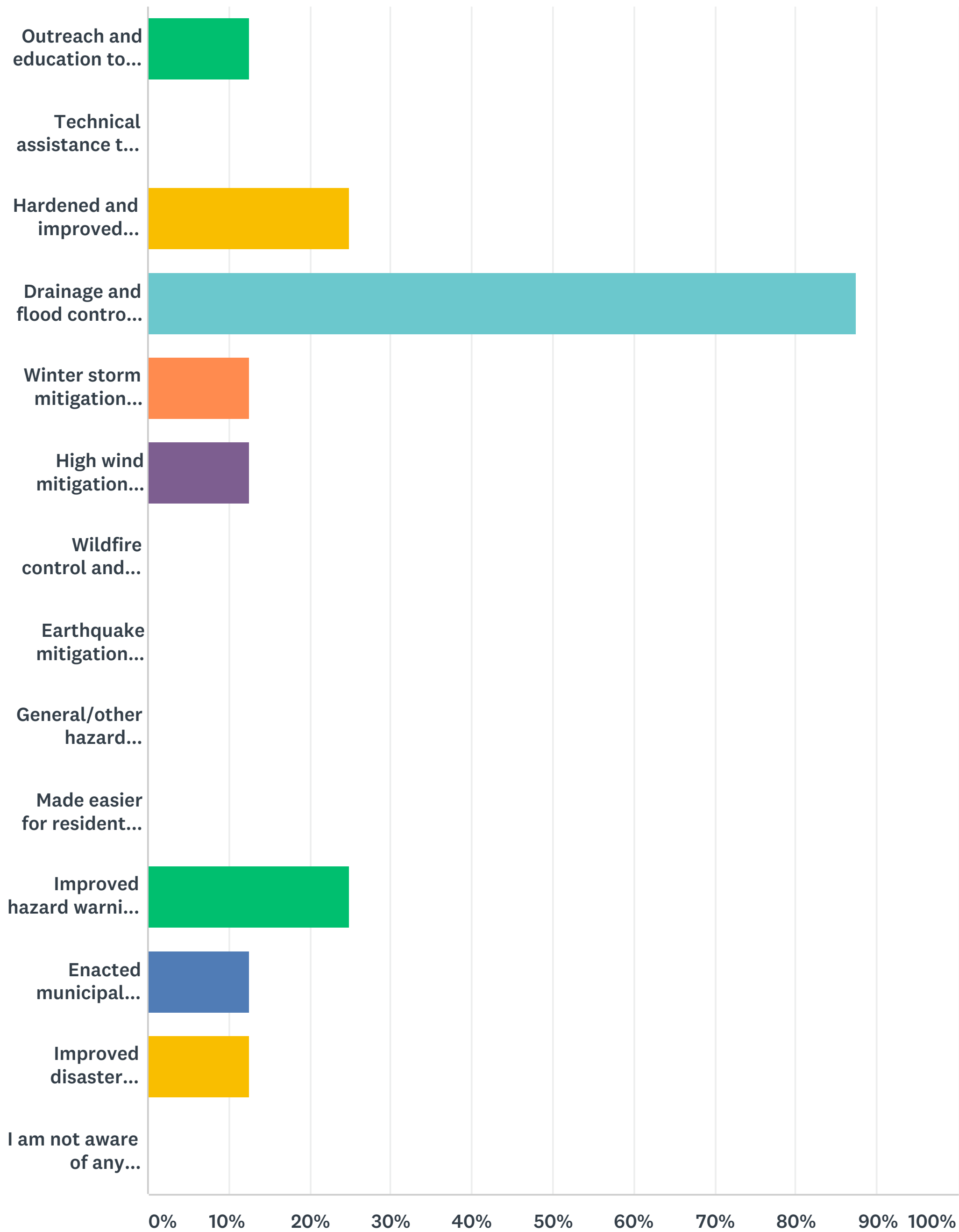
Answered: 9 Skipped: 2



ANSWER CHOICES	RESPONSES	
It is appropriate to plan for storm events to occur more frequently	22.22%	2
It is appropriate to plan for storm events to become more severe	11.11%	1
It is appropriate to plan for storm events to become more severe AND more frequent	55.56%	5
It is appropriate to plan for storm events to occur at a similar frequency and severity as in the past	11.11%	1
Other (please specify)	0.00%	0
TOTAL		9

Q11 To your knowledge, have any actions been performed in Meriden over the last five years to prepare for disasters?

Answered: 8 Skipped: 3

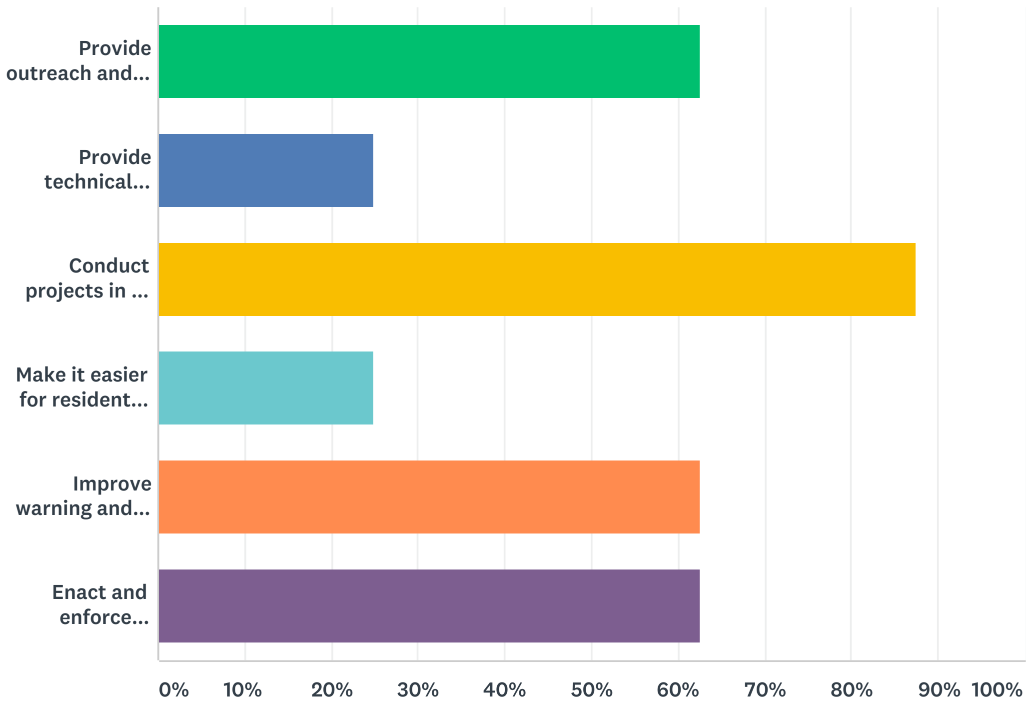


ANSWER CHOICES	RESPONSES	
Outreach and education to help residents, businesses, and organizations understand risks and be prepared	12.50%	1
Technical assistance to help residents, businesses, and organizations reduce losses from hazards and disasters	0.00%	0
Hardened and improved utility infrastructure (electric, gas/fuel, water, wastewater)	25.00%	2
Drainage and flood control projects	87.50%	7

Winter storm mitigation projects	12.50%	1
High wind mitigation projects	12.50%	1
Wildfire control and prevention projects	0.00%	0
Earthquake mitigation projects	0.00%	0
General/other hazard preparedness and mitigation projects	0.00%	0
Made easier for residents, businesses, and organizations to take their own mitigation actions	0.00%	0
Improved hazard warning and response systems	25.00%	2
Enacted municipal regulations, codes, and ordinances - such as zoning regulations and building codes - designed to protect residents and businesses from natural hazards and disasters	12.50%	1
Improved disaster response and recovery capabilities	12.50%	1
I am not aware of any improvements to the town's hazard mitigation capabilities	0.00%	0
Total Respondents: 8		

Q12 What are the most important things that your municipal government and leaders can do to help residents and businesses be prepared for a disaster, and become more resilient over time?

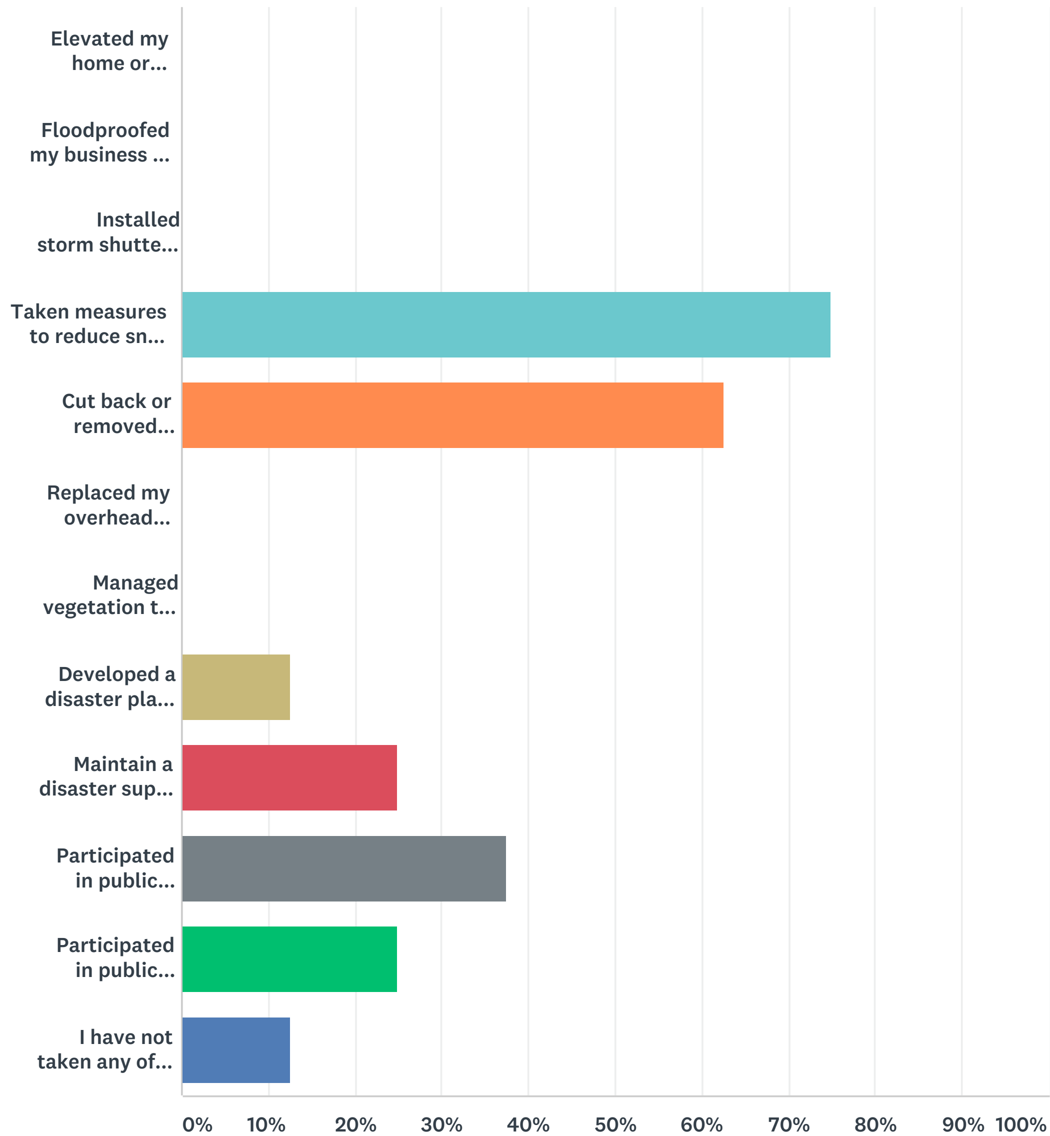
Answered: 8 Skipped: 3



ANSWER CHOICES	RESPONSES	
Provide outreach and education to residents, businesses, and organizations to help them understand risks and be prepared	62.50%	5
Provide technical assistance to residents, businesses, and organizations to help them reduce losses from hazards and disasters	25.00%	2
Conduct projects in the community, such as drainage and flood control projects, to mitigate for hazards and minimize impacts from disasters	87.50%	7
Make it easier for residents, businesses, and organizations to take their own actions to mitigate for hazards and become more resilient to disasters	25.00%	2
Improve warning and response systems to improve disaster management	62.50%	5
Enact and enforce regulations, codes, and ordinances such as zoning regulations and building codes	62.50%	5
Total Respondents: 8		

Q13 Have you taken any actions to protect your family, home, or business from natural hazards?

Answered: 8 Skipped: 3

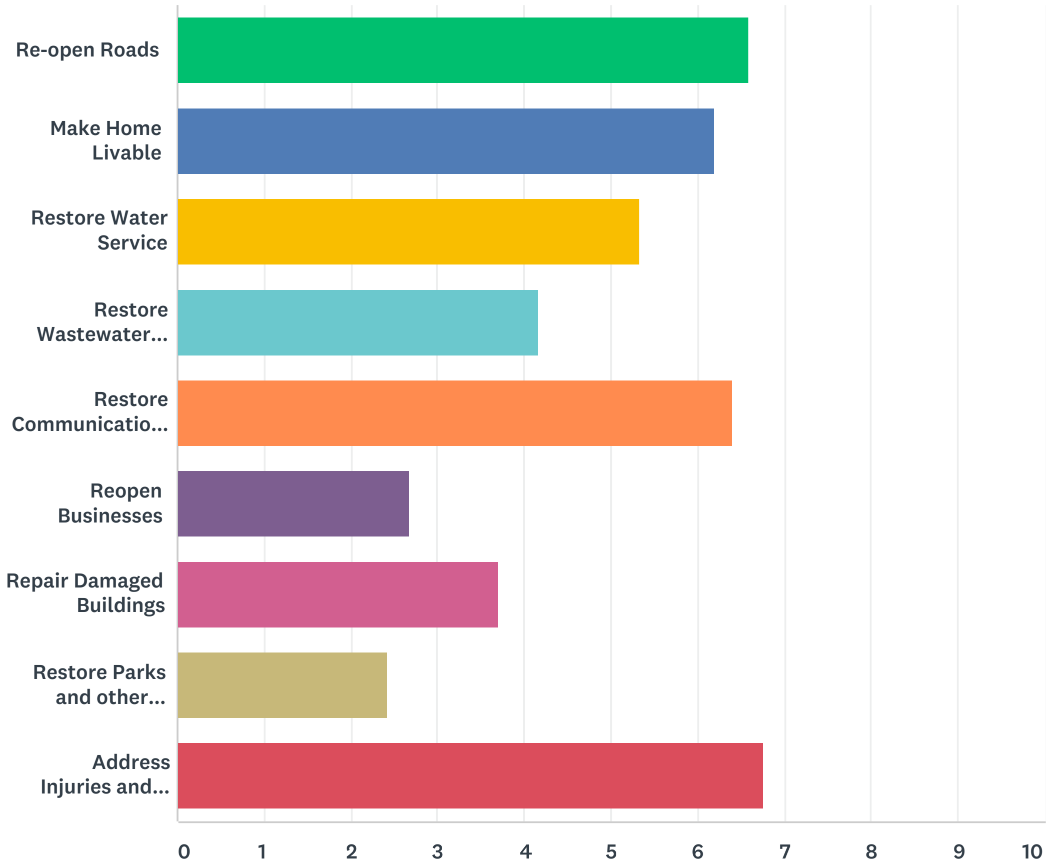


ANSWER CHOICES	RESPONSES	
Elevated my home or business to reduce flood damage	0.00%	0
Floodproofed my business to reduce flood damage	0.00%	0
Installed storm shutters or structural/roof braces to reduce wind damage	0.00%	0
Taken measures to reduce snow build-up on roofs	75.00%	6
Cut back or removed vegetation from my overhead utility lines or roof	62.50%	5
Replaced my overhead utility lines with underground lines	0.00%	0
Managed vegetation to reduce risk of wildfire reaching my home or business	0.00%	0

Developed a disaster plan for my family, home, or business	12.50%	1
Maintain a disaster supply kit for my family, home, or business	25.00%	2
Participated in public meetings to discuss the Plan of Conservation and Development or open space plans	37.50%	3
Participated in public meetings to discuss and approve changes to zoning or subdivision regulations	25.00%	2
I have not taken any of these actions	12.50%	1
Total Respondents: 8		

Q14 How important are the following activities to recovering from a hazard event?Most important = 1, least important = 10

Answered: 8 Skipped: 3



	1	2	3	4	5	6	7	8	9	TOTAL	SCORE
Re-open Roads	0.00% 0	40.00% 2	20.00% 1	20.00% 1	0.00% 0	20.00% 1	0.00% 0	0.00% 0	0.00% 0	5	6.60
Make Home Livable	0.00% 0	40.00% 2	20.00% 1	0.00% 0	0.00% 0	40.00% 2	0.00% 0	0.00% 0	0.00% 0	5	6.20
Restore Water Service	0.00% 0	0.00% 0	16.67% 1	50.00% 3	16.67% 1	0.00% 0	0.00% 0	16.67% 1	0.00% 0	6	5.33
Restore Wastewater Collection and Disposal (Sewer or Septic System)	0.00% 0	0.00% 0	0.00% 0	16.67% 1	33.33% 2	16.67% 1	16.67% 1	16.67% 1	0.00% 0	6	4.17
Restore Communication (Telephones, Cell Phones, Internet)	20.00% 1	20.00% 1	20.00% 1	0.00% 0	20.00% 1	0.00% 0	20.00% 1	0.00% 0	0.00% 0	5	6.40
Reopen Businesses	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	16.67% 1	33.33% 2	50.00% 3	0.00% 0	6	2.67
Repair Damaged Buildings	0.00% 0	14.29% 1	0.00% 0	0.00% 0	14.29% 1	0.00% 0	42.86% 3	28.57% 2	0.00% 0	7	3.71

Restore Parks and other Natural Resources	0.00% 0	0.00% 0	14.29% 1	0.00% 0	14.29% 1	0.00% 0	0.00% 0	0.00% 0	71.43% 5	7	2.43
Address Injuries and Casualties	62.50% 5	0.00% 0	12.50% 1	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	25.00% 2	8	6.75

Q15 If you could choose one action to reduce risks from natural hazards in Meriden, what would it be?

Answered: 8 Skipped: 3

Q16 Please provide any additional comments or questions to be addressed as Meriden updates its hazard mitigation plan.

Answered: 4 Skipped: 7

Q17 If you wish to be notified of the progress in updating the Hazard Mitigation Plan, please provide your name and email address.

Answered: 3 Skipped: 8

ANSWER CHOICES	RESPONSES	
Name	100.00%	3
Email Address	100.00%	3

APPENDIX D: HAZUS-MH DOCUMENTATION

Estimated Flood Losses

Hazus-MH: Flood Global Risk Report

Region Name: Nantucket

Flood Scenario: 1percentAnnualChanceNantucket

Print Date: Wednesday, December 06, 2017

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

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

Table of Contents

General Description of the Region

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

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Massachusetts

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

The geographical size of the region is 49 square miles and contains 1,312 census blocks. The region contains over 4 thousand households and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 11,923 buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2010 dollars). Approximately 92.32% of the buildings (and 81.82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	3,284,232	81.8%
Commercial	515,165	12.8%
Industrial	78,253	1.9%
Agricultural	13,161	0.3%
Religion	27,546	0.7%
Government	12,144	0.3%
Education	83,545	2.1%
Total	**4,014,046**	**100.0%**

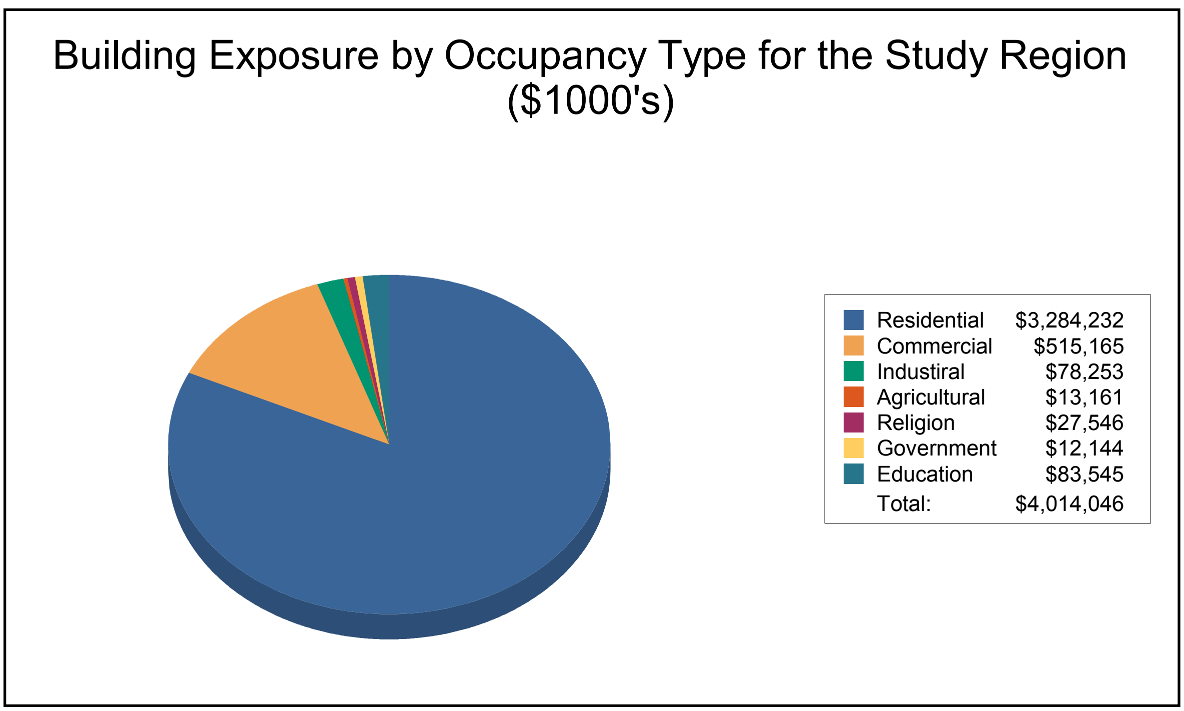


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,277,606	80.5%
Commercial	193,594	12.2%
Industrial	18,752	1.2%
Agricultural	3,888	0.2%
Religion	10,826	0.7%
Government	7,403	0.5%
Education	74,179	4.7%
Total	**1,586,248**	**100.0%**

Building Exposure by Occupancy Type for the Scenario ($1000's)

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire station, 2 police stations and no emergency operation centers.

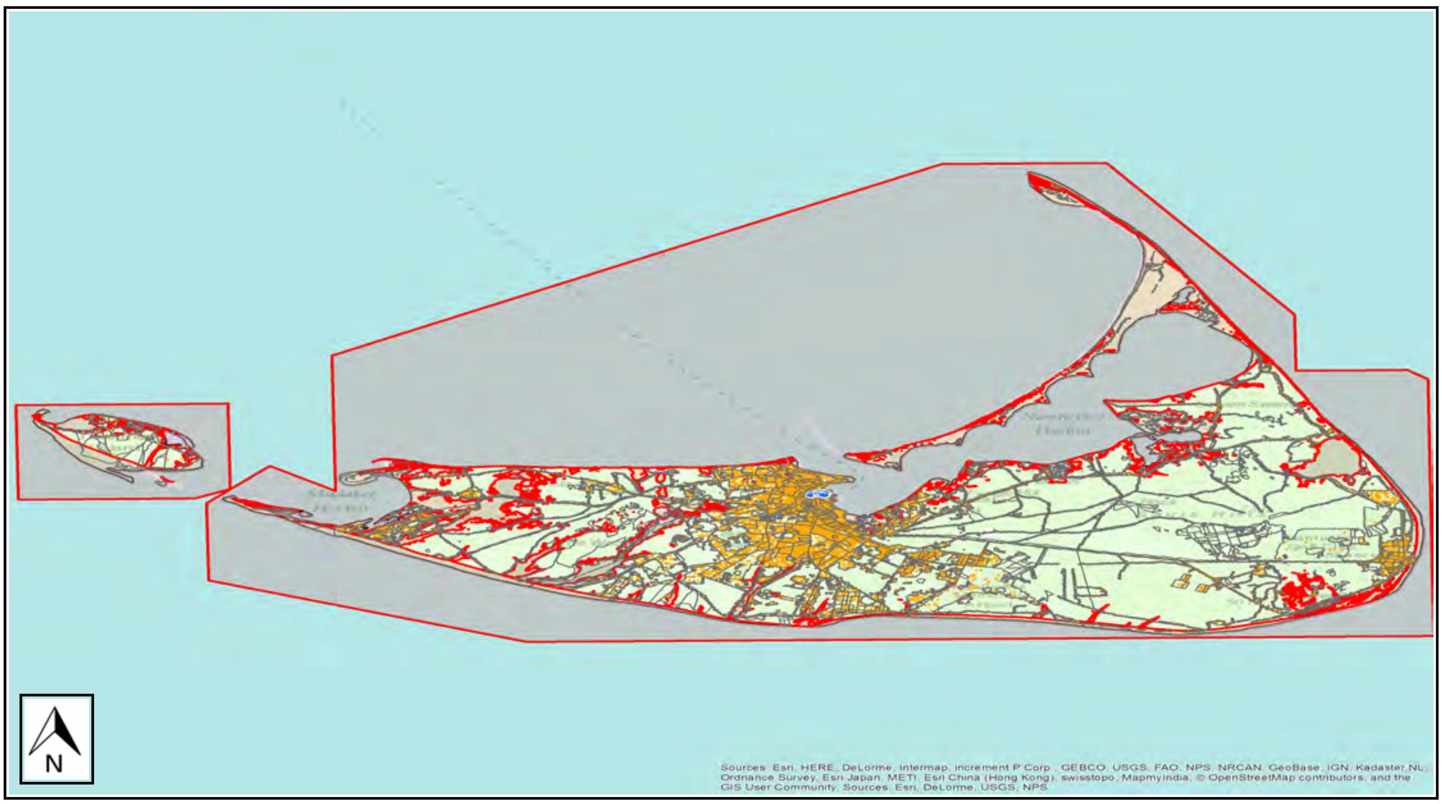
Flood Scenario Parameters

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

Study Region Name:	Nantucket
Scenario Name:	1percentAnnualChanceNantucket
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

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



Building Damage

General Building Stock Damage

Hazus estimates that about 232 buildings will be at least moderately damaged. This is over 33% of the total number of buildings in the scenario. There are an estimated 12 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

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

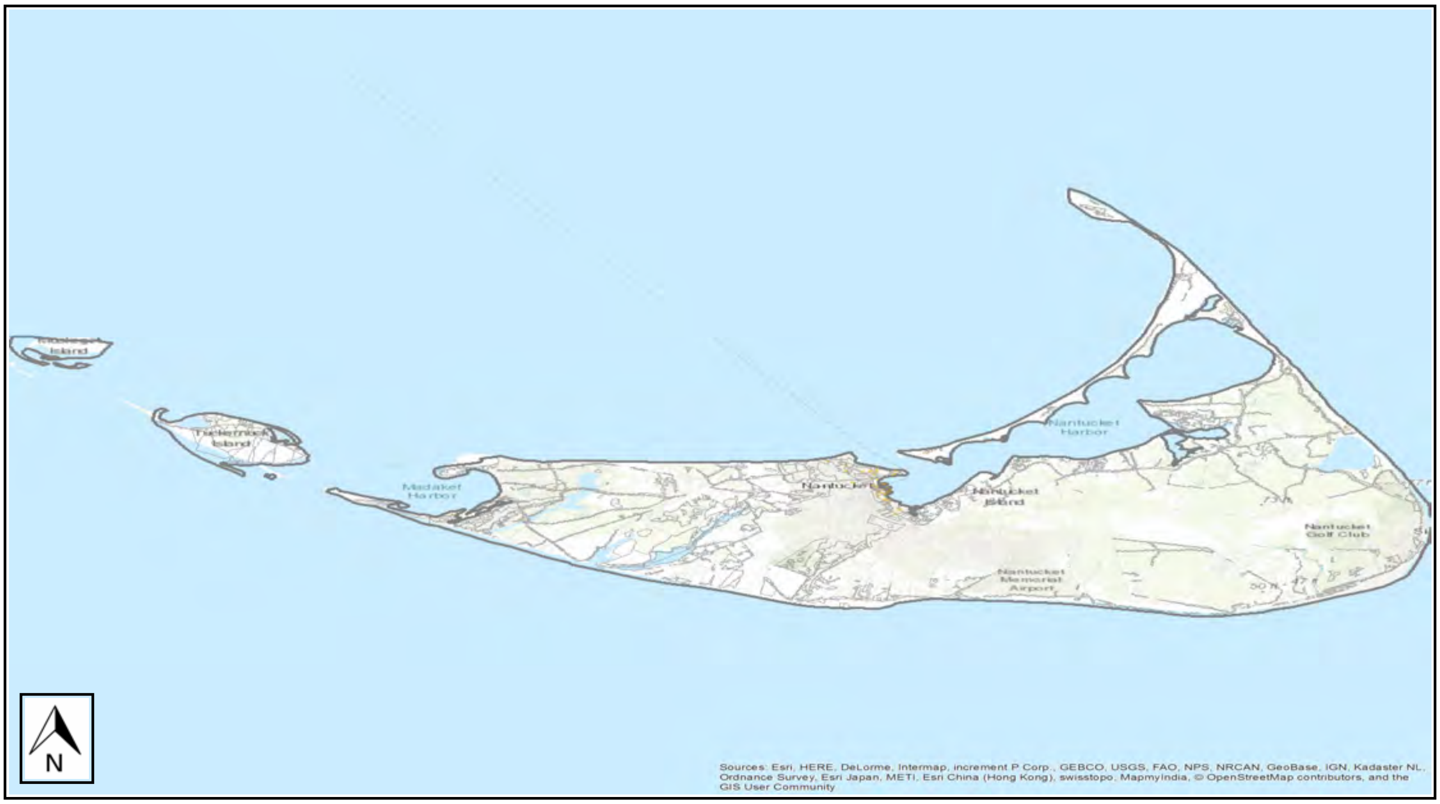


Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	1-10 (%)	11-20 Count	11-20 (%)	21-30 Count	21-30 (%)	31-40 Count	31-40 (%)	41-50 Count	41-50 (%)	Substantially Count	Substantially (%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	1	20.00	4	80.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	137	60.62	42	18.58	26	11.50	9	3.98	12	5.31
Total	**1**		**143**		**42**		**26**		**9**		**12**	

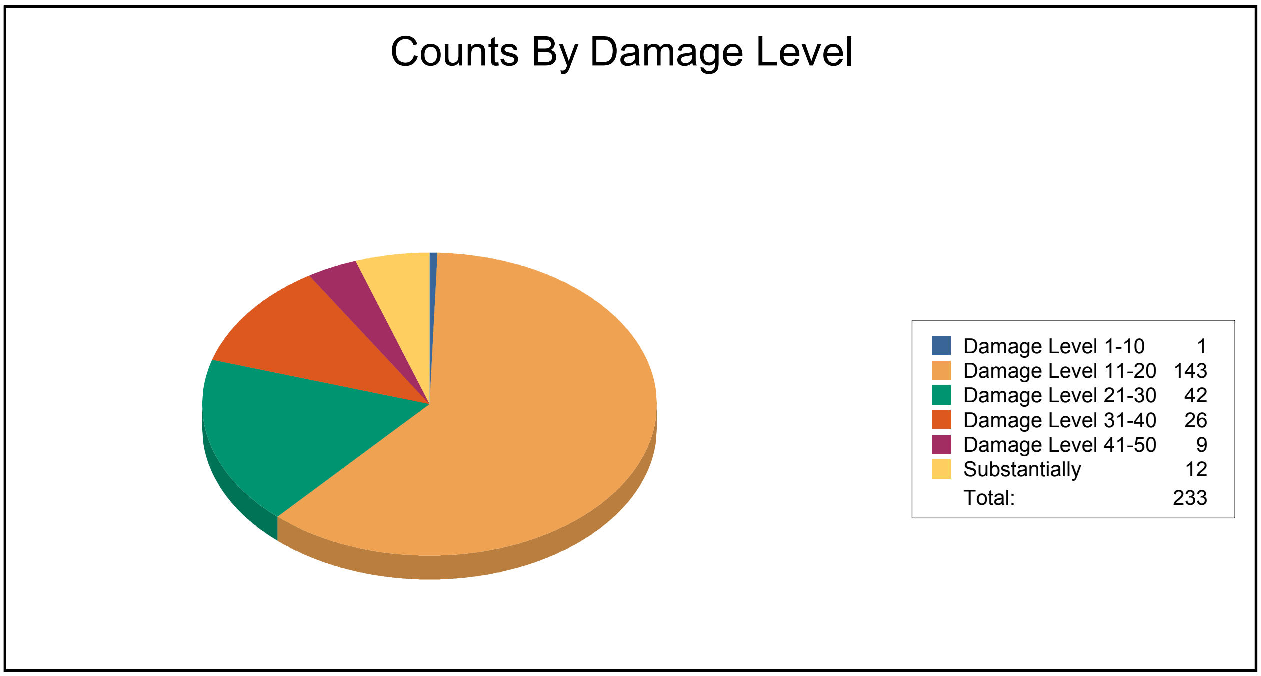


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	1	100	0	0	0	0	0	0	0	0
Steel	1	20	4	80	0	0	0	0	0	0	0	0
Wood	0	0	136	60	42	19	26	12	9	4	12	5

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 19 hospital beds available for use. On the day of the scenario flood event, the model estimates that 19 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	1	0	0	0
Police Stations	2	2	0	2
Schools	4	0	0	0

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

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

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

Induced Flood Damage

Debris Generation

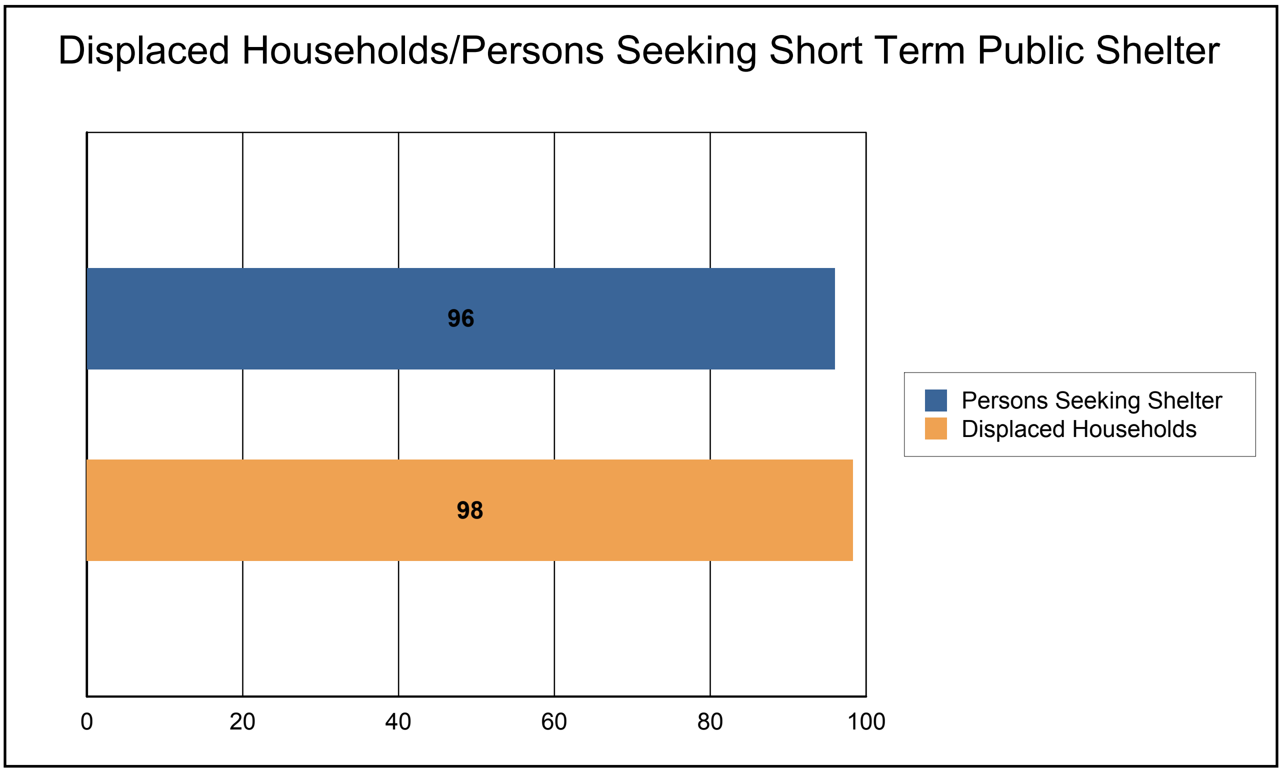
Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because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

Analysis has not been performed for this Scenario.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 98 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 96 people (out of a total population of 10,172) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 123.78 million dollars, which represents 7.80 % of the total replacement value of the scenario buildings.

Building-Related Losses

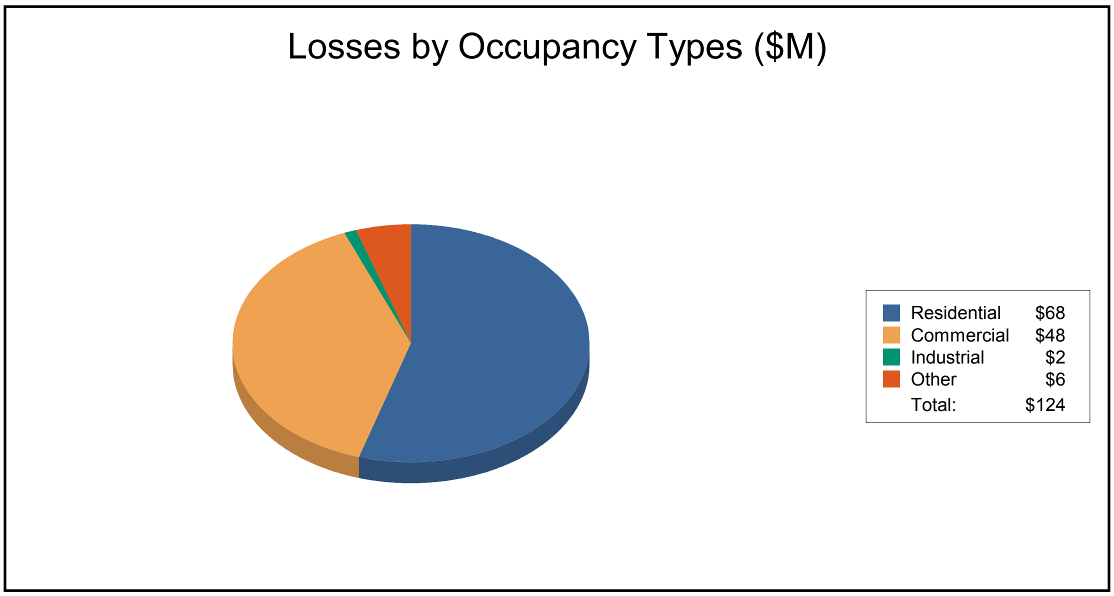
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability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

The total building-related losses were 122.78 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 54.75% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	36.47	12.02	0.57	0.84	49.90
	Content	31.11	35.03	0.93	4.94	72.00
	Inventory	0.00	0.78	0.09	0.02	0.88
	Subtotal	**67.58**	**47.82**	**1.58**	**5.80**	**122.78**
Business Interruption						
	Income	0.02	0.27	0.00	0.00	0.29
	Relocation	0.07	0.03	0.00	0.00	0.10
	Rental Income	0.05	0.02	0.00	0.00	0.07
	Wage	0.06	0.22	0.00	0.27	0.54
	Subtotal	**0.20**	**0.53**	**0.00**	**0.27**	**1.00**
ALL	**Total**	**67.77**	**48.36**	**1.58**	**6.07**	**123.78**



Appendix A: County Listing for the Region

Massachusetts

- Nantucket

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Total Study Region	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Estimated Losses from Hurricanes

Hazus-MH: Hurricane Global Risk Report

Region Name: Nantucket

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Thursday, December 07, 2017

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

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

Table of Contents

General Description of the Region

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

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

- Massachusetts

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

The geographical size of the region is 49.41 square miles and contains 5 census tracts. There are over 4 thousand households in the region and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

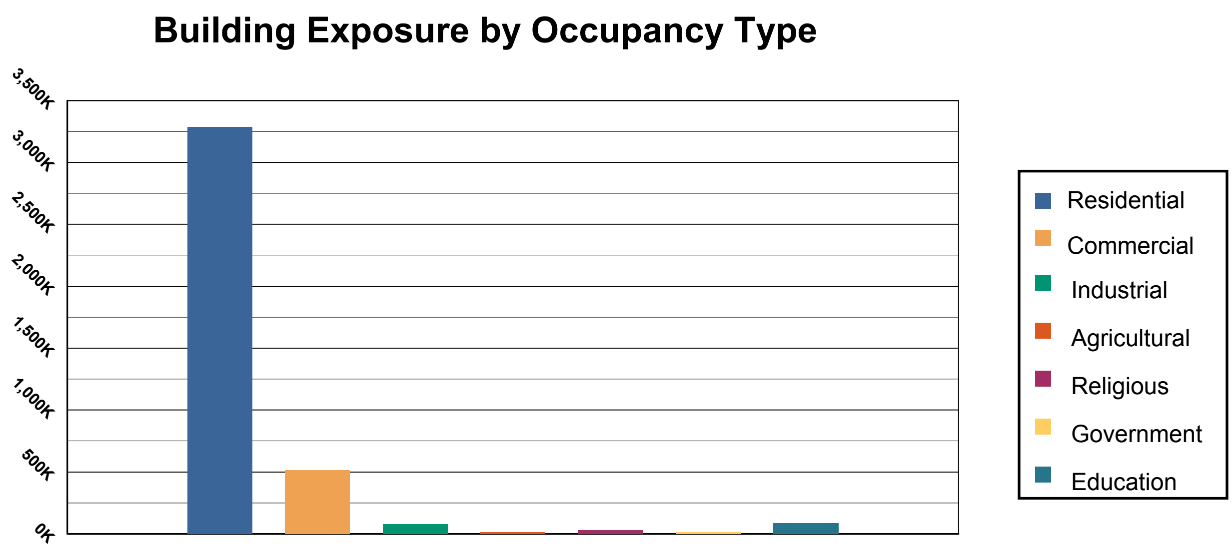


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	3,284,232	81.82%
Commercial	515,165	12.83%
Industrial	78,253	1.95%
Agricultural	13,161	0.33%
Religious	27,546	0.69%
Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

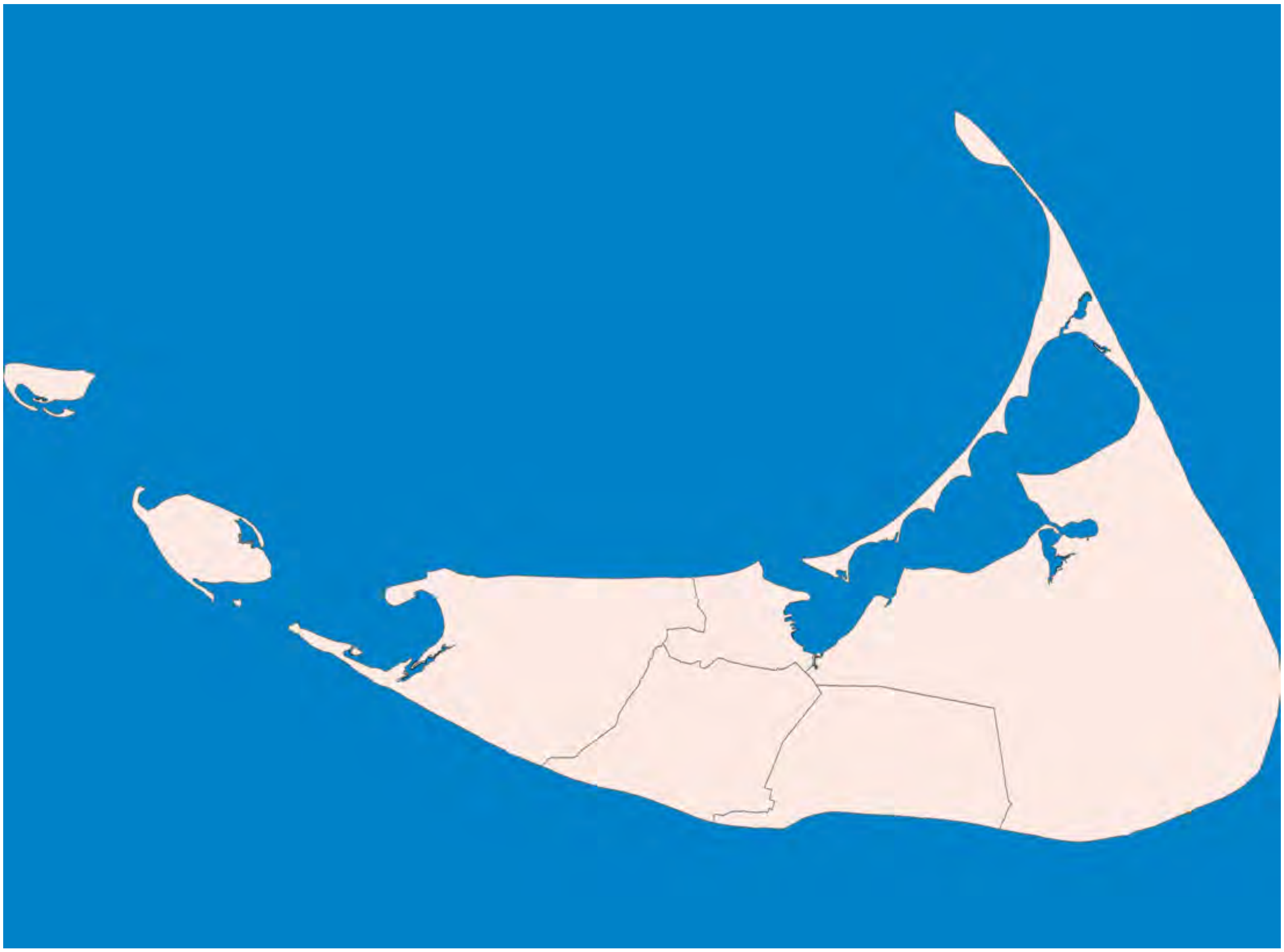
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

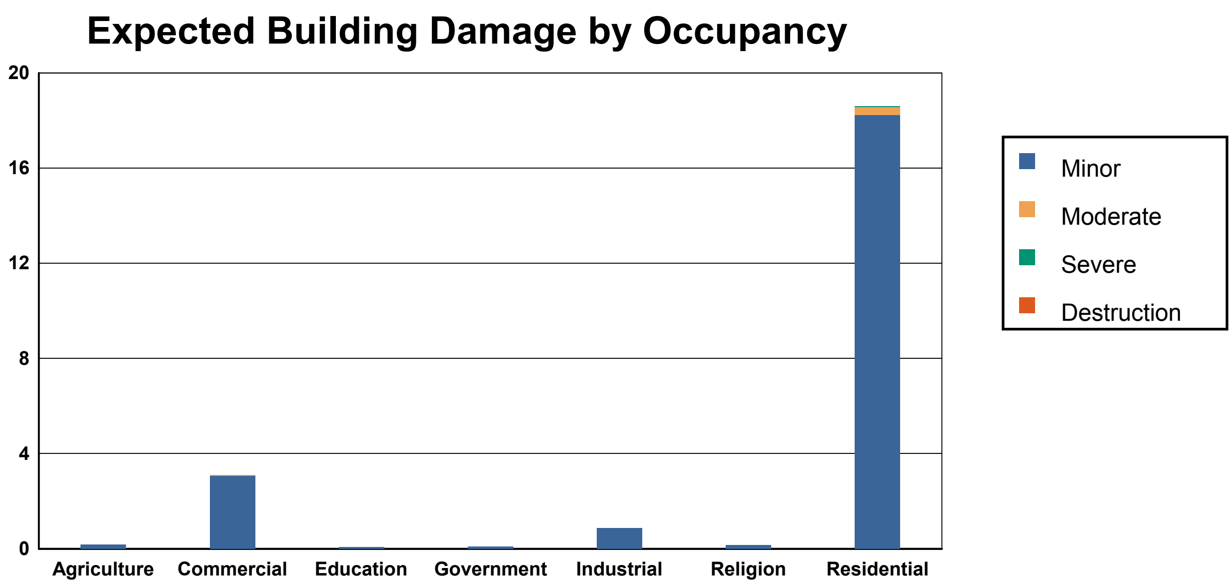


Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	44	99.61	0	0.37	0	0.01	0	0.00	0	0.00
Commercial	627	99.51	3	0.49	0	0.01	0	0.00	0	0.00
Education	16	99.52	0	0.48	0	0.00	0	0.00	0	0.00
Government	15	99.44	0	0.56	0	0.00	0	0.00	0	0.00
Industrial	172	99.50	1	0.50	0	0.00	0	0.00	0	0.00
Religion	38	99.58	0	0.41	0	0.01	0	0.00	0	0.00
Residential	10,988	99.83	18	0.17	0	0.00	0	0.00	0	0.00
Total	**11,900**		**23**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	35	99.43	0	0.57	0	0.00	0	0.00	0	0.00
Masonry	556	99.47	3	0.51	0	0.02	0	0.00	0	0.00
MH	6	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	392	99.45	2	0.54	0	0.00	0	0.00	0	0.00
Wood	10,516	99.86	15	0.14	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

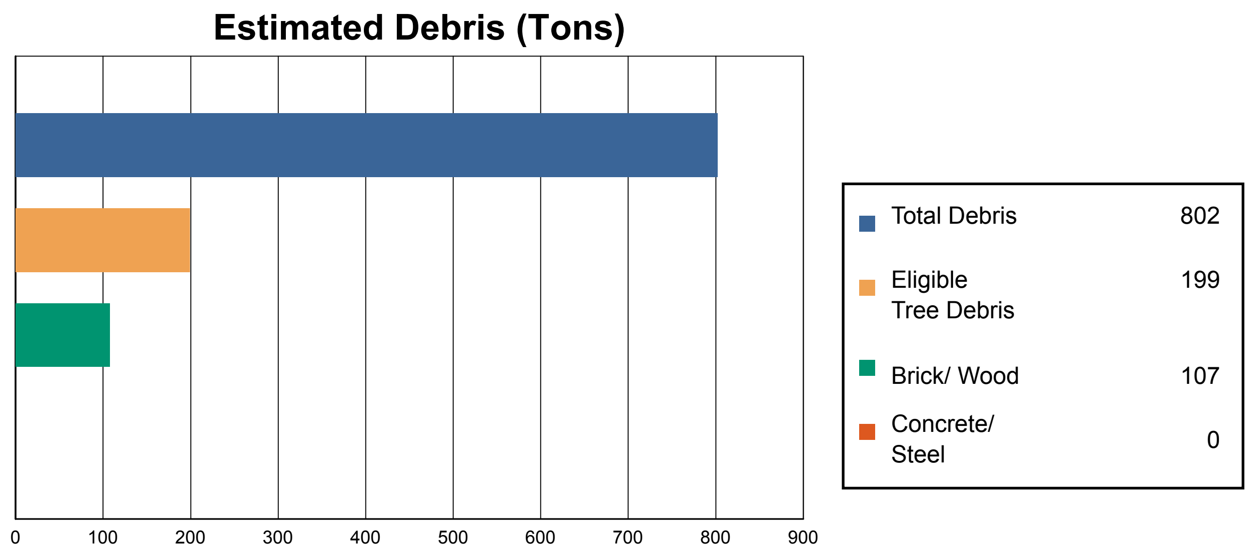
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	0	0	1
Police Stations	2	0	0	2
Schools	4	0	0	4

Induced Hurricane Damage

Debris Generation

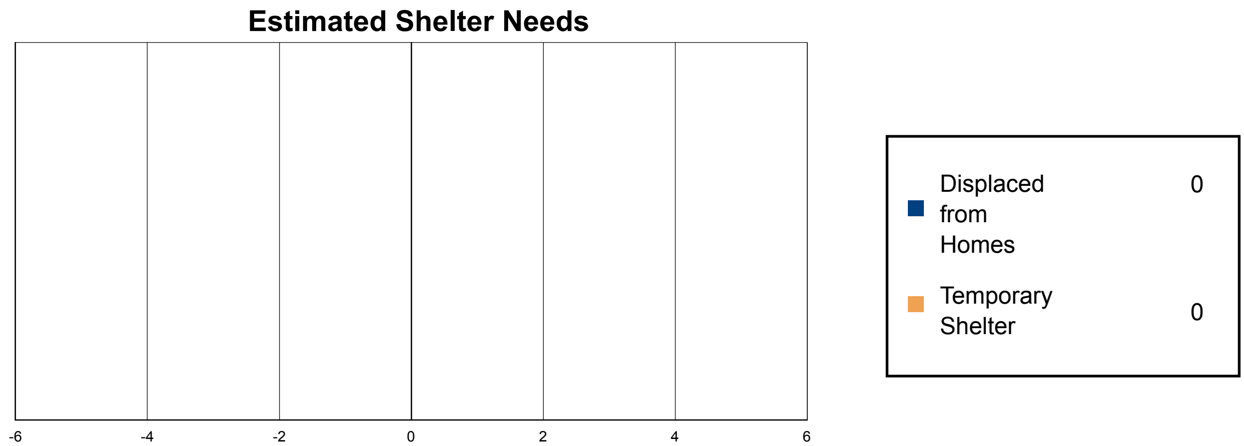


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 802 tons of debris will be generated. Of the total amount, 495 tons (62%) is Other Tree Debris. Of the remaining 307 tons, Brick/Wood comprises 35% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 4 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 199 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

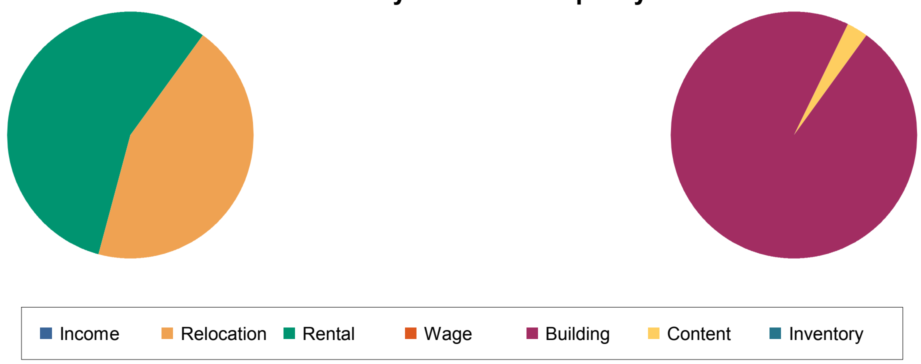
The total economic loss estimated for the hurricane is 2.4 million dollars, which represents 0.06 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 2 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 96% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

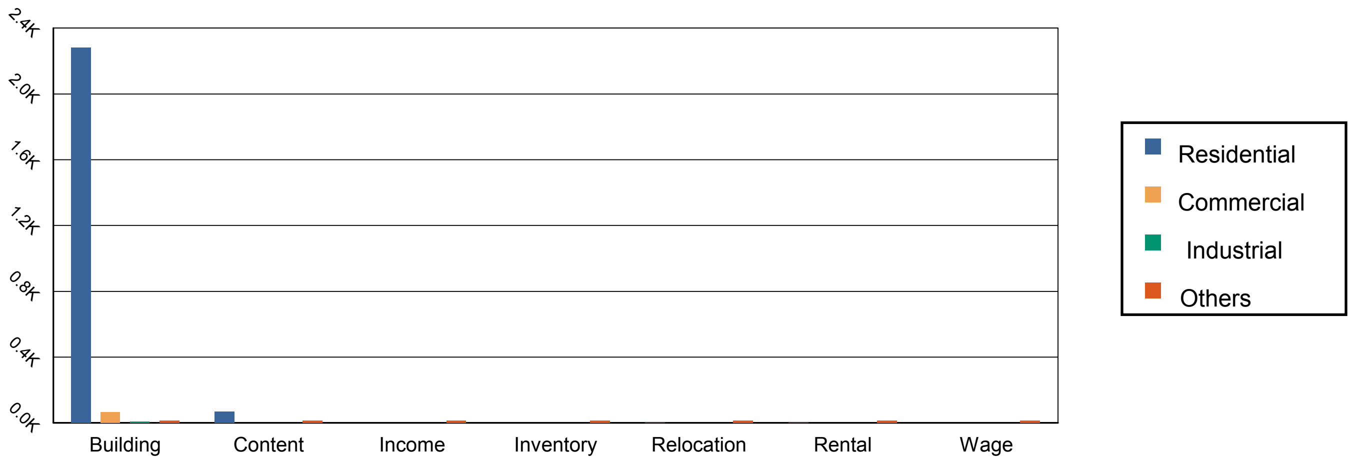


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,280.51	64.26	7.84	13.60	2,366.21
	Content	67.75	0.00	0.00	0.00	67.75
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2,348.26**	**64.26**	**7.84**	**13.60**	**2,433.96**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	2.43	0.18	0.00	0.03	2.64
	Rental	3.34	0.00	0.00	0.00	3.34
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**5.77**	**0.18**	**0.00**	**0.03**	**5.99**
Total						
	Total	**2,354.03**	**64.44**	**7.85**	**13.62**	**2,439.94**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Hazus-MH: Hurricane Global Risk Report

Region Name: Nantucket

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Thursday, December 07, 2017

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

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

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

- Massachusetts

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

The geographical size of the region is 49.41 square miles and contains 5 census tracts. There are over 4 thousand households in the region and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

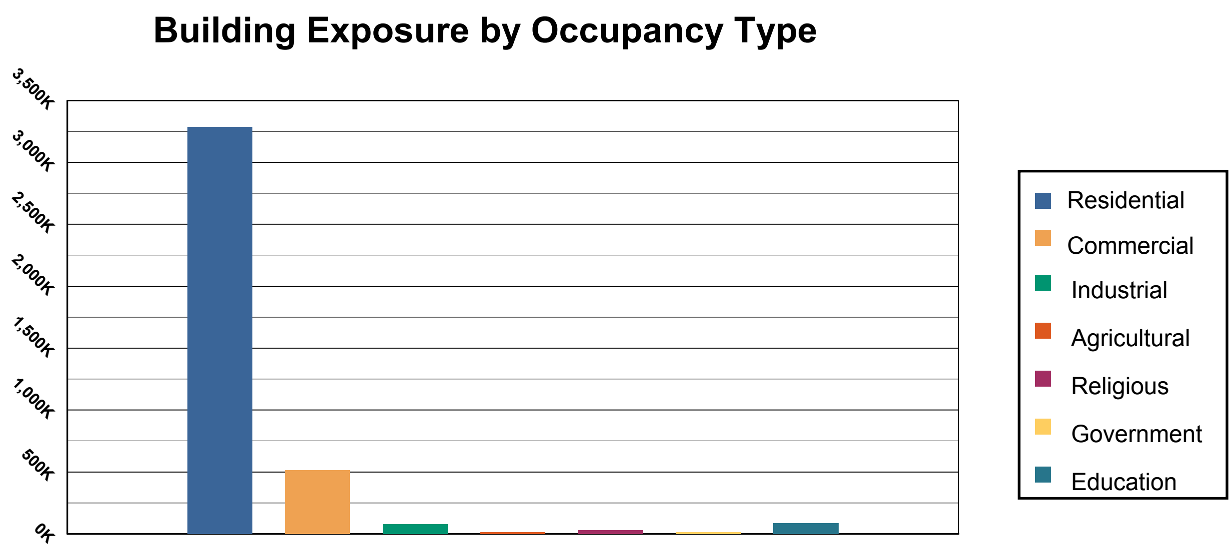


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	3,284,232	81.82%
Commercial	515,165	12.83%
Industrial	78,253	1.95%
Agricultural	13,161	0.33%
Religious	27,546	0.69%
Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

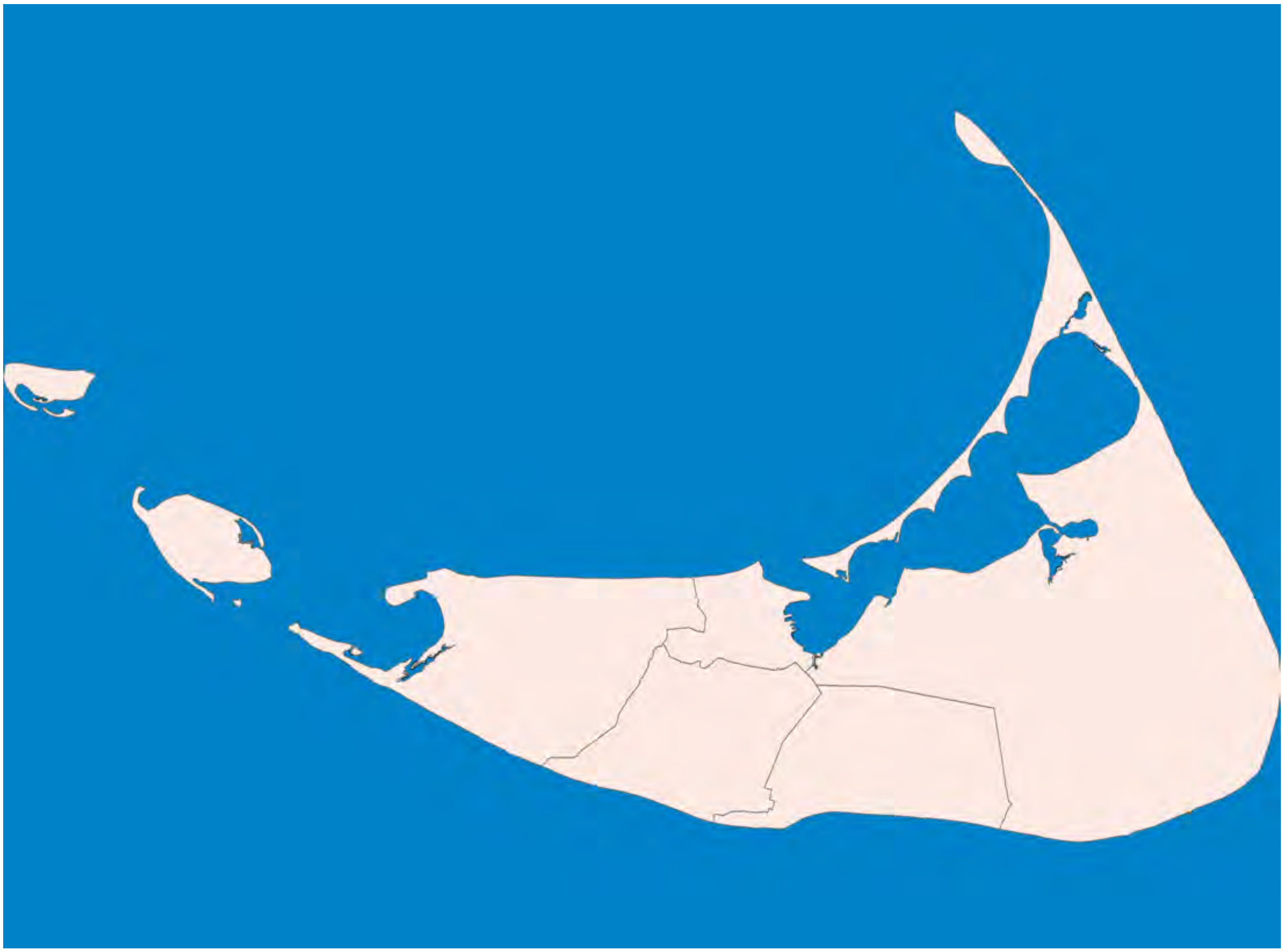
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 29 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

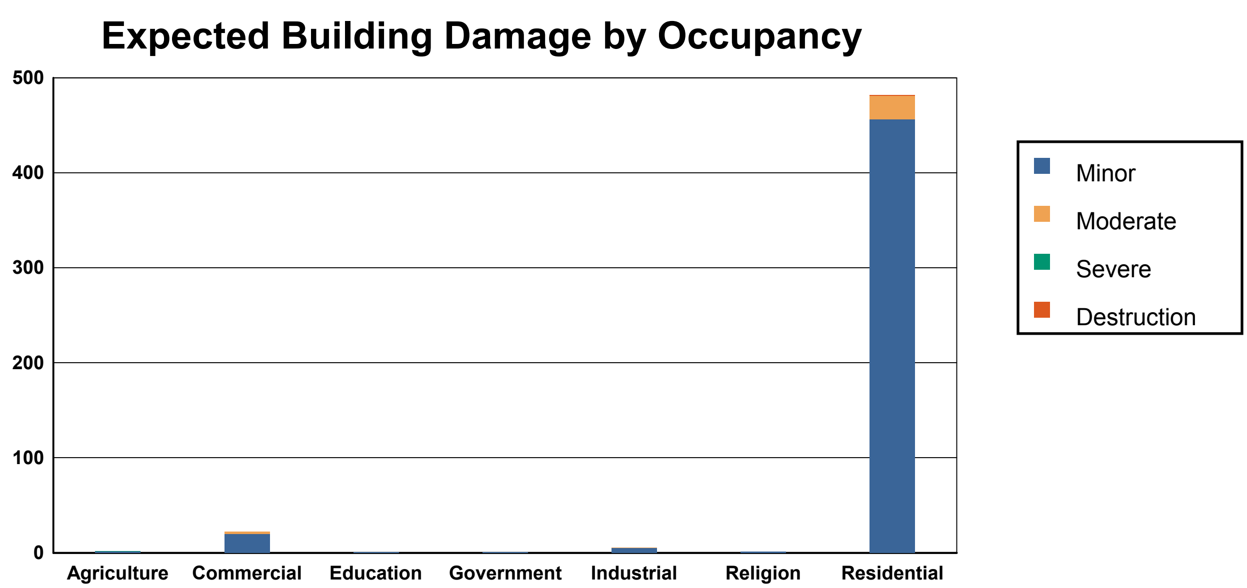


Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	42	96.09	1	3.26	0	0.47	0	0.17	0	0.01
Commercial	608	96.45	20	3.18	2	0.35	0	0.02	0	0.00
Education	16	97.26	0	2.62	0	0.12	0	0.00	0	0.00
Government	14	96.27	1	3.39	0	0.33	0	0.01	0	0.00
Industrial	167	96.74	5	2.99	0	0.24	0	0.03	0	0.00
Religion	37	96.42	1	3.34	0	0.23	0	0.01	0	0.00
Residential	10,525	95.62	456	4.14	25	0.22	0	0.00	1	0.01
Total	**11,409**		**485**		**28**		**1**		**1**	

Table 3: Expected Building Damage by Building Type : 20 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	34	96.63	1	3.15	0	0.22	0	0.00	0	0.00
Masonry	534	95.52	22	3.89	3	0.56	0	0.03	0	0.00
MH	6	99.94	0	0.05	0	0.01	0	0.00	0	0.00
Steel	380	96.55	12	3.09	1	0.34	0	0.02	0	0.00
Wood	10,079	95.71	430	4.08	20	0.19	0	0.00	1	0.01

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

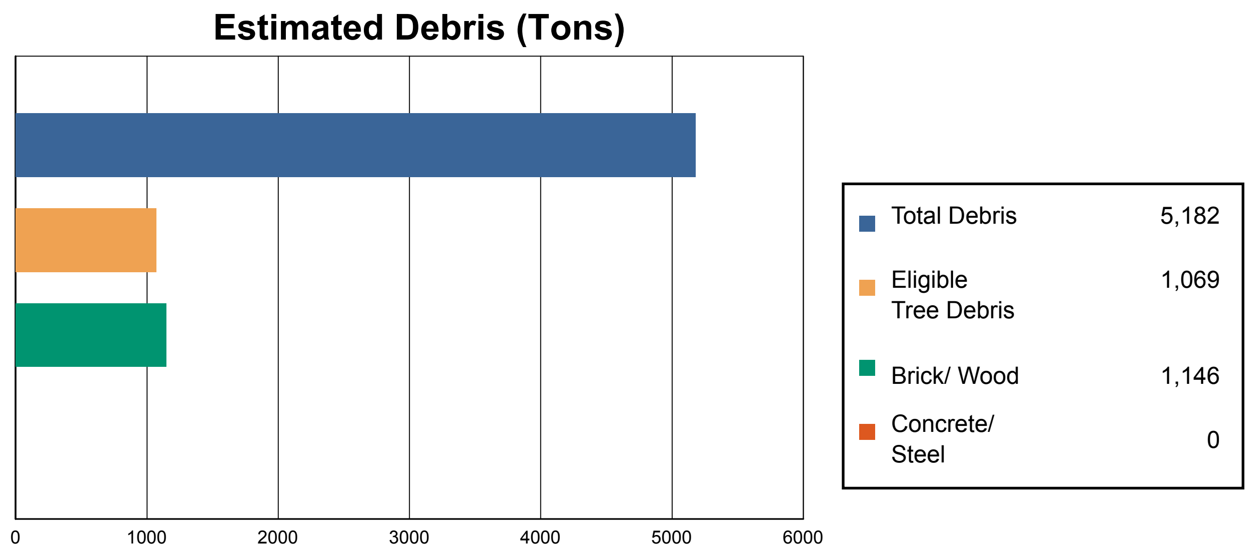
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	0	0	1
Police Stations	2	0	0	2
Schools	4	0	0	4

Induced Hurricane Damage

Debris Generation

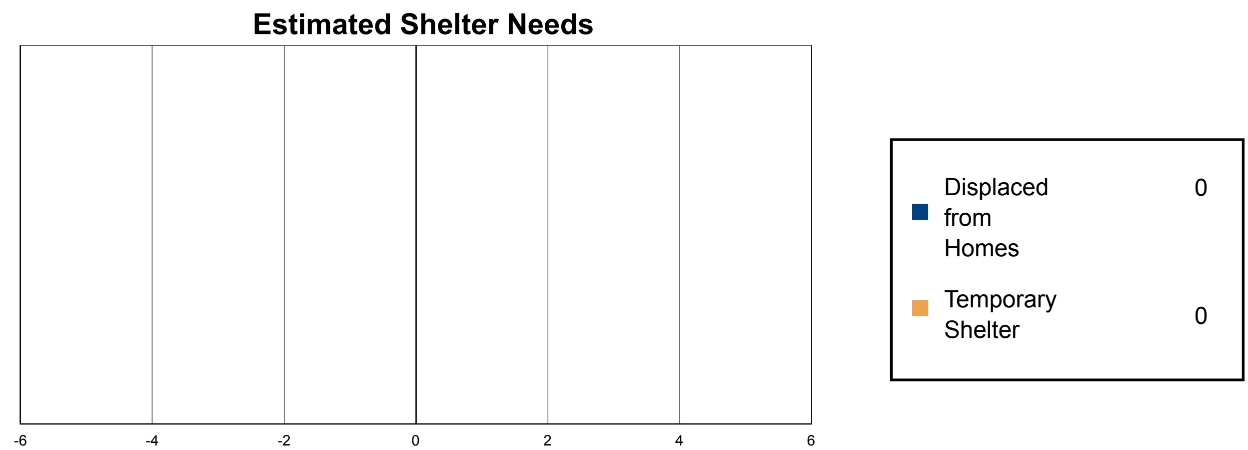


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 5,182 tons of debris will be generated. Of the total amount, 2,978 tons (57%) is Other Tree Debris. Of the remaining 2,204 tons, Brick/Wood comprises 52% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 45 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,069 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

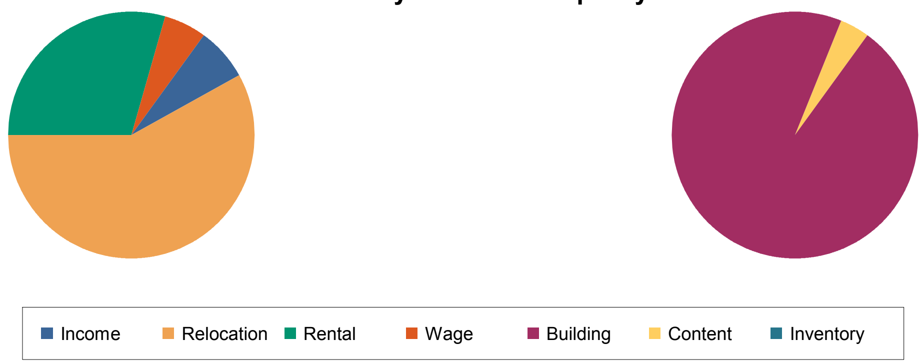
The total economic loss estimated for the hurricane is 15.5 million dollars, which represents 0.39 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 15 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 94% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

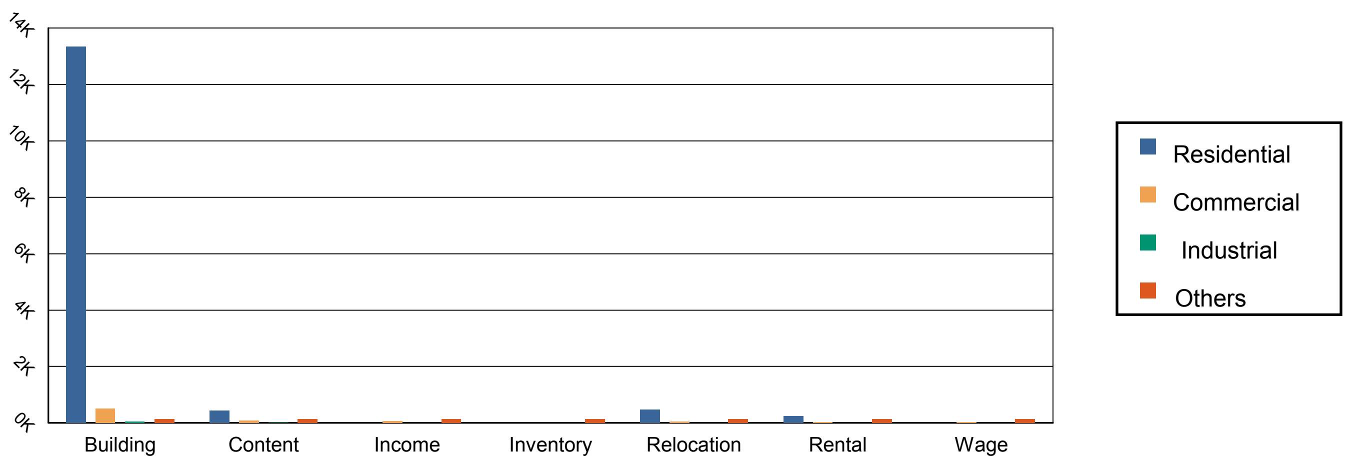


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	13,347.40	504.08	53.04	101.54	14,006.05
	Content	441.51	84.37	11.59	12.61	550.08
	Inventory	0.00	1.43	1.58	0.66	3.67
	Subtotal	**13,788.90**	**589.88**	**66.21**	**114.81**	**14,559.80**
Business Interruption Loss						
	Income	0.00	60.19	0.16	3.80	64.16
	Relocation	474.77	46.66	1.55	5.63	528.60
	Rental	237.77	28.97	0.13	0.47	267.34
	Wage	0.00	39.63	0.28	11.56	51.47
	Subtotal	**712.54**	**175.45**	**2.12**	**21.46**	**911.57**
Total						
	Total	**14,501.44**	**765.33**	**68.33**	**136.27**	**15,471.37**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Hazus-MH: Hurricane Global Risk Report

Region Name:	Nantucket
Hurricane Scenario:	Probabilistic 50-year Return Period
Print Date:	Thursday, December 07, 2017

Disclaimer:

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

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

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General Description of the Region

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

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

- Massachusetts

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

The geographical size of the region is 49.41 square miles and contains 5 census tracts. There are over 4 thousand households in the region and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

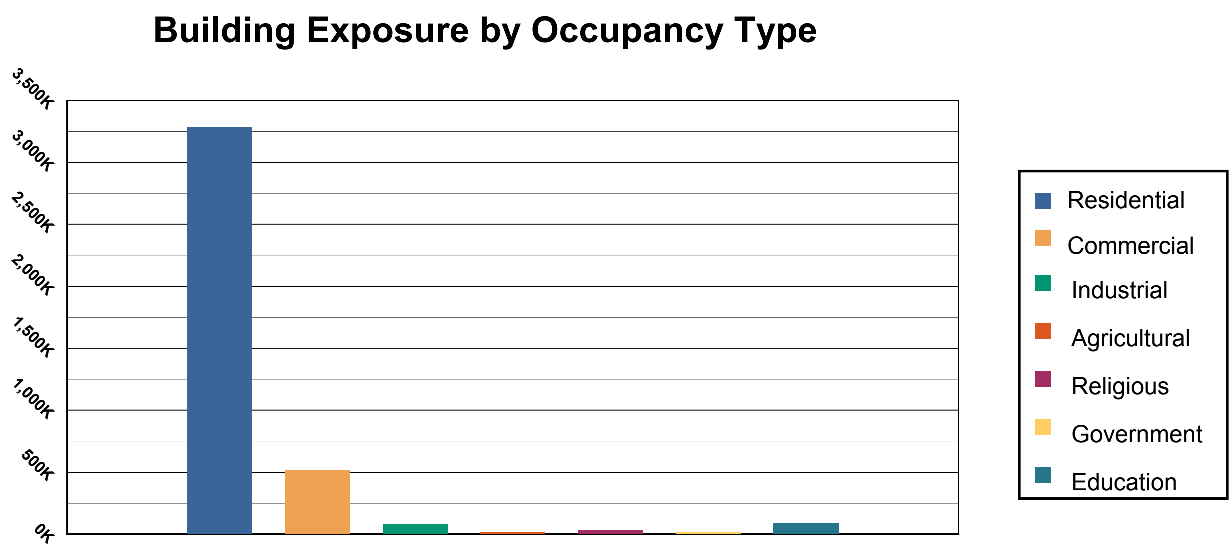


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	3,284,232	81.82%
Commercial	515,165	12.83%
Industrial	78,253	1.95%
Agricultural	13,161	0.33%
Religious	27,546	0.69%
Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

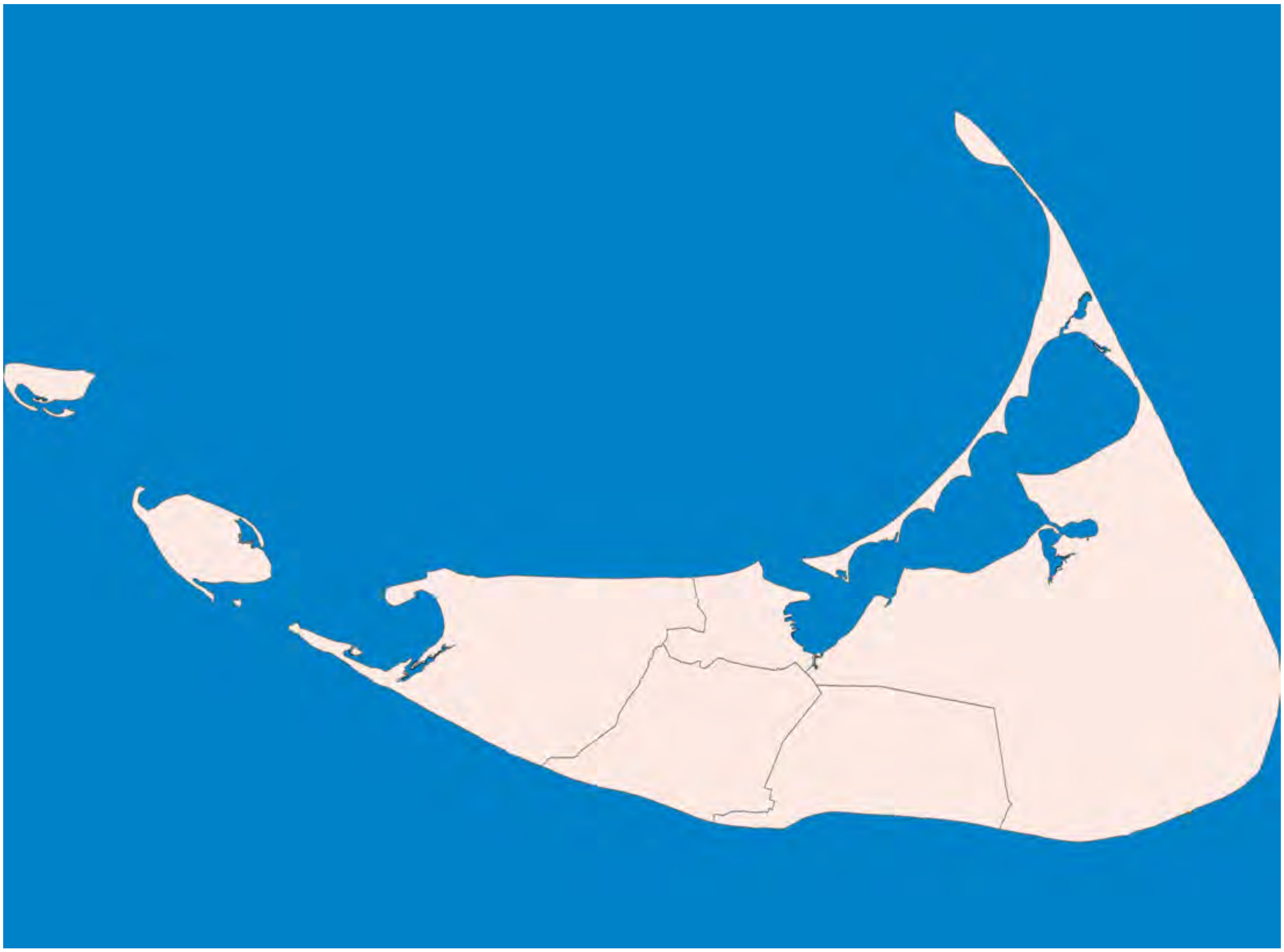
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 464 buildings will be at least moderately damaged. This is over 4% of the total number of buildings in the region. There are an estimated 30 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

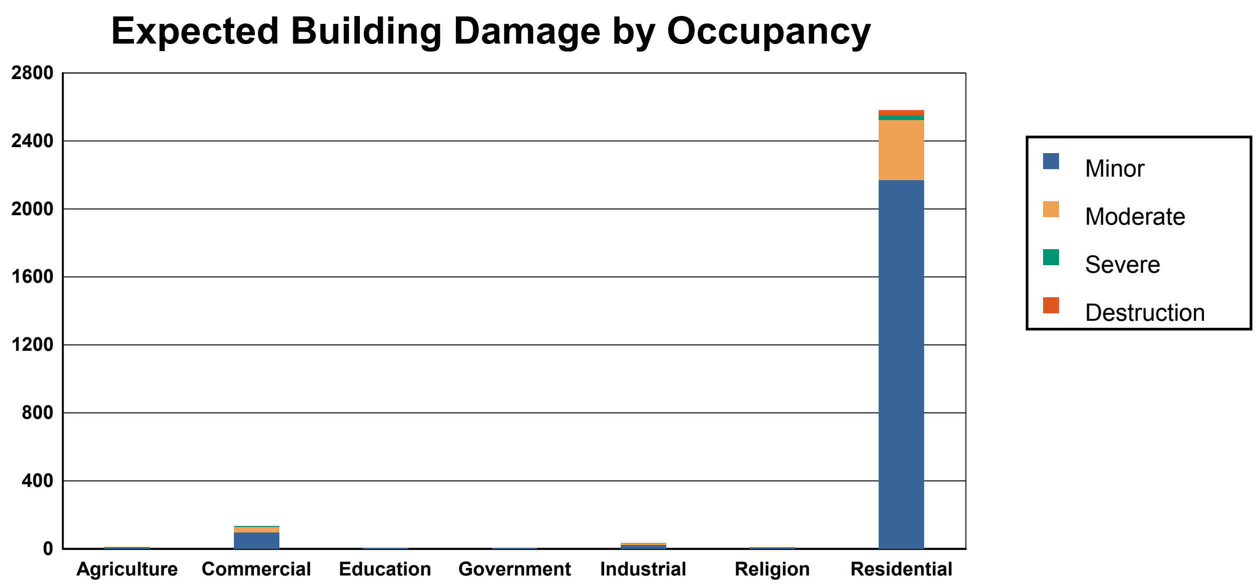


Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	34	78.04	7	15.22	2	4.44	1	2.06	0	0.24
Commercial	498	79.07	95	15.06	33	5.20	4	0.67	0	0.00
Education	13	81.73	2	13.99	1	3.98	0	0.30	0	0.00
Government	11	76.43	2	15.86	1	6.72	0	0.98	0	0.00
Industrial	141	81.42	23	13.51	8	4.38	1	0.66	0	0.03
Religion	30	78.69	6	16.43	2	4.42	0	0.45	0	0.00
Residential	8,426	76.55	2,169	19.70	354	3.22	27	0.25	30	0.27
Total	**9,154**		**2,305**		**400**		**34**		**30**	

Table 3: Expected Building Damage by Building Type : 50 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	28	80.91	5	13.76	2	4.91	0	0.42	0	0.00
Masonry	434	77.72	90	16.12	31	5.49	3	0.55	1	0.11
MH	6	97.37	0	1.74	0	0.70	0	0.01	0	0.19
Steel	315	79.91	54	13.72	22	5.56	3	0.82	0	0.00
Wood	8,079	76.72	2,085	19.80	313	2.97	25	0.24	29	0.27

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

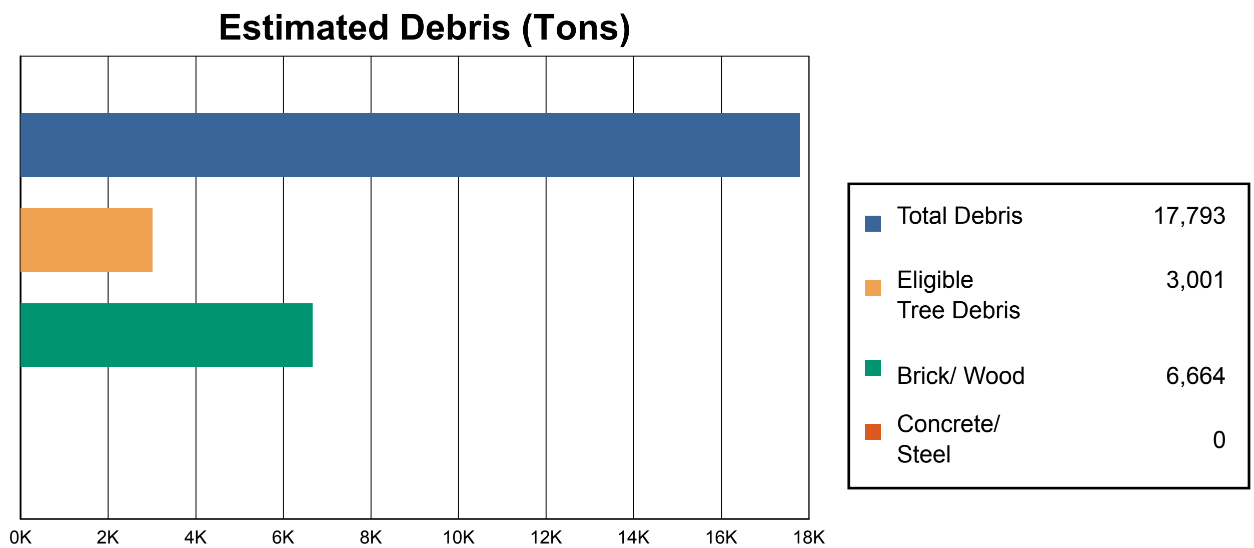
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	0	0	1
Police Stations	2	0	0	2
Schools	4	0	0	3

Induced Hurricane Damage

Debris Generation

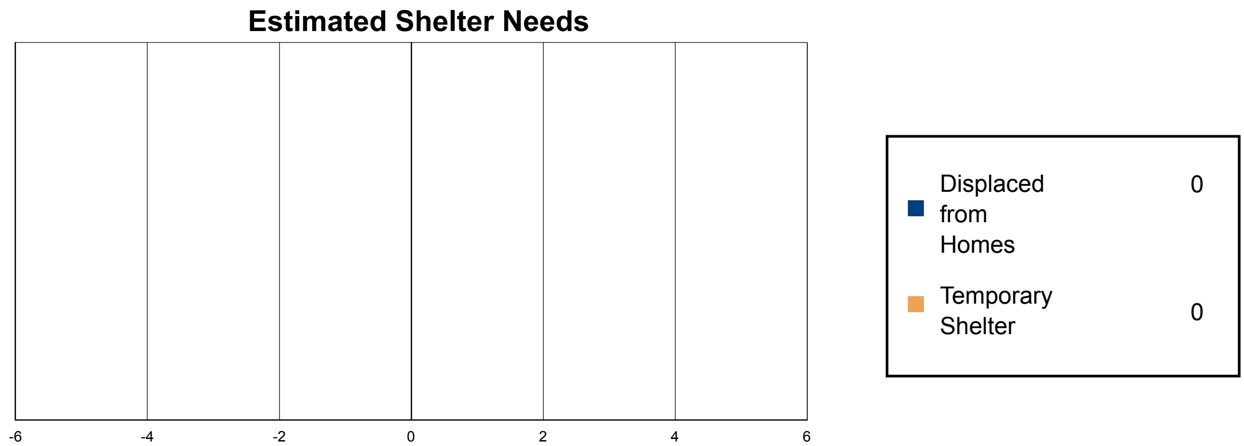


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 17,793 tons of debris will be generated. Of the total amount, 8,135 tons (46%) is Other Tree Debris. Of the remaining 9,658 tons, Brick/Wood comprises 69% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 266 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 3,001 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

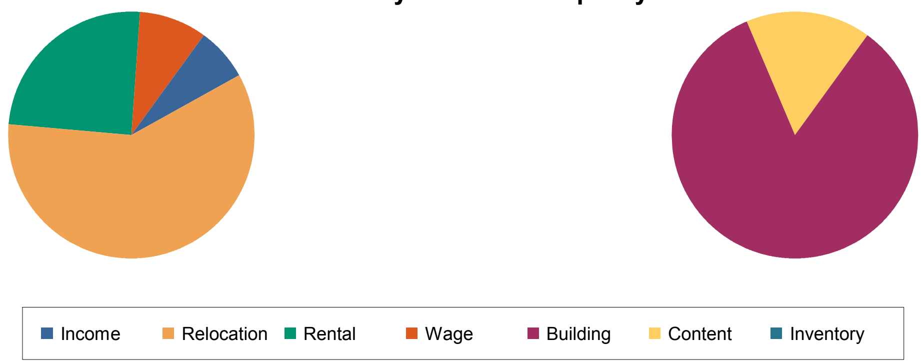
The total economic loss estimated for the hurricane is 82.4 million dollars, which represents 2.05 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 82 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

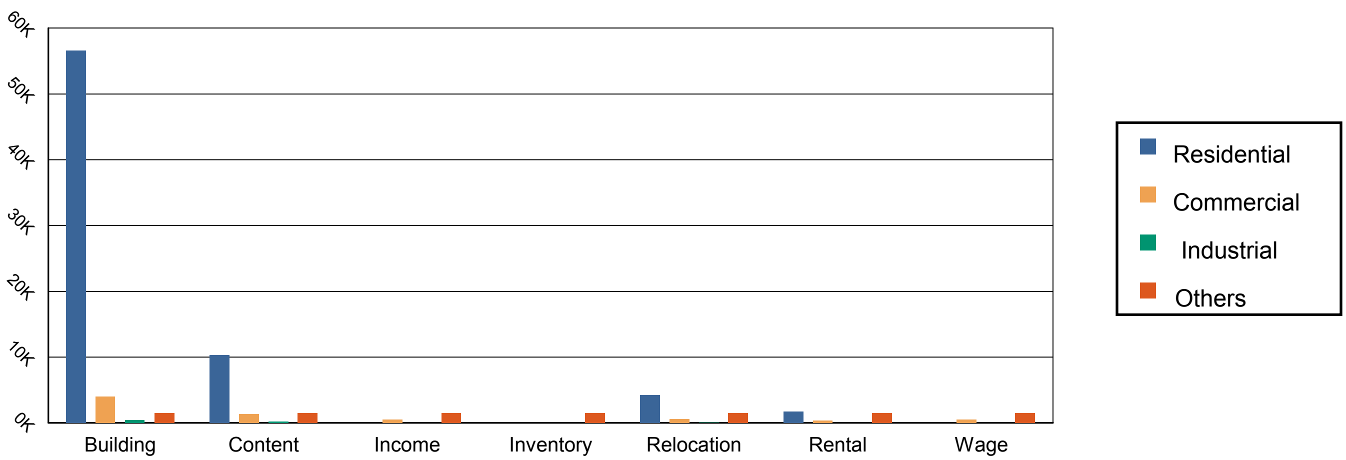


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	56,563.79	3,986.61	432.04	794.08	61,776.53
	Content	10,338.42	1,368.64	213.27	250.77	12,171.09
	Inventory	0.00	20.28	26.91	8.42	55.61
	Subtotal	**66,902.21**	**5,375.53**	**672.23**	**1,053.27**	**74,003.23**
Business Interruption Loss						
	Income	0.39	502.75	4.94	60.74	568.83
	Relocation	4,217.03	595.82	41.10	135.18	4,989.12
	Rental	1,690.19	343.08	4.05	11.84	2,049.17
	Wage	0.92	479.47	8.61	258.61	747.60
	Subtotal	**5,908.53**	**1,921.13**	**58.69**	**466.37**	**8,354.72**
Total						
	Total	**72,810.74**	**7,296.65**	**730.92**	**1,519.64**	**82,357.95**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	**Residential**	**Non-Residential**	**Total**
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Hazus-MH: Hurricane Global Risk Report

Region Name: Nantucket

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, December 07, 2017

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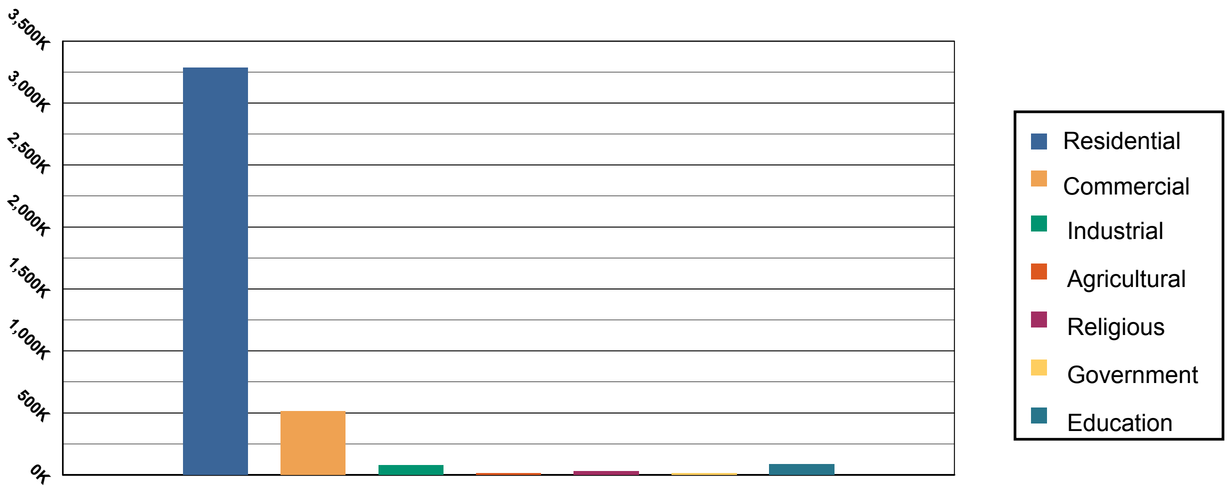
There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Building Exposure by Occupancy Type



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Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

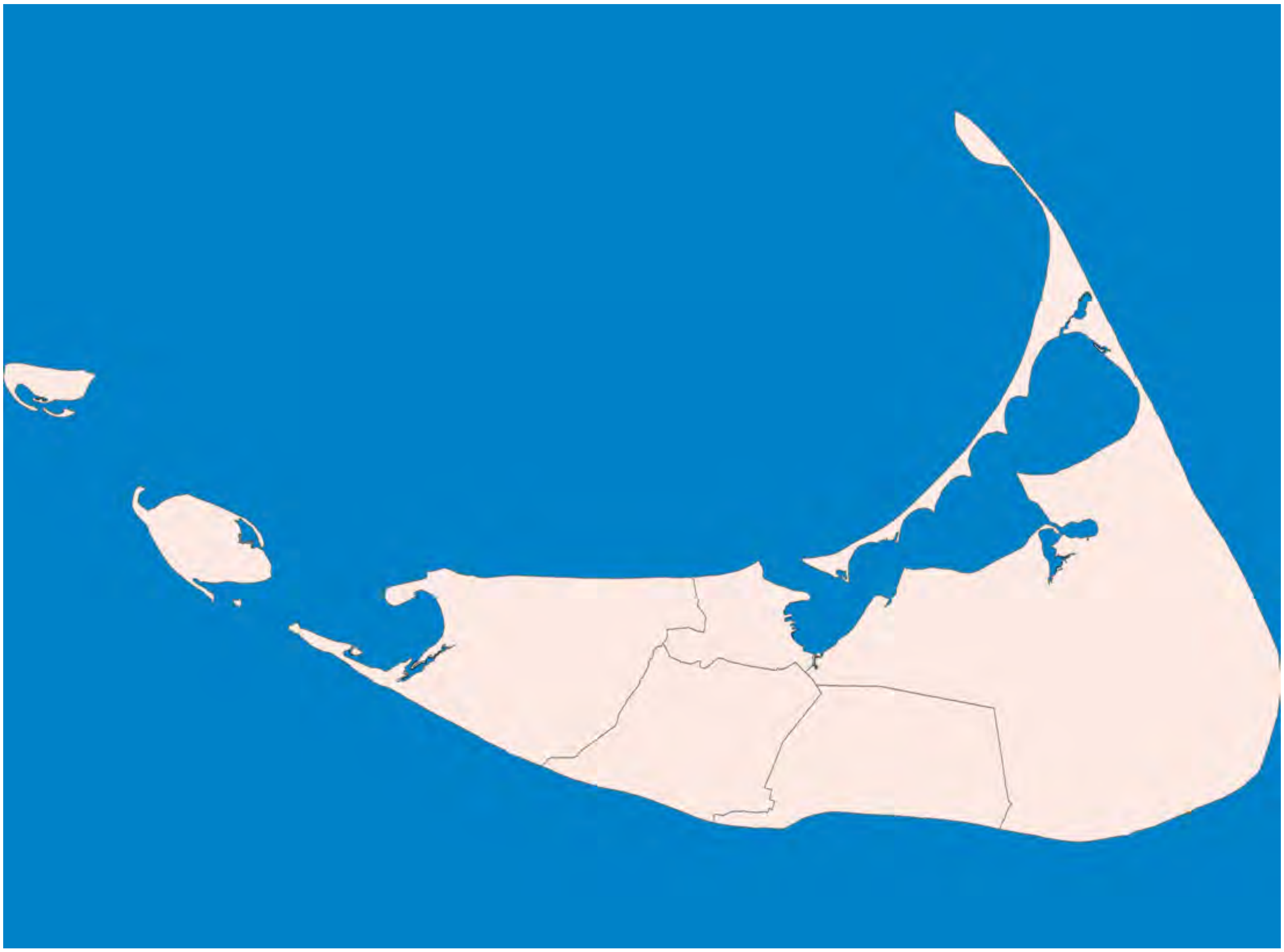
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 1,440 buildings will be at least moderately damaged. This is over 12% of the total number of buildings in the region. There are an estimated 144 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

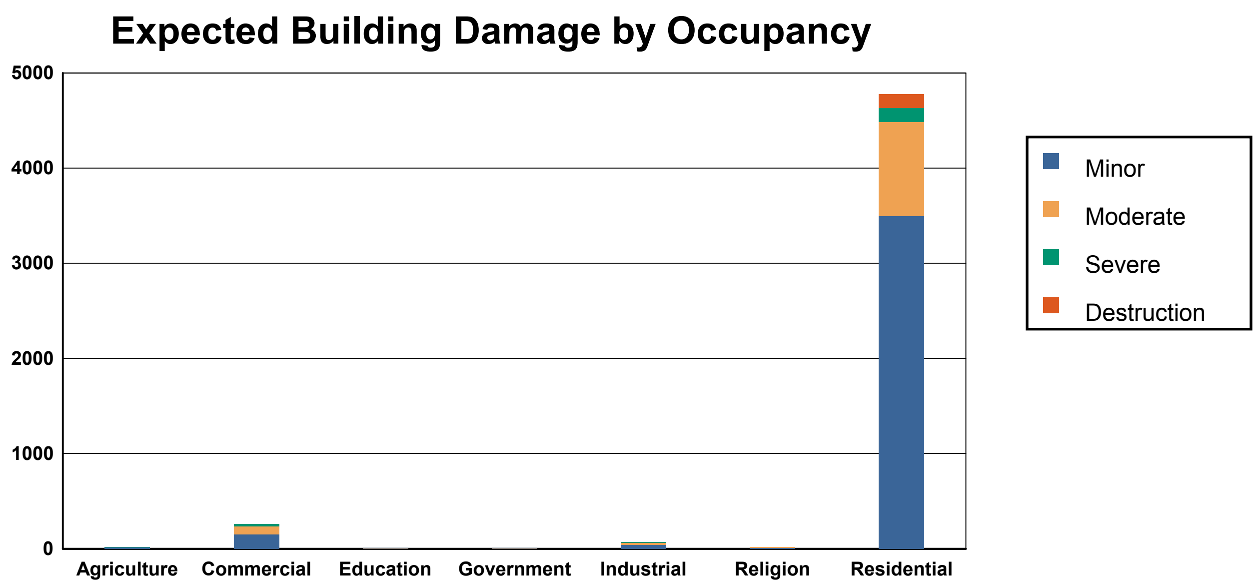


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	55.39	12	26.31	5	11.46	3	5.85	0	0.99
Commercial	370	58.74	149	23.72	89	14.15	21	3.37	0	0.02
Education	10	62.37	4	22.75	2	12.63	0	2.25	0	0.00
Government	9	57.46	3	22.62	2	15.64	1	4.28	0	0.00
Industrial	103	59.59	39	22.41	24	14.16	6	3.70	0	0.13
Religion	22	58.38	10	26.43	5	12.60	1	2.59	0	0.00
Residential	6,230	56.60	3,498	31.78	984	8.94	153	1.39	143	1.30
Total	**6,768**		**3,715**		**1,111**		**185**		**144**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	21	59.36	8	21.92	5	15.48	1	3.23	0	0.00
Masonry	322	57.52	142	25.42	78	13.96	14	2.54	3	0.55
MH	6	92.97	0	3.77	0	2.37	0	0.13	0	0.75
Steel	233	59.20	83	21.05	61	15.45	17	4.28	0	0.02
Wood	5,972	56.71	3,387	32.16	894	8.49	142	1.34	136	1.29

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

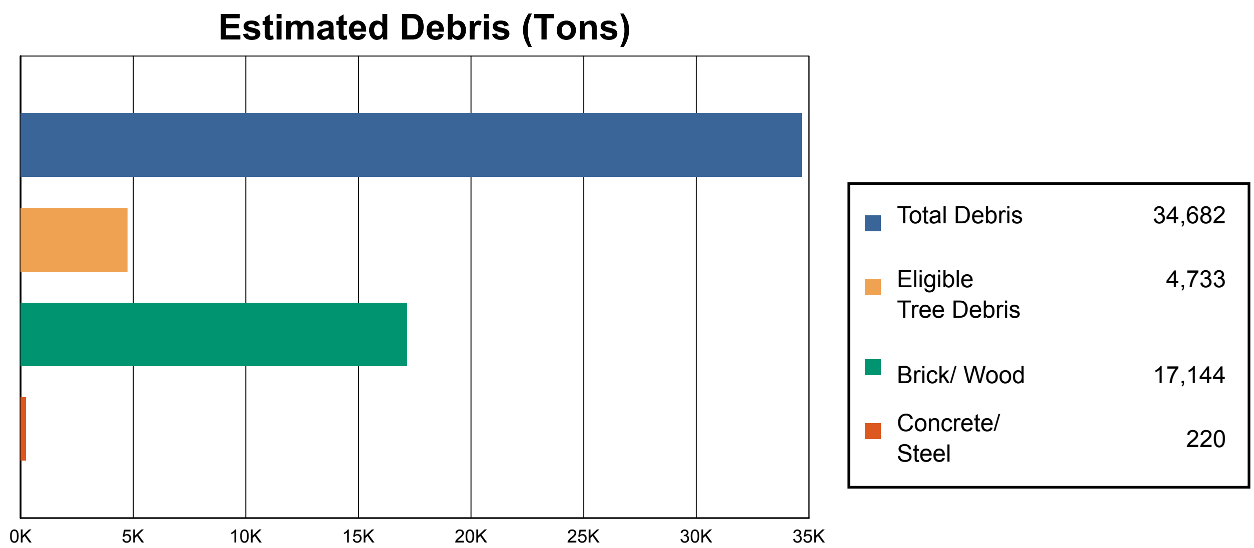
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	0	0	1
Police Stations	2	0	0	2
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation

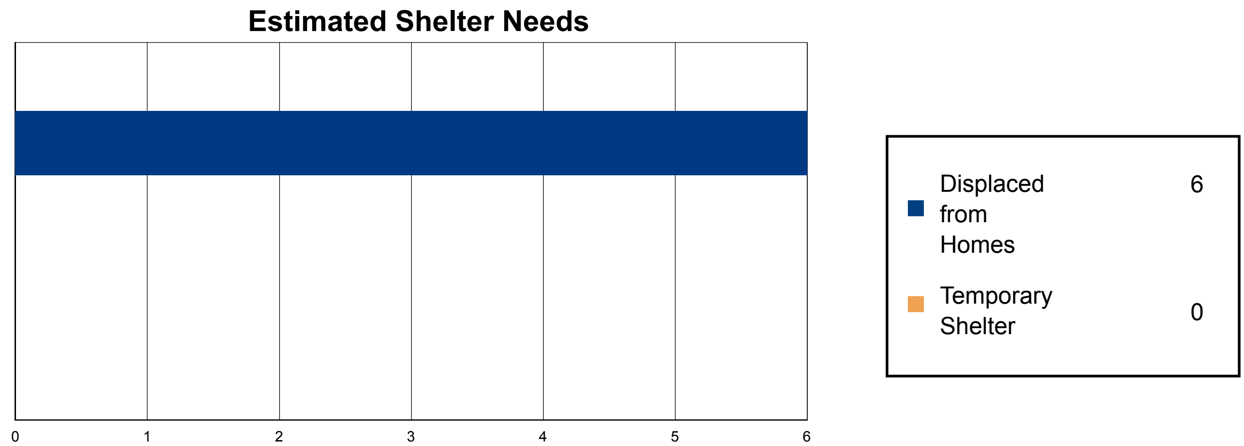


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 34,682 tons of debris will be generated. Of the total amount, 12,702 tons (37%) is Other Tree Debris. Of the remaining 21,980 tons, Brick/Wood comprises 78% of the total, Reinforced Concrete/Steel comprises of 1% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 690 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 4,733 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 6 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

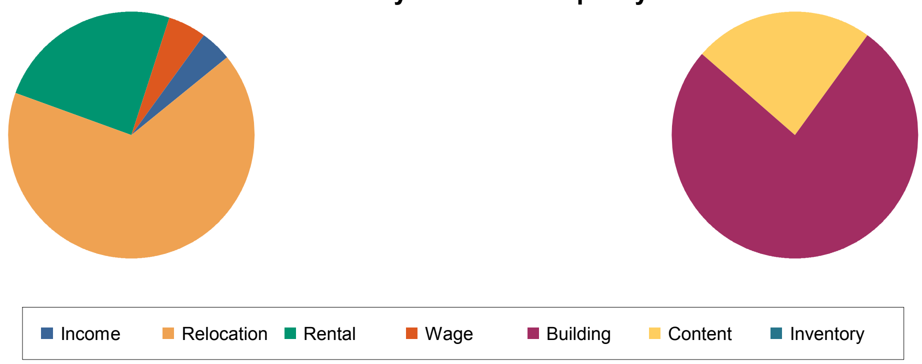
The total economic loss estimated for the hurricane is 244.9 million dollars, which represents 6.10 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 245 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

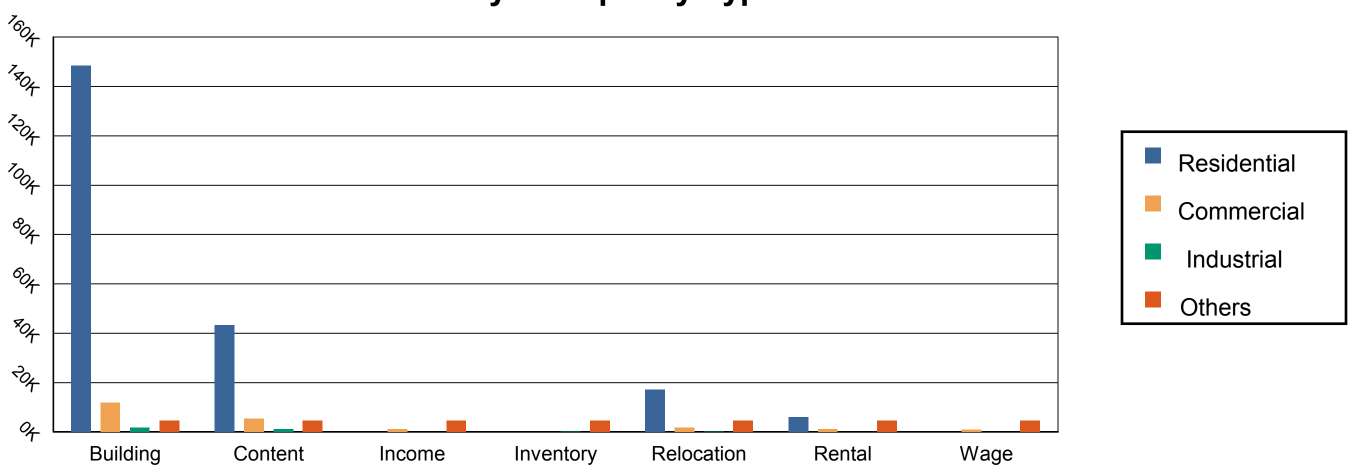


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	148,352.40	11,928.36	1,753.89	2,531.33	164,565.98
	Content	43,234.44	5,336.92	1,070.98	1,049.62	50,691.96
	Inventory	0.00	86.18	131.81	27.06	245.05
	Subtotal	**191,586.84**	**17,351.45**	**2,956.68**	**3,608.01**	**215,502.99**
Business Interruption Loss						
	Income	13.75	1,047.16	13.37	116.85	1,191.14
	Relocation	17,103.58	1,828.61	172.46	482.23	19,586.88
	Rental	6,058.46	1,055.03	16.86	39.08	7,169.43
	Wage	32.21	972.67	23.02	462.18	1,490.08
	Subtotal	**23,207.99**	**4,903.47**	**225.71**	**1,100.34**	**29,437.52**
Total						
	Total	**214,794.84**	**22,254.93**	**3,182.39**	**4,708.36**	**244,940.51**

Appendix A: County Listing for the Region

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Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

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General Building Stock

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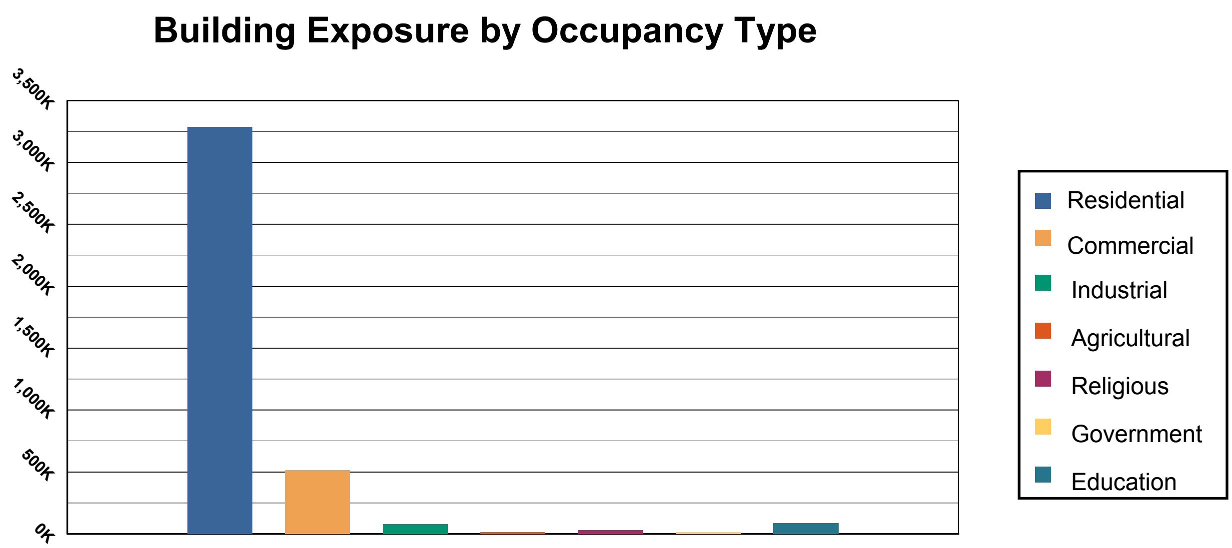

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For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

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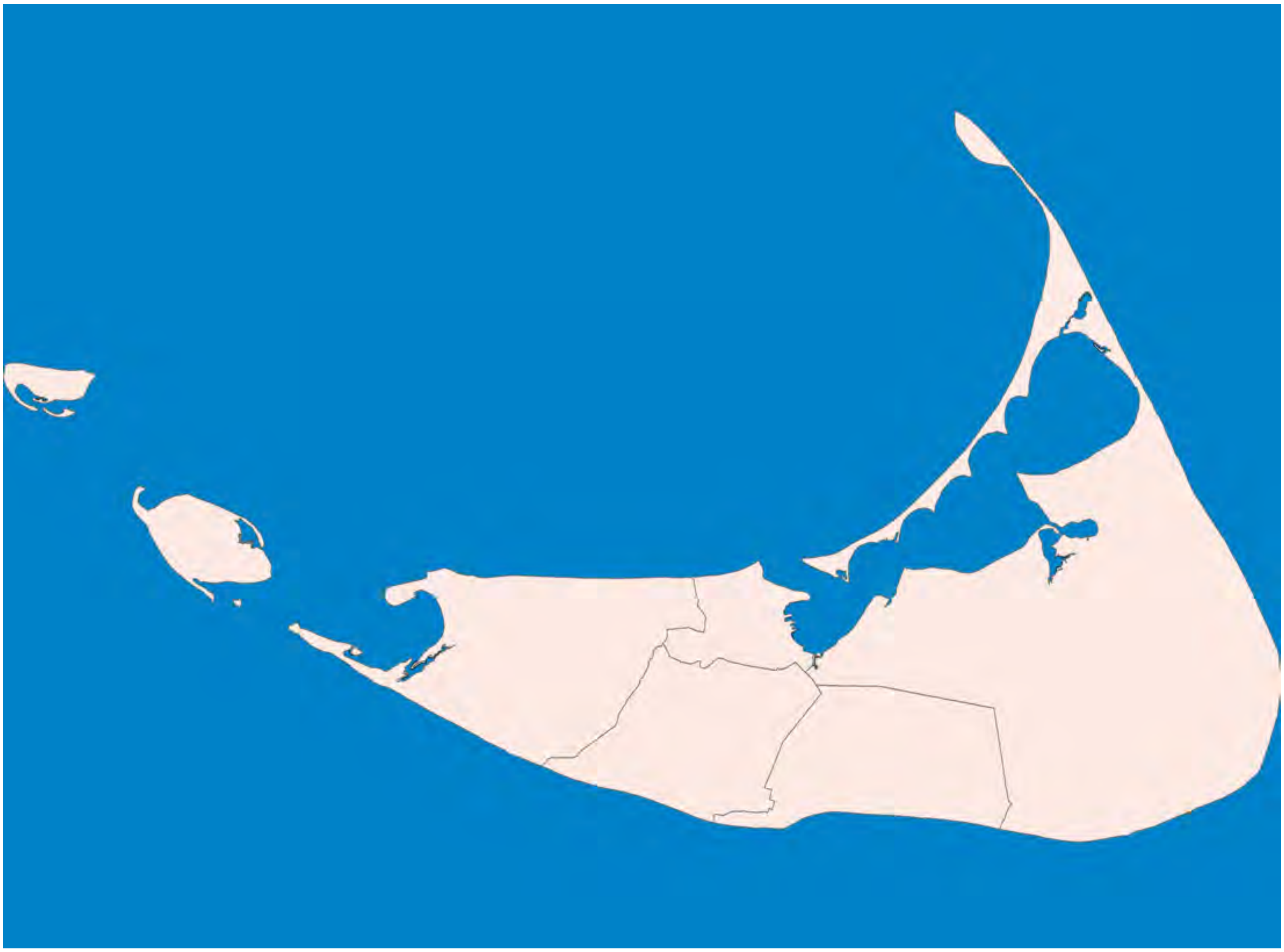


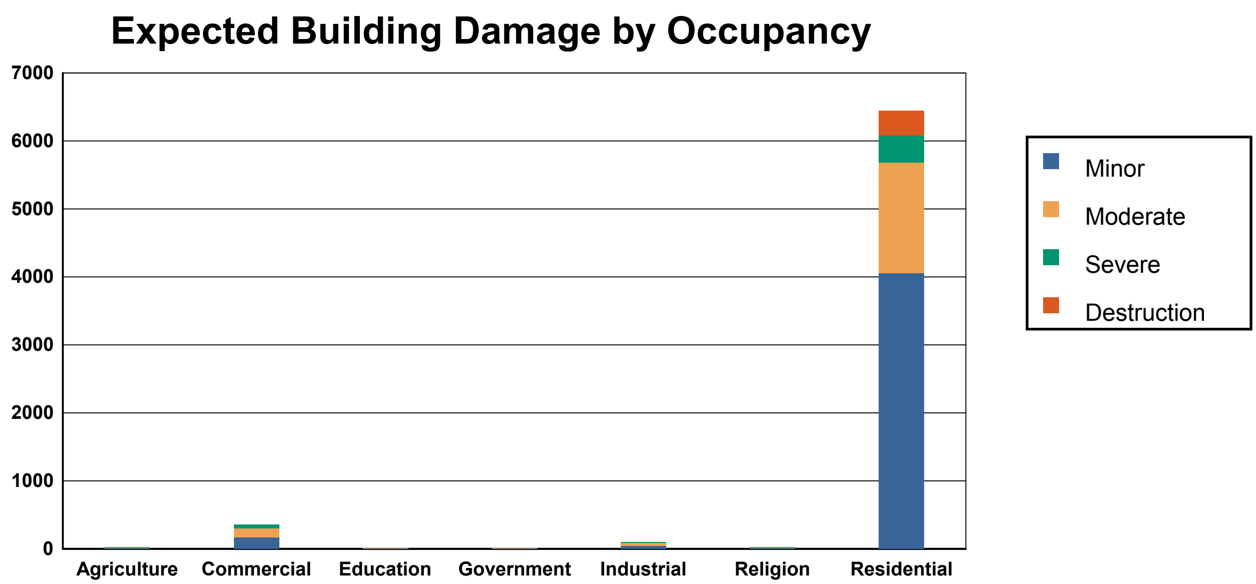
Scenario Name: Probabilistic

Type: Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 2,668 buildings will be at least moderately damaged. This is over 22% of the total number of buildings in the region. There are an estimated 364 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.



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Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	18	39.79	14	31.09	8	17.32	4	9.68	1	2.11
Commercial	274	43.43	168	26.62	137	21.79	51	8.10	0	0.06
Education	7	45.69	4	26.09	3	21.10	1	7.12	0	0.00
Government	6	41.84	4	24.41	4	23.41	2	10.34	0	0.00
Industrial	76	44.11	43	24.81	38	21.85	16	8.98	0	0.25
Religion	16	42.84	12	30.45	8	20.03	3	6.67	0	0.01
Residential	4,564	41.46	4,050	36.80	1,632	14.82	399	3.62	363	3.29
Total	**4,961**		**4,294**		**1,829**		**475**		**364**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	44.28	8	23.60	8	23.97	3	8.15	0	0.00
Masonry	239	42.68	160	28.66	119	21.23	34	6.05	8	1.38
MH	5	86.78	0	5.61	0	5.00	0	0.50	0	2.10
Steel	173	43.88	89	22.63	92	23.30	40	10.13	0	0.06
Wood	4,371	41.51	3,940	37.42	1,505	14.29	369	3.51	345	3.27

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

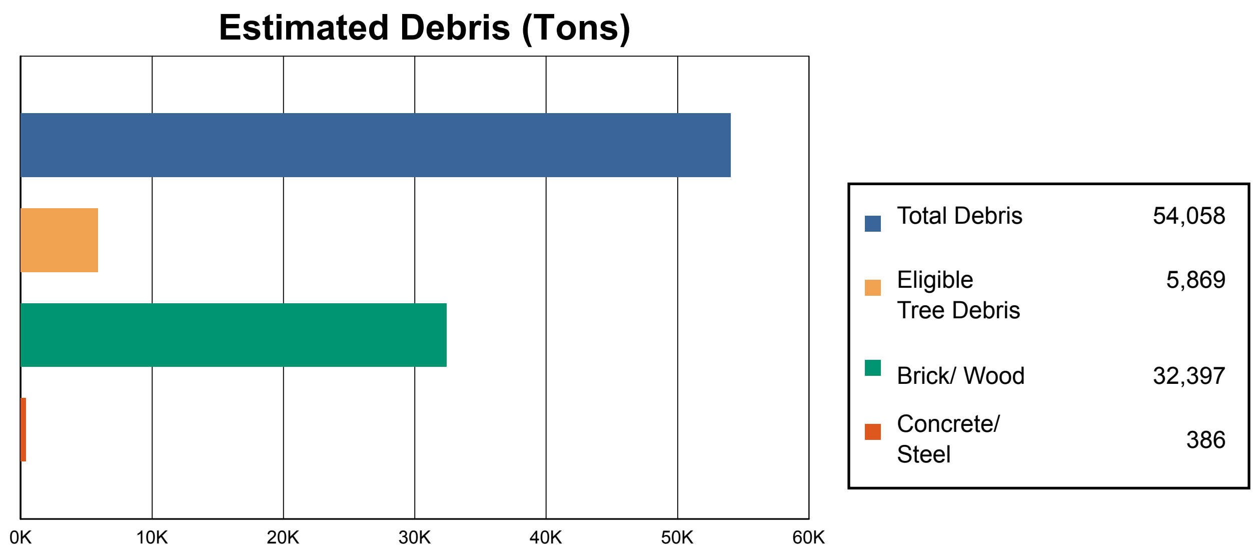
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	0	0	0
Police Stations	2	0	0	2
Schools	4	0	0	0

Induced Hurricane Damage

Debris Generation



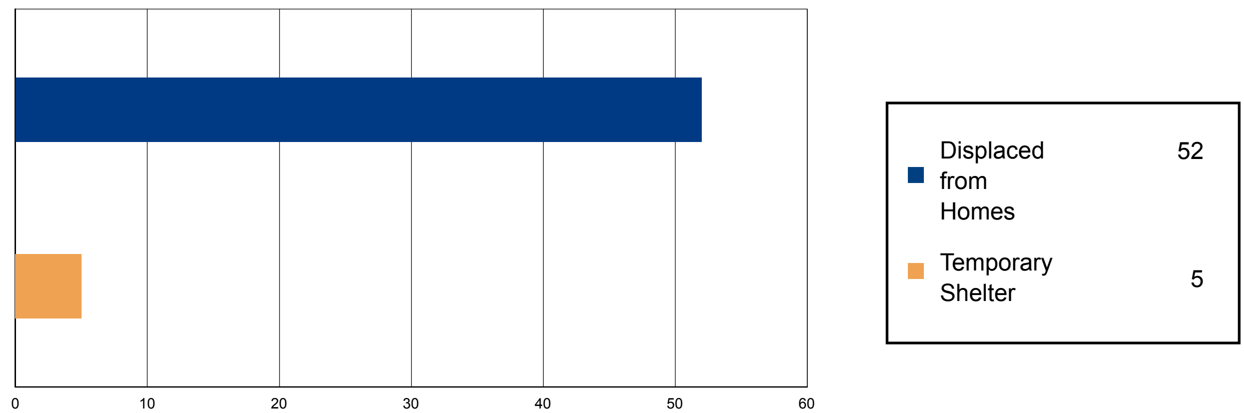
Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 54,058 tons of debris will be generated. Of the total amount, 15,490 tons (29%) is Other Tree Debris. Of the remaining 38,568 tons, Brick/Wood comprises 84% of the total, Reinforced Concrete/Steel comprises of 1% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 1308 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 5,869 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Estimated Shelter Needs



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 52 households to be displaced due to the hurricane. Of these, 5 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

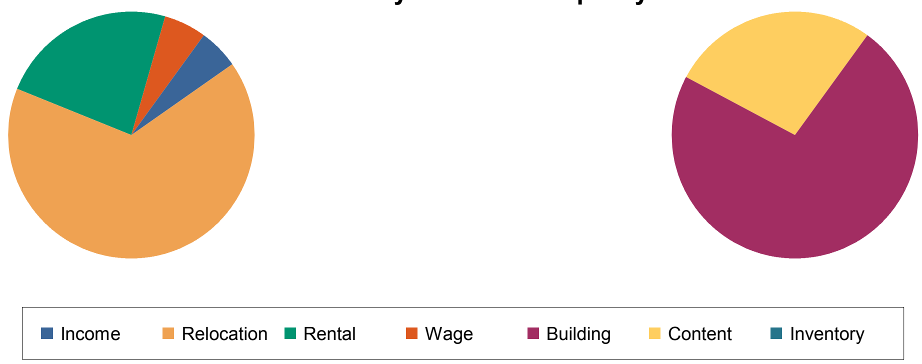
The total economic loss estimated for the hurricane is 501.8 million dollars, which represents 12.50 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 502 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

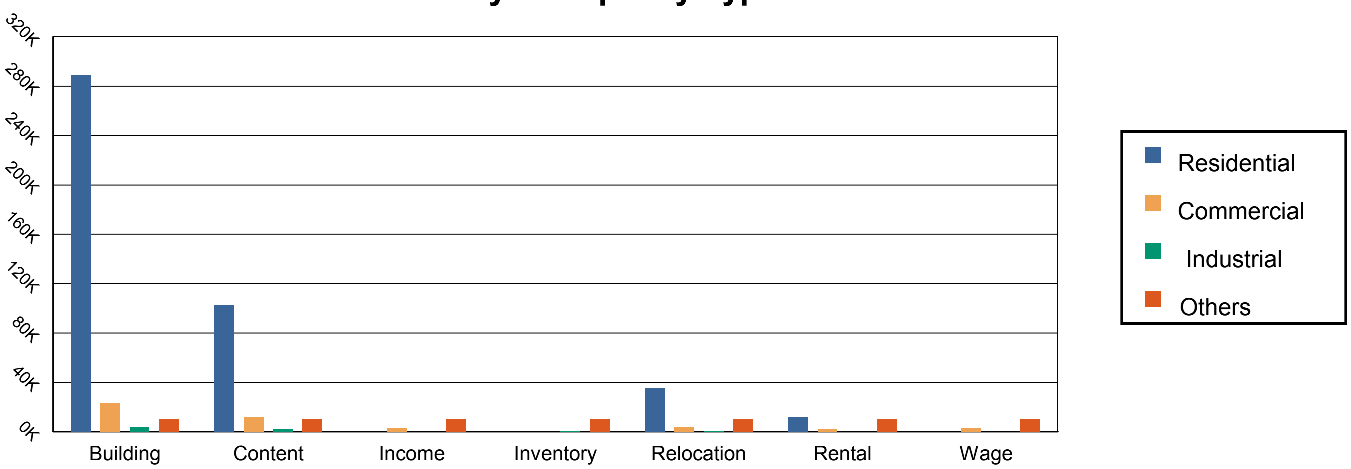


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	289,452.44	22,819.23	3,397.76	5,499.37	321,168.80
	Content	102,729.89	11,505.17	2,200.05	2,661.06	119,096.18
	Inventory	0.00	181.09	266.05	49.57	496.71
	Subtotal	**392,182.33**	**34,505.49**	**5,863.86**	**8,210.01**	**440,761.70**
Business Interruption Loss						
	Income	85.29	2,942.44	23.58	123.12	3,174.43
	Relocation	35,395.90	3,420.32	317.34	1,013.47	40,147.03
	Rental	12,200.15	2,034.91	32.60	81.29	14,348.94
	Wage	199.77	2,622.25	40.45	464.06	3,326.53
	Subtotal	**47,881.11**	**11,019.92**	**413.97**	**1,681.94**	**60,996.93**
Total						
	Total	**440,063.44**	**45,525.41**	**6,277.83**	**9,891.95**	**501,758.63**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Hazus-MH: Hurricane Global Risk Report

Region Name: Nantucket

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Thursday, December 07, 2017

Table of Contents

General Description of the Region

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

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

- Massachusetts

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

The geographical size of the region is 49.41 square miles and contains 5 census tracts. There are over 4 thousand households in the region and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

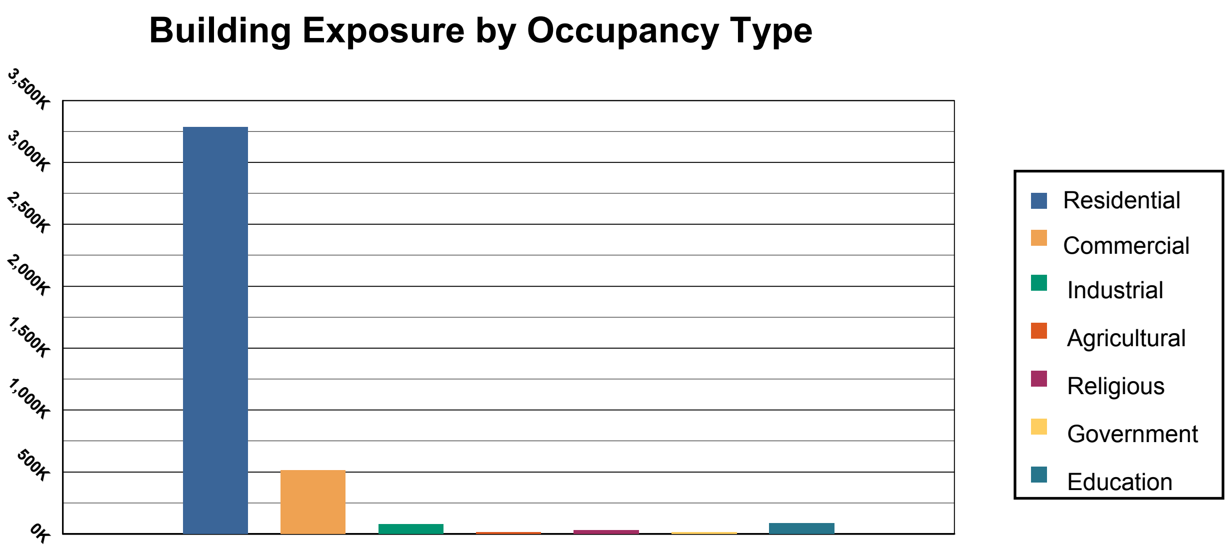


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	3,284,232	81.82%
Commercial	515,165	12.83%
Industrial	78,253	1.95%
Agricultural	13,161	0.33%
Religious	27,546	0.69%
Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 4,656 buildings will be at least moderately damaged. This is over 39% of the total number of buildings in the region. There are an estimated 880 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

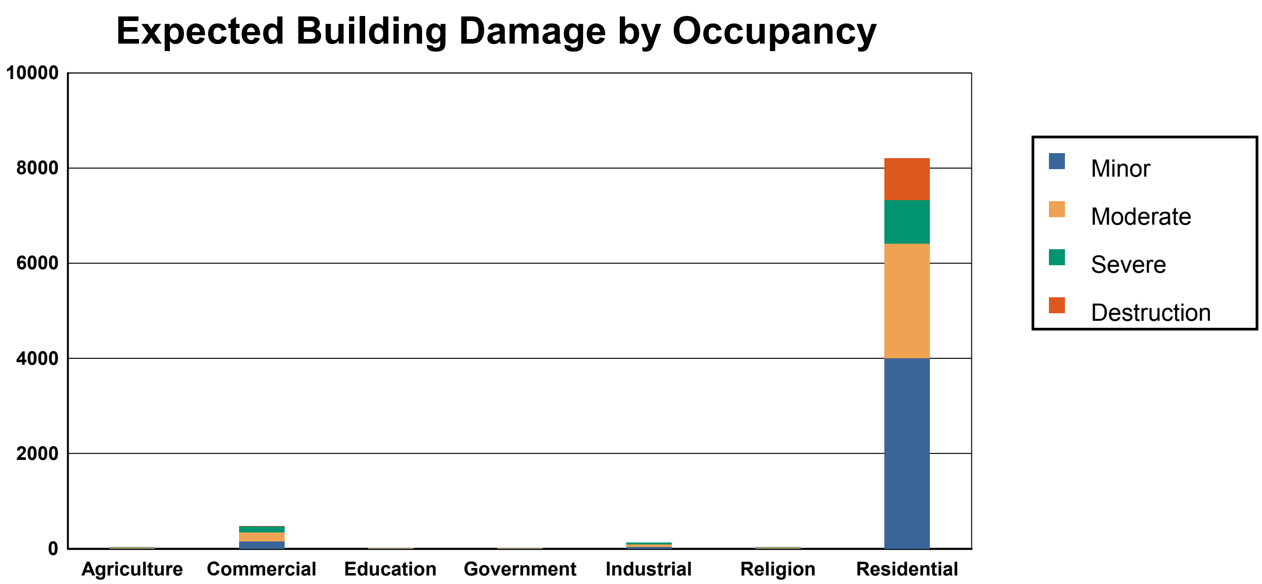


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	11	24.58	14	31.83	11	23.86	7	15.42	2	4.32
Commercial	160	25.36	158	25.02	188	29.81	123	19.59	1	0.22
Education	4	27.90	4	24.45	5	28.74	3	18.89	0	0.02
Government	3	22.07	3	20.63	5	30.40	4	26.87	0	0.03
Industrial	48	27.61	40	23.07	50	28.68	35	20.08	1	0.56
Religion	9	24.53	11	29.79	11	28.83	6	16.75	0	0.11
Residential	2,802	25.45	4,000	36.34	2,411	21.91	918	8.34	875	7.95
Total	**3,037**		**4,230**		**2,680**		**1,097**		**880**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	9	26.97	7	20.71	11	31.71	7	20.62	0	0.00
Masonry	151	27.08	154	27.51	159	28.39	77	13.80	18	3.22
MH	4	73.22	0	7.01	1	10.16	0	2.10	0	7.50
Steel	104	26.31	78	19.76	119	30.08	93	23.71	1	0.15
Wood	2,672	25.38	3,915	37.18	2,263	21.49	849	8.06	832	7.90

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

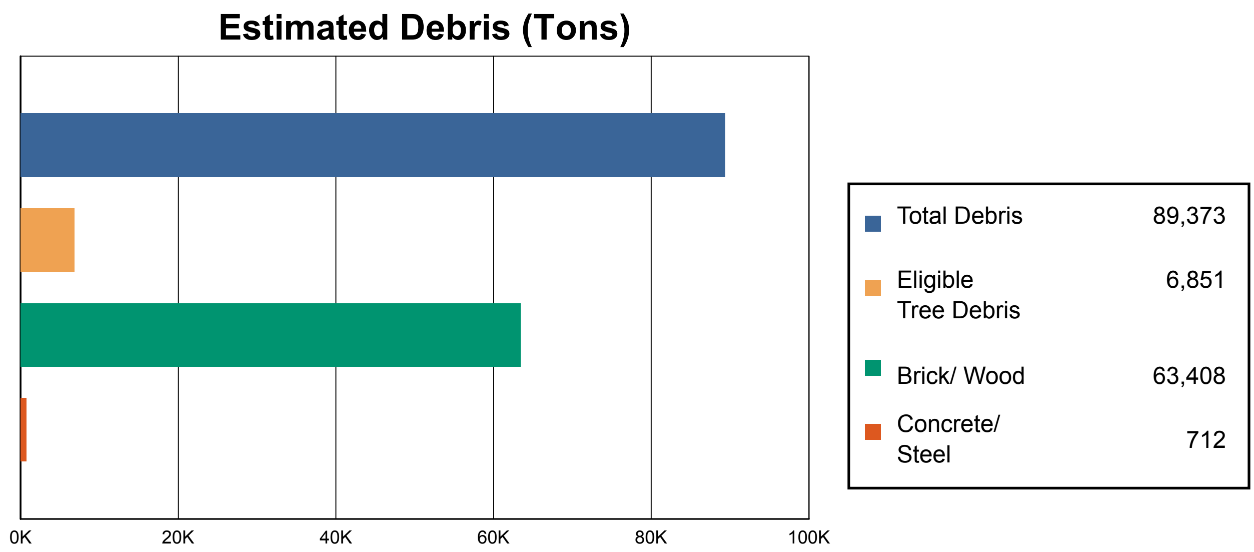
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Hospitals	1	1	0	0
Police Stations	2	2	0	2
Schools	4	4	0	0

Induced Hurricane Damage

Debris Generation

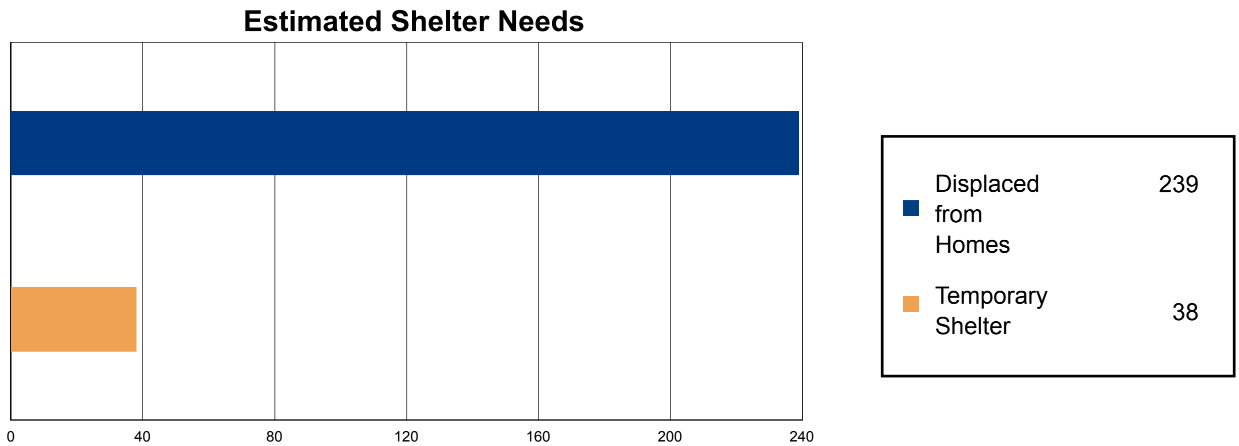


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 89,373 tons of debris will be generated. Of the total amount, 18,128 tons (20%) is Other Tree Debris. Of the remaining 71,245 tons, Brick/Wood comprises 89% of the total, Reinforced Concrete/Steel comprises of 1% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 2576 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 6,851 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 239 households to be displaced due to the hurricane. Of these, 38 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

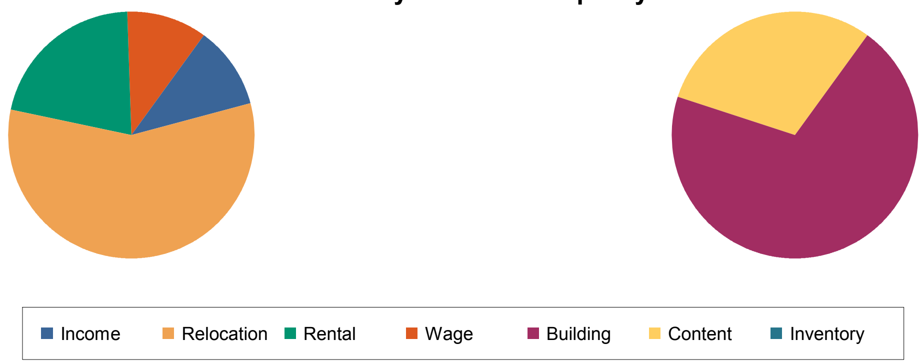
The total economic loss estimated for the hurricane is 1061.5 million dollars, which represents 26.44 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 1,061 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 86% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

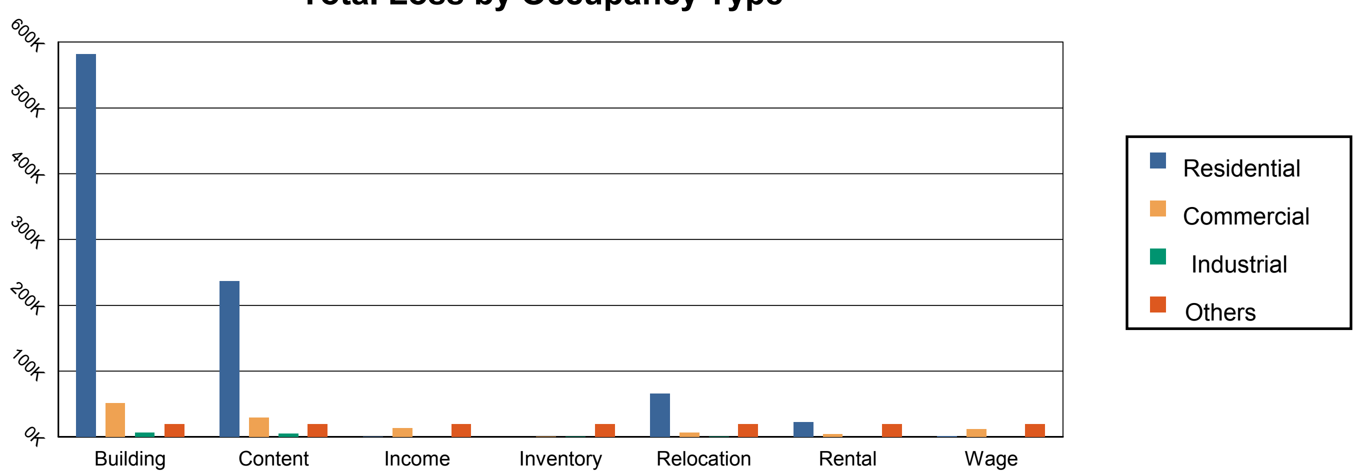


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	581,952.80	51,492.22	6,883.75	10,954.01	651,282.79
	Content	237,178.75	29,965.63	4,857.18	6,014.89	278,016.45
	Inventory	0.00	445.19	580.53	89.60	1,115.33
	Subtotal	**819,131.55**	**81,903.04**	**12,321.46**	**17,058.51**	**930,414.57**
Business Interruption Loss						
	Income	569.03	13,379.41	55.11	153.50	14,157.05
	Relocation	65,754.93	7,141.21	563.70	1,928.27	75,388.11
	Rental	22,951.60	4,507.73	65.55	177.68	27,702.56
	Wage	1,332.92	11,904.16	95.22	458.82	13,791.13
	Subtotal	**90,608.49**	**36,932.52**	**779.58**	**2,718.27**	**131,038.85**
Total						
	Total	**909,740.04**	**118,835.56**	**13,101.04**	**19,776.77**	**1,061,453.42**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Hazus-MH: Hurricane Global Risk Report

Region Name: Nantucket

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Thursday, December 07, 2017

Disclaimer:

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

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

Table of Contents

General Description of the Region

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

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

- Massachusetts

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

The geographical size of the region is 49.41 square miles and contains 5 census tracts. There are over 4 thousand households in the region and has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 million dollars (2014 dollars). Approximately 92% of the buildings (and 82% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,923 buildings in the region which have an aggregate total replacement value of 4,014 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

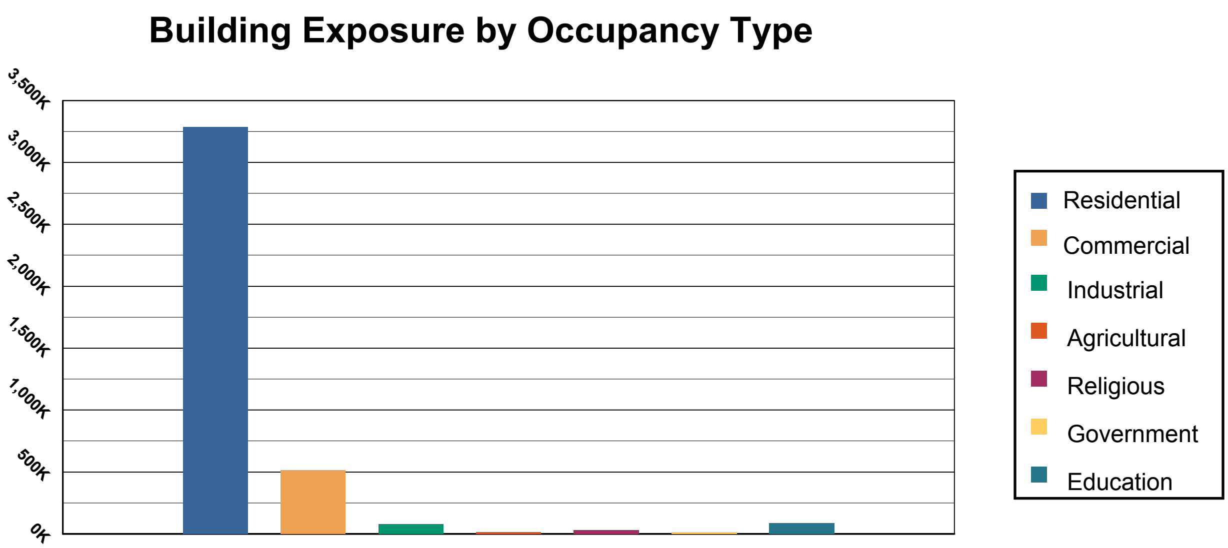


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	3,284,232	81.82%
Commercial	515,165	12.83%
Industrial	78,253	1.95%
Agricultural	13,161	0.33%
Religious	27,546	0.69%
Government	12,144	0.30%
Education	83,545	2.08%
Total	**4,014,046**	**100.00%**

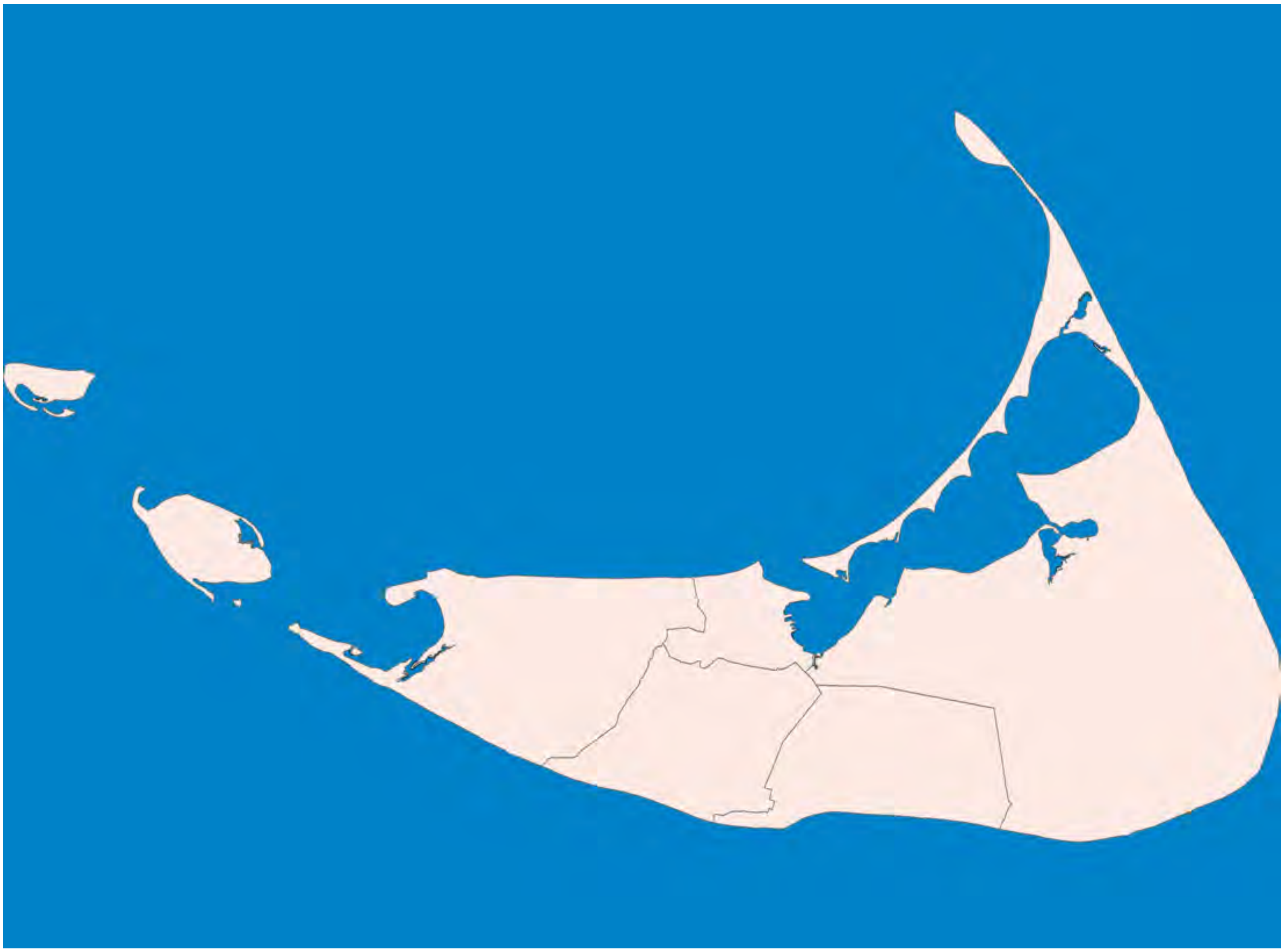
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and no emergency operation facilities.

Hurricane Scenario

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

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 5,899 buildings will be at least moderately damaged. This is over 49% of the total number of buildings in the region. There are an estimated 1,341 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

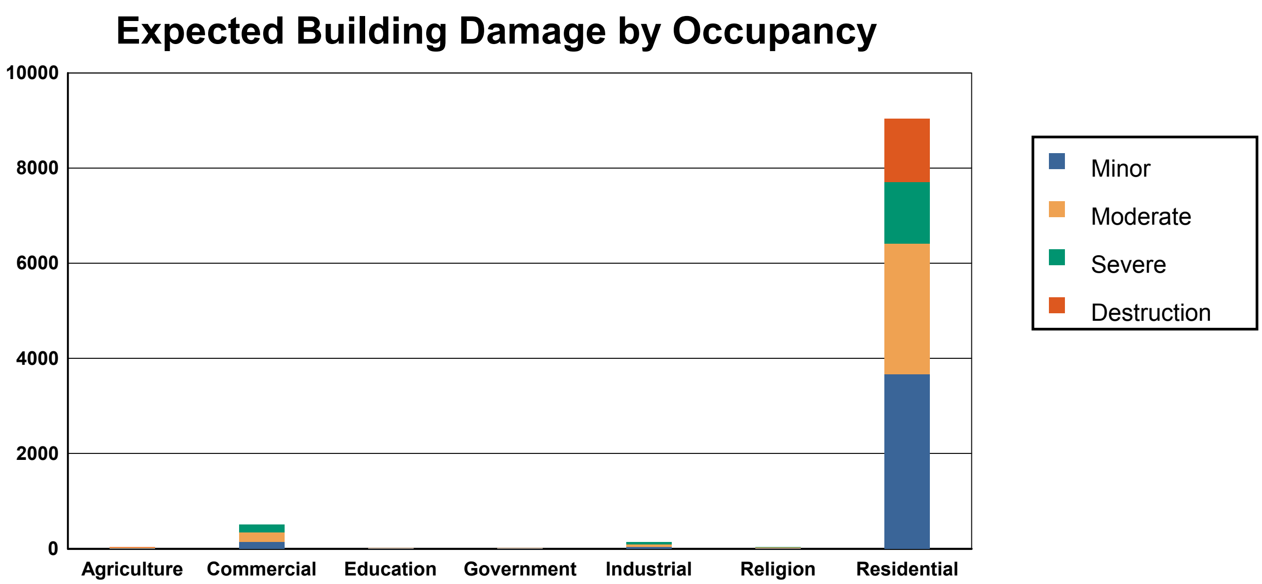


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	7	16.31	13	30.00	12	27.82	9	19.60	3	6.27
Commercial	122	19.32	145	22.94	201	31.86	161	25.51	2	0.37
Education	3	20.08	4	22.21	5	31.48	4	26.19	0	0.04
Government	3	17.59	3	18.68	5	31.33	5	32.35	0	0.05
Industrial	35	19.98	36	20.55	53	30.84	48	27.89	1	0.74
Religion	7	18.44	11	27.68	12	31.54	8	22.11	0	0.23
Residential	1,966	17.86	3,671	33.36	2,735	24.85	1,300	11.81	1,335	12.13
Total	**2,142**		**3,882**		**3,023**		**1,535**		**1,341**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	7	20.26	6	18.40	12	33.54	10	27.80	0	0.00
Masonry	110	19.64	141	25.19	175	31.23	106	18.96	28	4.99
MH	4	70.29	0	6.79	1	10.88	0	2.58	1	9.47
Steel	79	20.02	69	17.49	123	31.30	122	30.94	1	0.24
Wood	1,870	17.76	3,601	34.19	2,585	24.54	1,206	11.46	1,269	12.05

Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 0.00% of the beds will be in service. By 30 days, 100.00% will be operational.

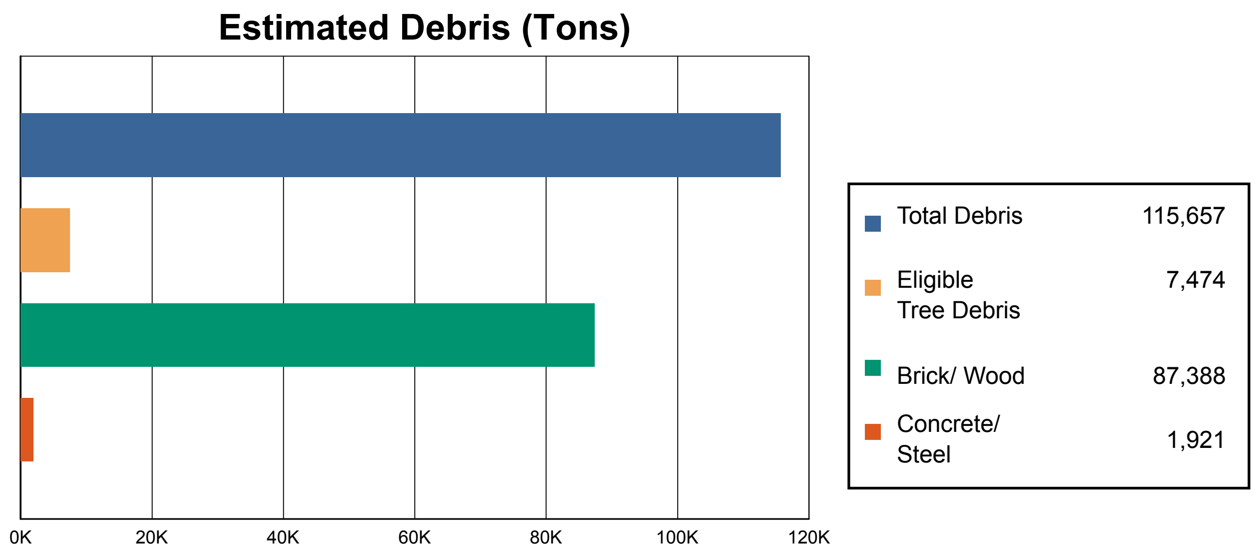
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	1	0	1
Hospitals	1	1	0	0
Police Stations	2	2	0	2
Schools	4	4	0	0

Induced Hurricane Damage

Debris Generation

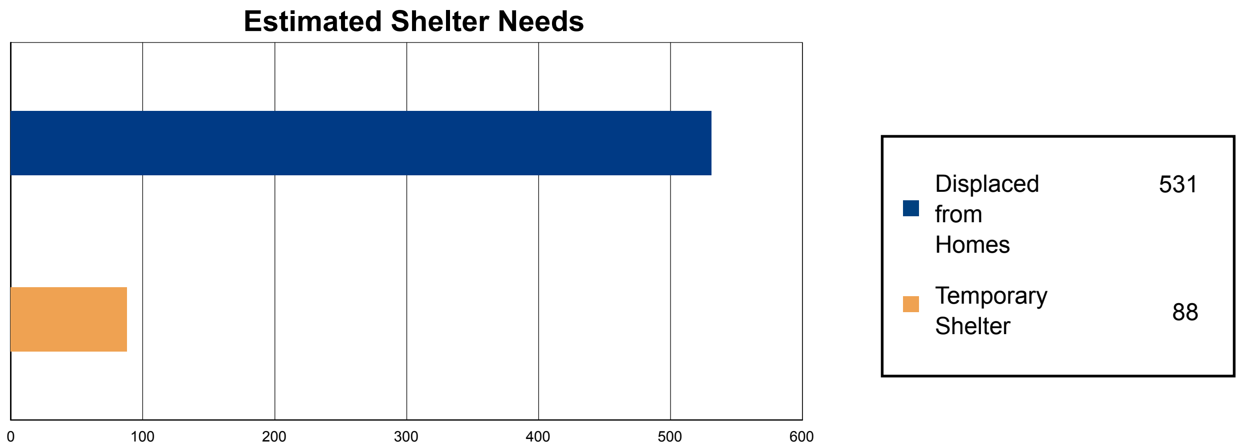


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 115,657 tons of debris will be generated. Of the total amount, 19,626 tons (17%) is Other Tree Debris. Of the remaining 96,031 tons, Brick/Wood comprises 91% of the total, Reinforced Concrete/Steel comprises of 2% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 3542 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 7,474 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 531 households to be displaced due to the hurricane. Of these, 88 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Economic Loss

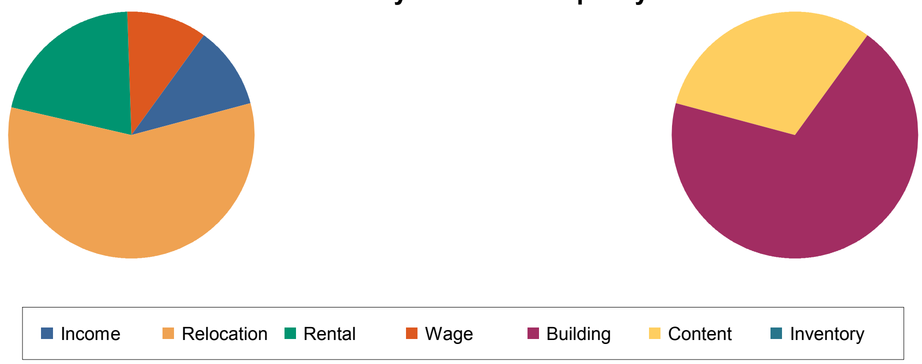
The total economic loss estimated for the hurricane is 1457.7 million dollars, which represents 36.31 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 1,458 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 86% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

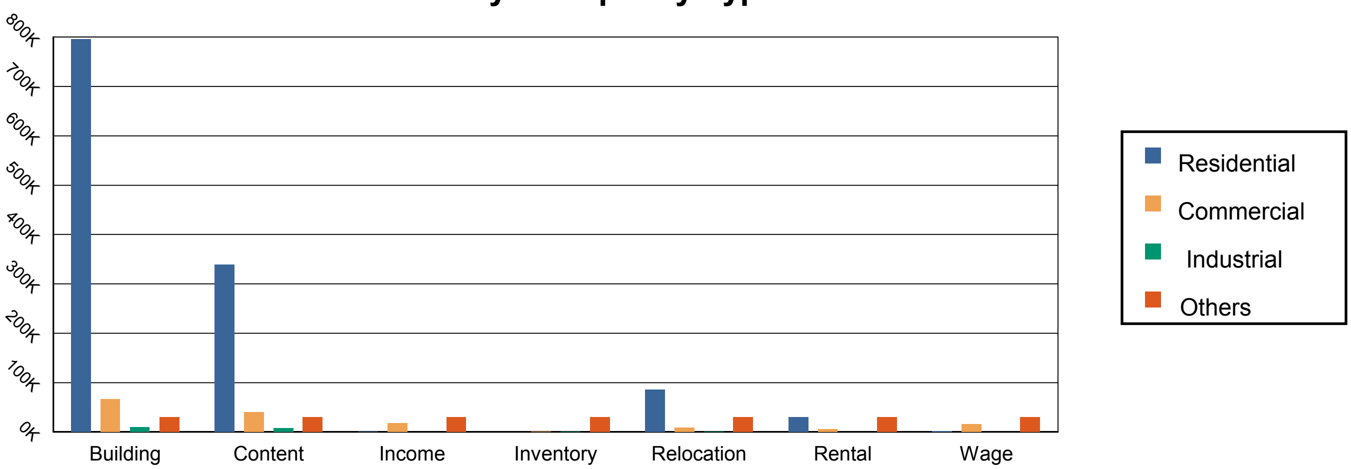


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	796,087.47	66,224.99	9,896.08	16,808.80	889,017.34
	Content	338,835.63	39,990.56	7,209.91	9,749.23	395,785.33
	Inventory	0.00	602.83	856.05	126.40	1,585.28
	Subtotal	**1,134,923.09**	**106,818.38**	**17,962.04**	**26,684.44**	**1,286,387.95**
Business Interruption Loss						
	Income	763.77	17,412.59	80.94	135.88	18,393.18
	Relocation	86,416.63	8,905.72	752.41	2,859.42	98,934.18
	Rental	29,936.14	5,710.21	92.75	241.62	35,980.72
	Wage	1,789.07	15,612.68	140.72	414.58	17,957.05
	Subtotal	**118,905.61**	**47,641.20**	**1,066.82**	**3,651.50**	**171,265.13**
Total						
	Total	**1,253,828.70**	**154,459.59**	**19,028.86**	**30,335.93**	**1,457,653.08**

Appendix A: County Listing for the Region

Massachusetts
- Nantucket

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Nantucket	10,172	3,284,232	729,814	4,014,046
Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**
Study Region Total	**10,172**	**3,284,232**	**729,814**	**4,014,046**

Quick Assessment Report

December 7, 2017

Study Region : Nantucket

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	49
Number of Census Tracts	5
Number of People in the Region	10,172

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	11,007	3,284,232
Commercial	630	515,165
Other	286	214,649
Total	11,923	4,014,046

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	18	0	0	0	19
20	456	25	0	1	482
50	2,169	354	27	30	2,581
100	3,498	984	153	143	4,777
200	4,050	1,632	399	363	6,443
500	4,000	2,411	918	875	8,205
1000	3,671	2,735	1,300	1,335	9,041

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	23	0	0	0	23
20	485	28	1	1	514
50	2,305	400	34	30	2,769
100	3,715	1,111	185	144	5,155
200	4,294	1,829	475	364	6,962
500	4,230	2,680	1,097	880	8,886
1000	3,882	3,023	1,535	1,341	9,781

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	6	0
200	52	5
500	239	38
1000	531	88

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption (Income) Losses***
ReturnPeriod	***Residential***	***Total***	
10	2,348	2,434	6
20	13,789	14,560	912
50	66,902	74,003	8,355
100	191,587	215,503	29,438
200	392,182	440,762	60,997
500	819,132	930,415	131,039
1000	1,134,923	1,286,388	171,265
Annualized	7,985	8,924	1,102

Disclaimer:

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

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

Estimated Losses from Earthquakes

Hazus-MH: Earthquake Global Risk Report

Region Name: Nantucket

Earthquake Scenario: 100-Year M-7

Print Date: December 07, 2017

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

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

Table of Contents

General Description of the Region

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

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

Massachusetts

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

The geographical size of the region is 49.39 square miles and contains 5 census tracts. There are over 4 thousand households in the region which has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 (millions of dollars). Approximately 92.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 278 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 11 thousand buildings in the region which have an aggregate total replacement value of 4,014 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 411.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 2 bridges, 1,162 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

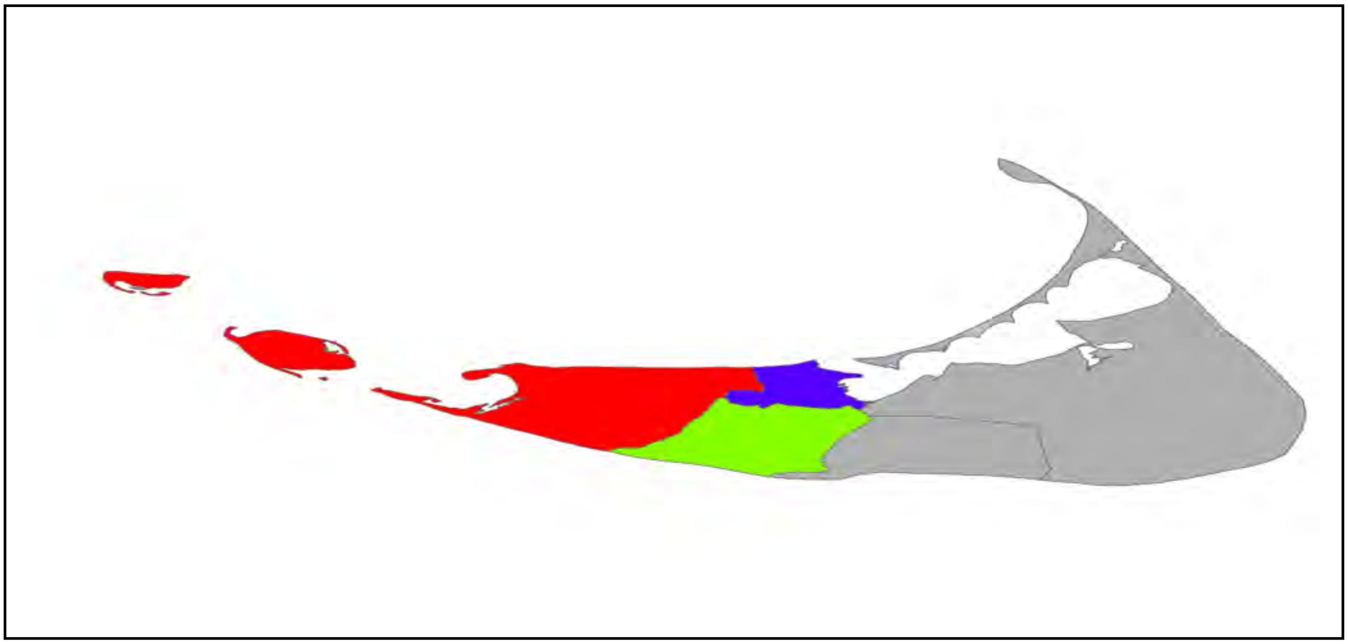
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	6.60
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**6.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	3	113.90
		Subtotal	**124.50**
		Total	**133.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	11.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**11.60**
Waste Water	Distribution Lines	NA	7.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**7.00**
Natural Gas	Distribution Lines	NA	4.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	255.20
		Subtotal	**255.20**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**278.70**

Earthquake Scenario

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



Scenario Name	100-Year M-7
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

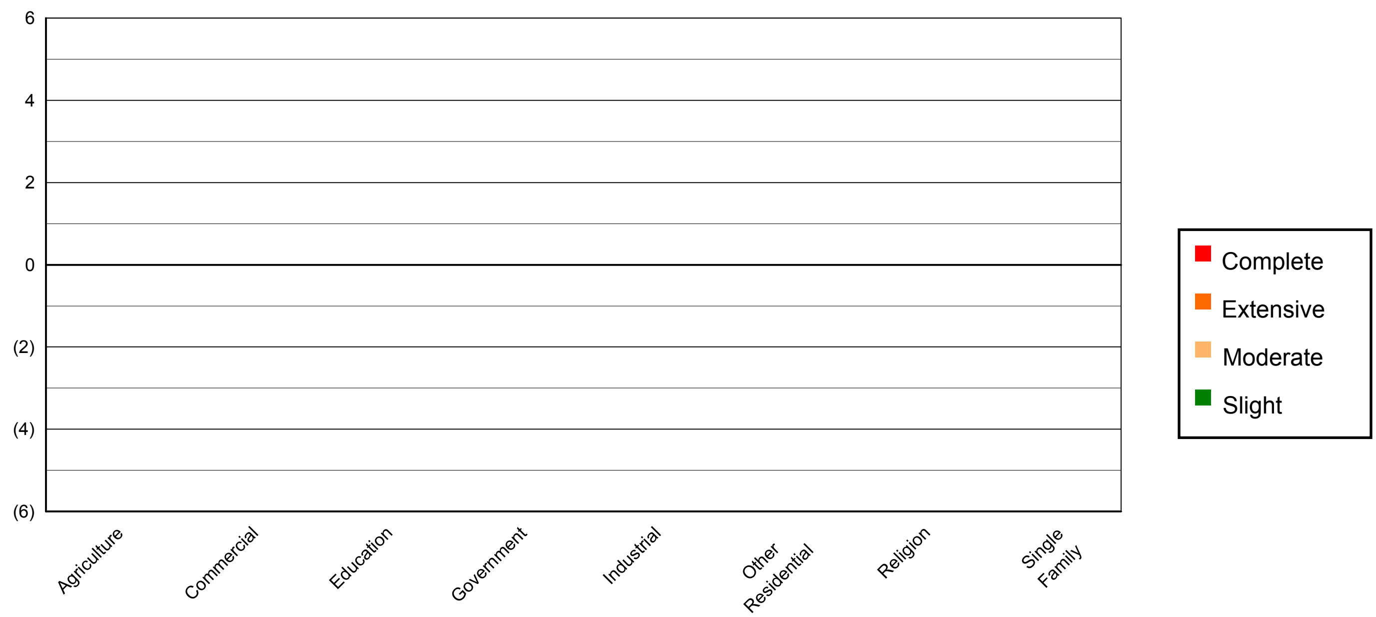


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	44	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	630	5.28	0	0.00	0	0.00	0	0.00	0	0.00
Education	16	0.13	0	0.00	0	0.00	0	0.00	0	0.00
Government	15	0.13	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	173	1.45	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	397	3.33	0	0.00	0	0.00	0	0.00	0	0.00
Religion	38	0.32	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	10,610	88.99	0	0.00	0	0.00	0	0.00	0	0.00
Total	**11,923**		**0**		**0**		**0**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10,586	88.79	0	0.00	0	0.00	0	0.00	0	0.00
Steel	428	3.59	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	71	0.59	0	0.00	0	0.00	0	0.00	0	0.00
Precast	28	0.23	0	0.00	0	0.00	0	0.00	0	0.00
RM	101	0.85	0	0.00	0	0.00	0	0.00	0	0.00
URM	682	5.72	0	0.00	0	0.00	0	0.00	0	0.00
MH	27	0.23	0	0.00	0	0.00	0	0.00	0	0.00
Total	**11,923**		**0**		**0**		**0**		**0**	

*Note:

RM	Reinforced Masonry
URM	Unreinforced Masonry
MH	Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only 18 hospital beds (99.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	1	0	0	1
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	2	0	0	2
FireStations	1	0	0	1

Transportation Lifeline Damage

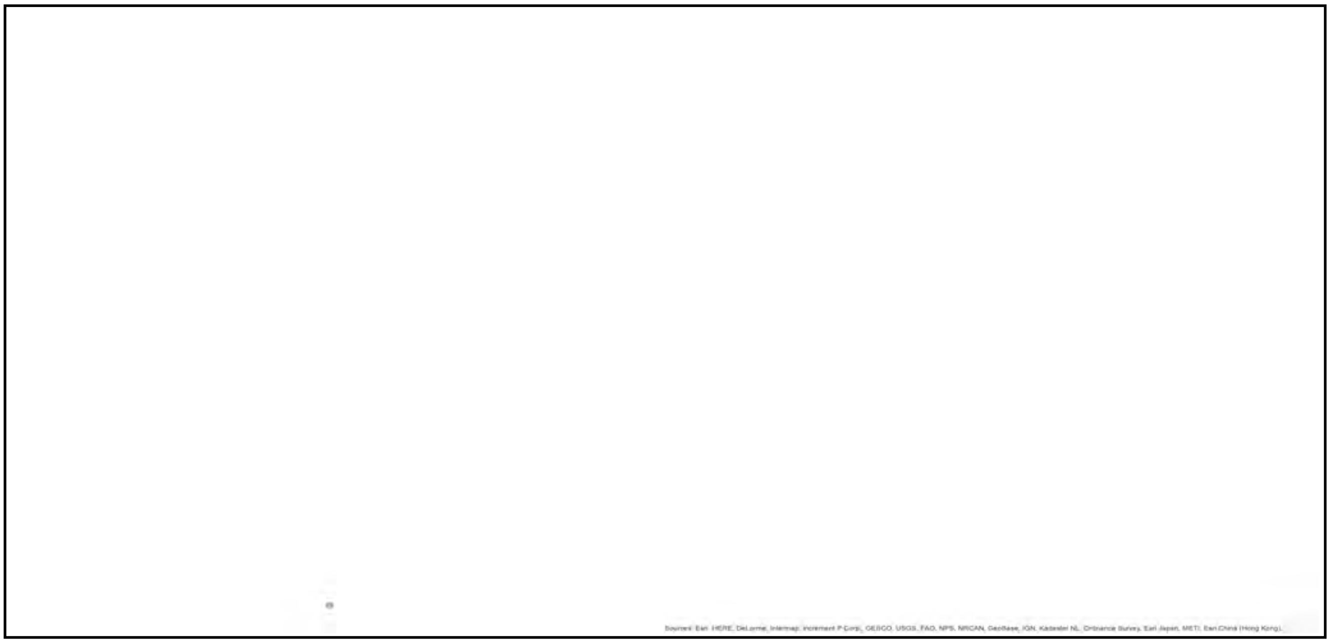


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	1	0	0	1	1
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	2	0	0	2	2

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	581	0	0
Waste Water	349	0	0
Natural Gas	233	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,229	0	0	0	0	0
Electric Power		0	0	0	0	0

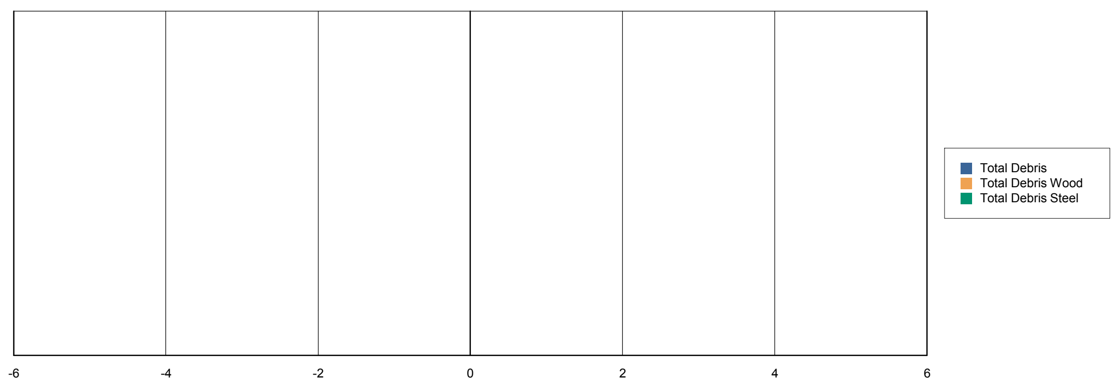
Induced Earthquake Damage

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
		0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

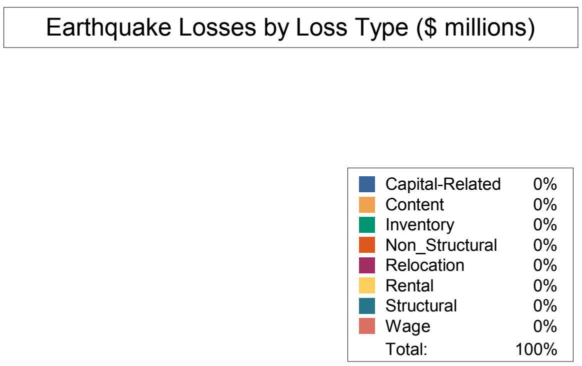
Economic Loss

The total economic loss estimated for the earthquake is 0.00 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.



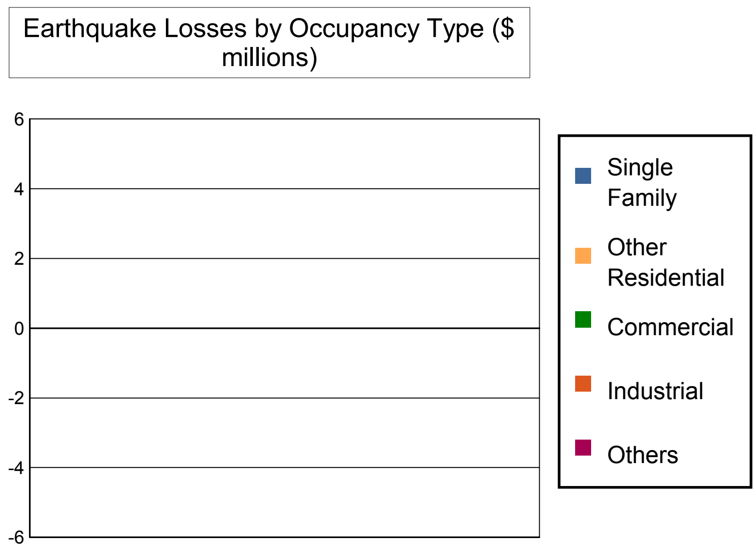


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

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

Transportation and Utility Lifeline Losses

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	0.00	$0.00	0.00
	Bridges	6.58	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**7**	**0.00**	
Railways	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.00	0.02
	Subtotal	**1**	**0.00**	
Ferry	Facilities	1.33	$0.00	0.00
	Subtotal	**1**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	10.65	$0.00	0.01
	Runways	113.89	$0.00	0.00
	Subtotal	**125**	**0.00**	
	Total	**133.70**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	11.60	$0.00	0.00
	Subtotal	**11.63**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	7.00	$0.00	0.00
	Subtotal	**6.98**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.70	$0.00	0.00
	Subtotal	**4.65**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	255.20	$0.00	0.00
	Subtotal	**255.20**	**$0.00**	
Communication	Facilities	0.20	$0.00	0.00
	Subtotal	**0.23**	**$0.00**	
	Total	**278.69**	**$0.00**	

Appendix A: County Listing for the Region

Nantucket,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Nantucket	10,172	3,284	729	4,014
Total State		**10,172**	**3,284**	**729**	**4,014**
Total Region		**10,172**	**3,284**	**729**	**4,014**

Hazus-MH: Earthquake Global Risk Report

Region Name: Nantucket

Earthquake Scenario: 500-year M-7

Print Date: December 07, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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

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

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

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Note:
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The geographical size of the region is 49.39 square miles and contains 5 census tracts. There are over 4 thousand households in the region which has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 (millions of dollars). Approximately 92.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 278 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 11 thousand buildings in the region which have an aggregate total replacement value of 4,014 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 411.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 2 bridges, 1,162 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

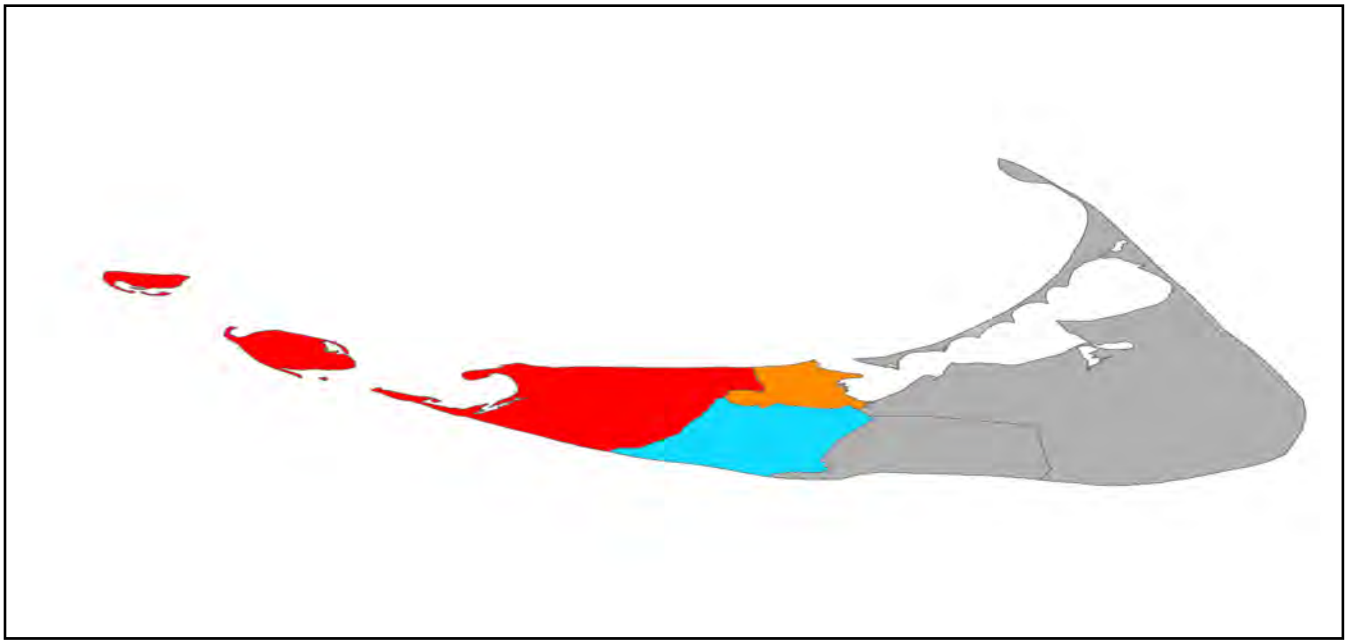
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	6.60
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**6.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	3	113.90
		Subtotal	**124.50**
		Total	**133.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	11.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**11.60**
Waste Water	Distribution Lines	NA	7.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**7.00**
Natural Gas	Distribution Lines	NA	4.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	255.20
		Subtotal	**255.20**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**278.70**

Earthquake Scenario

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



Scenario Name	500-year M-7
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 18 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

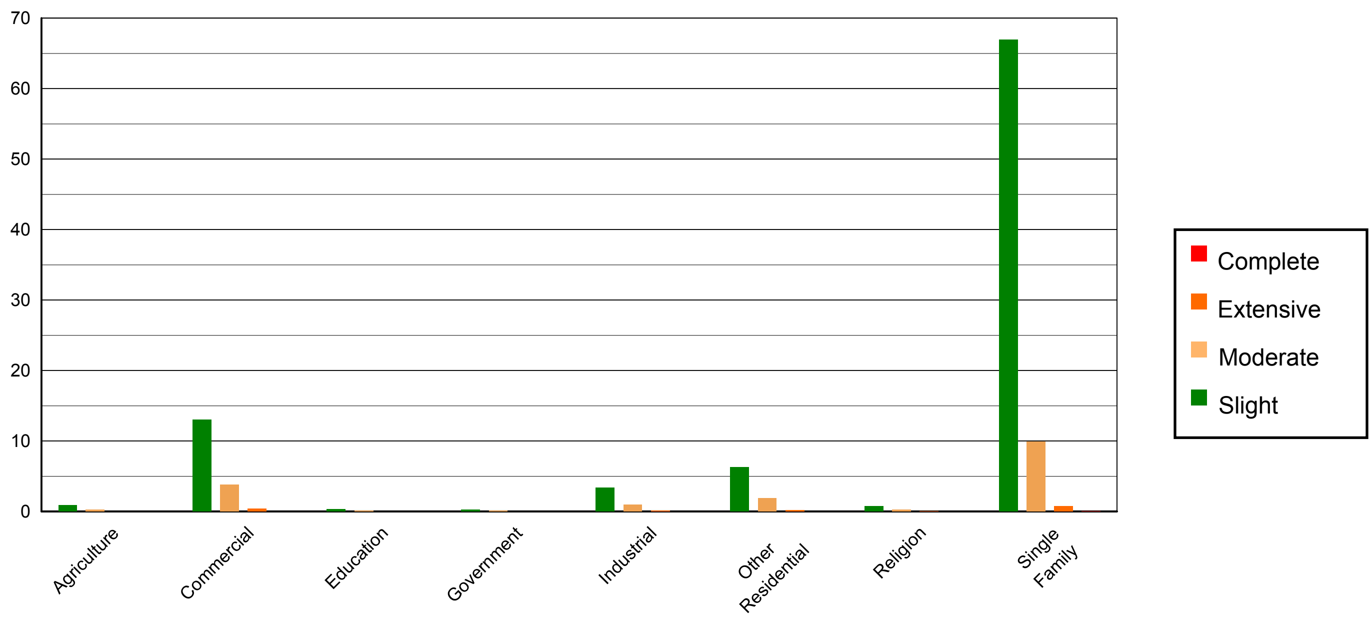


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	43	0.36	1	0.92	0	1.24	0	1.51	0	0.82
Commercial	613	5.19	13	14.20	4	22.14	0	27.45	0	19.62
Education	16	0.13	0	0.34	0	0.51	0	0.61	0	0.52
Government	15	0.12	0	0.31	0	0.46	0	0.51	0	0.29
Industrial	169	1.43	3	3.64	1	5.61	0	6.46	0	3.71
Other Residential	389	3.29	6	6.81	2	10.83	0	11.43	0	10.93
Religion	37	0.31	1	0.82	0	1.46	0	1.98	0	1.96
Single Family	10,532	89.16	67	72.97	10	57.75	1	50.06	0	62.15
Total	**11,812**		**92**		**17**		**2**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10,528	89.12	54	59.29	4	24.80	0	0.00	0	0.00
Steel	419	3.55	7	7.78	2	10.53	0	9.34	0	0.00
Concrete	70	0.59	1	1.16	0	1.33	0	0.59	0	0.00
Precast	27	0.22	1	0.83	0	2.38	0	3.80	0	0.00
RM	98	0.83	2	1.74	1	3.88	0	4.76	0	0.00
URM	645	5.46	26	27.92	9	55.00	1	81.16	0	100.00
MH	25	0.22	1	1.28	0	2.08	0	0.34	0	0.00
Total	**11,812**		**92**		**17**		**2**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only 17 hospital beds (93.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 98.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	1	0	0	1
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	2	0	0	2
FireStations	1	0	0	1

Transportation Lifeline Damage

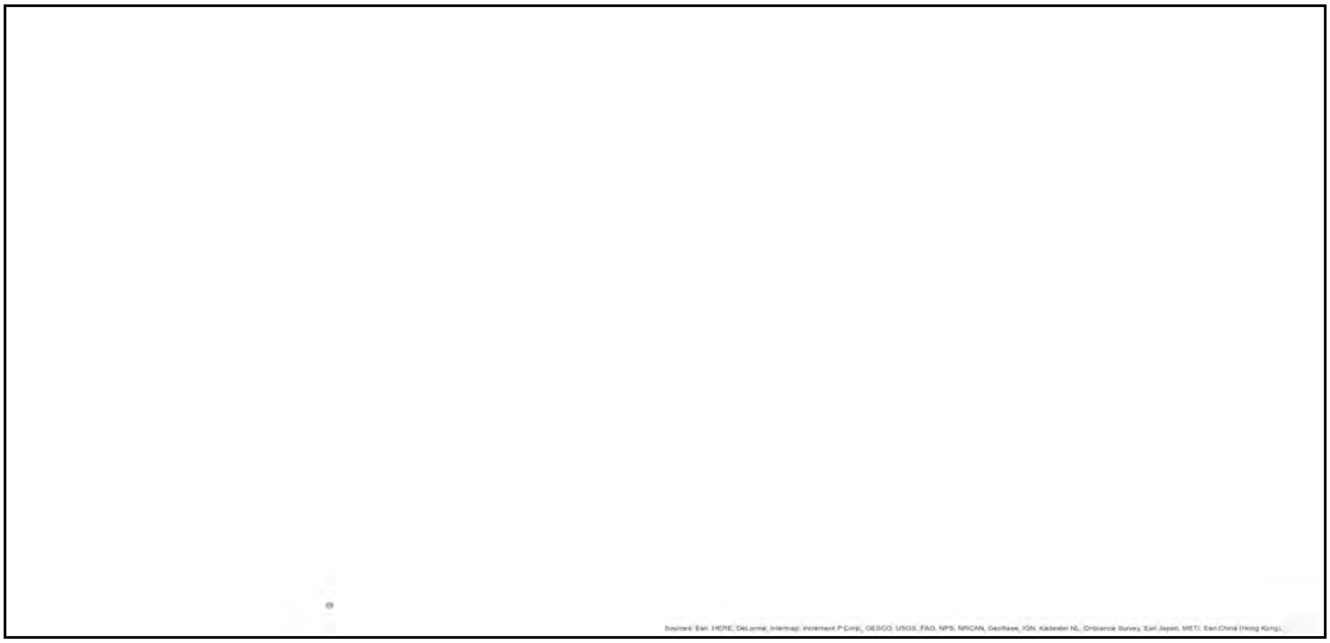


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	1	0	0	1	1
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	2	0	0	2	2

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	581	1	0
Waste Water	349	0	0
Natural Gas	233	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,229	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 77.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)

Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

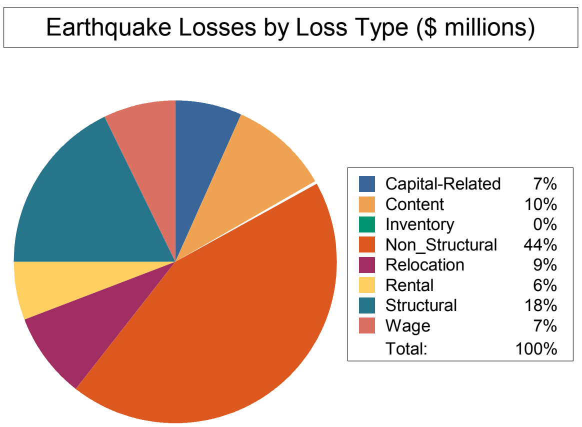
Economic Loss

The total economic loss estimated for the earthquake is 2.47 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 2.25 (millions of dollars); 28 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 55 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.



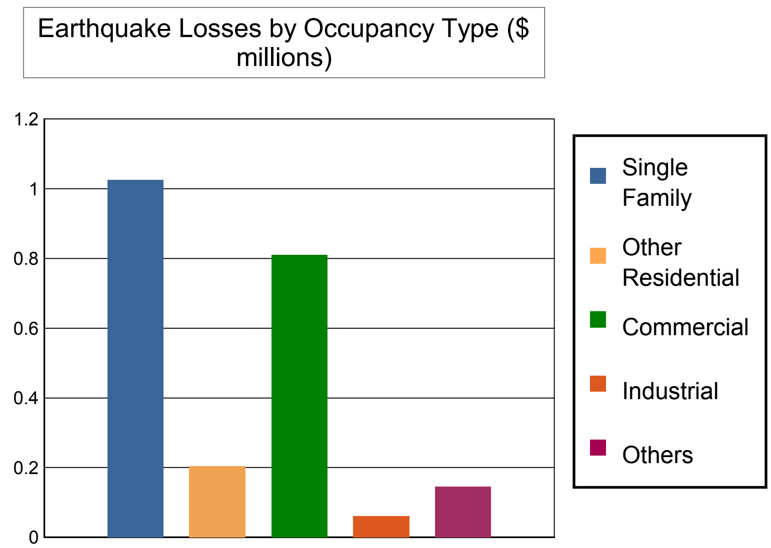


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.02	0.13	0.00	0.01	0.16
	Capital-Related	0.00	0.01	0.14	0.00	0.00	0.15
	Rental	0.02	0.04	0.07	0.00	0.00	0.13
	Relocation	0.07	0.01	0.08	0.01	0.03	0.19
	Subtotal	**0.09**	**0.07**	**0.42**	**0.01**	**0.04**	**0.63**
Capital Stock Losses							
	Structural	0.19	0.03	0.13	0.02	0.04	0.41
	Non_Structural	0.61	0.09	0.20	0.02	0.05	0.98
	Content	0.13	0.01	0.06	0.01	0.02	0.23
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.93**	**0.13**	**0.40**	**0.05**	**0.11**	**1.62**
	Total	**1.03**	**0.20**	**0.81**	**0.06**	**0.15**	**2.25**

Transportation and Utility Lifeline Losses

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	0.00	$0.00	0.00
	Bridges	6.58	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**7**	**0.00**	
Railways	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.01	0.80
	Subtotal	**1**	**0.00**	
Ferry	Facilities	1.33	$0.00	0.00
	Subtotal	**1**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	10.65	$0.08	0.72
	Runways	113.89	$0.00	0.00
	Subtotal	**125**	**0.10**	
	Total	**133.70**	**0.10**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	11.60	$0.00	0.02
	Subtotal	**11.63**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	7.00	$0.00	0.03
	Subtotal	**6.98**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.70	$0.00	0.01
	Subtotal	**4.65**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	255.20	$0.13	0.05
	Subtotal	**255.20**	**$0.13**	
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Nantucket,MA

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			Residential	Non-Residential	Total
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Total State		**10,172**	**3,284**	**729**	**4,014**
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Earthquake Scenario: 1000yr M-7

Print Date: December 07, 2017

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For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 411.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 2 bridges, 1,162 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

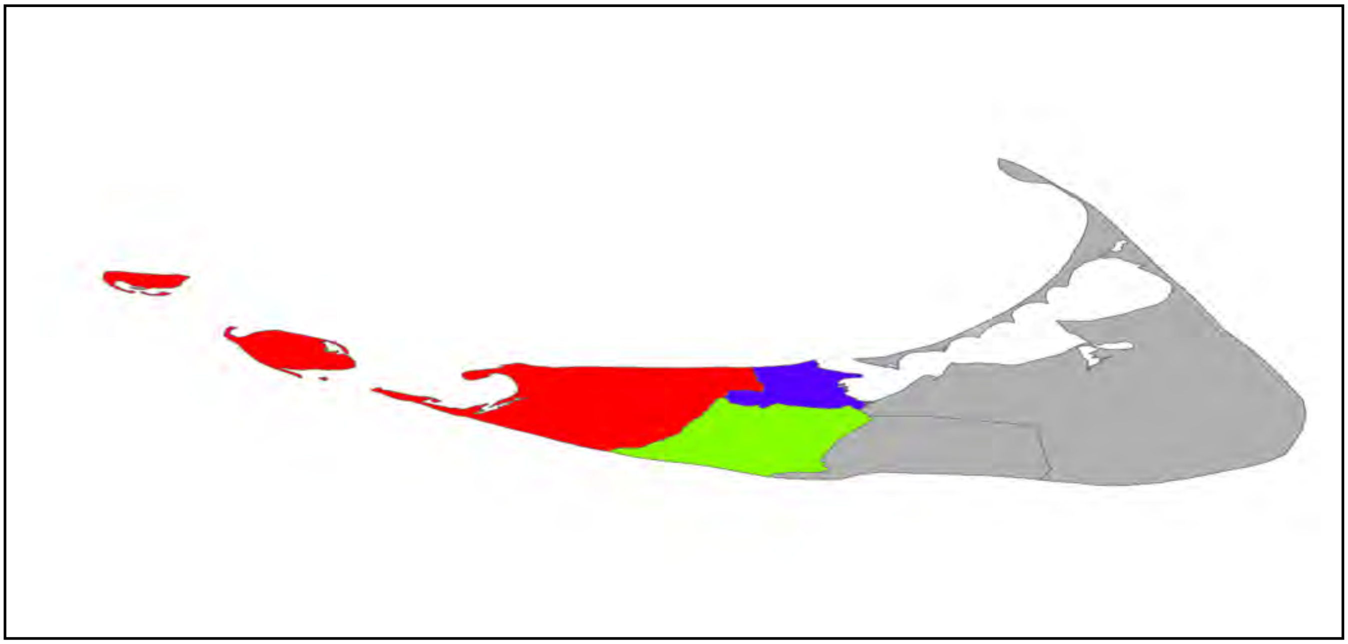
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	6.60
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**6.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	3	113.90
		Subtotal	**124.50**
		Total	**133.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	11.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**11.60**
Waste Water	Distribution Lines	NA	7.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**7.00**
Natural Gas	Distribution Lines	NA	4.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	255.20
		Subtotal	**255.20**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**278.70**

Earthquake Scenario

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



Scenario Name	1000yr M-7
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	1,000.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 47 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

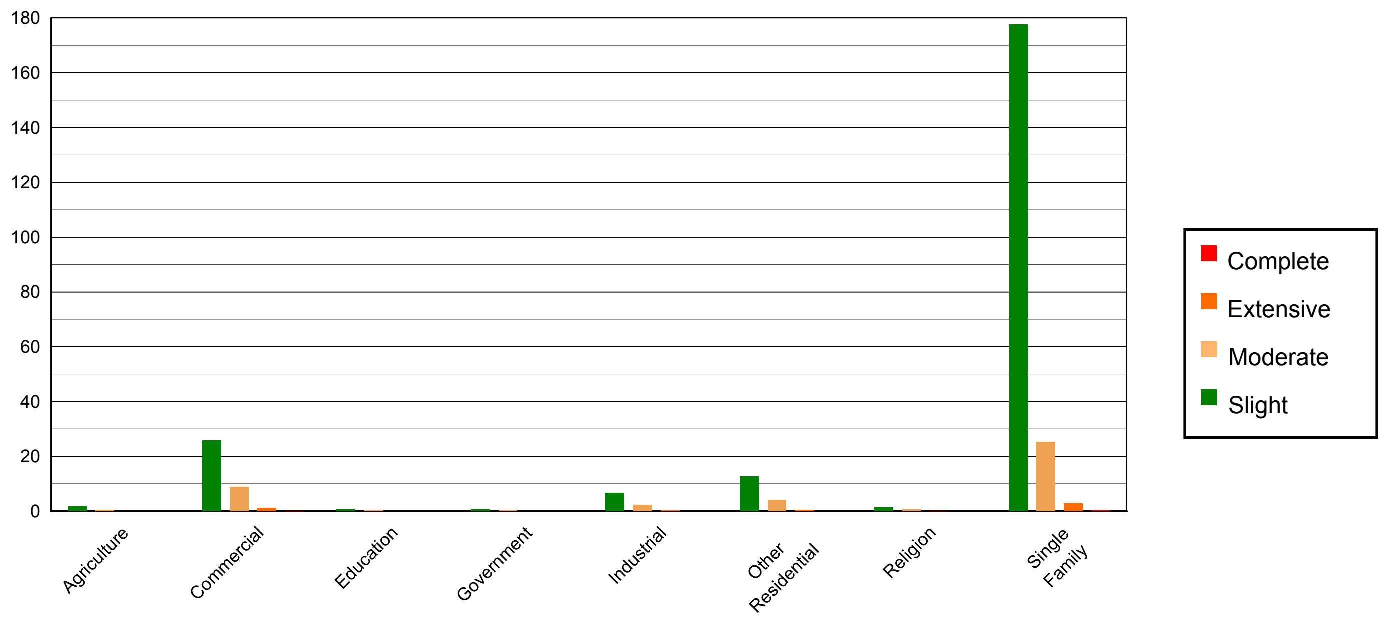


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	42	0.36	2	0.76	0	1.19	0	1.28	0	0.85
Commercial	594	5.10	26	11.38	9	21.03	1	22.56	0	21.61
Education	15	0.13	1	0.27	0	0.49	0	0.50	0	0.58
Government	14	0.12	1	0.25	0	0.46	0	0.43	0	0.39
Industrial	164	1.41	7	2.95	2	5.54	0	5.47	0	4.45
Other Residential	380	3.26	13	5.57	4	9.95	0	9.64	0	10.82
Religion	36	0.31	1	0.64	1	1.30	0	1.59	0	1.96
Single Family	10,404	89.32	178	78.18	25	60.05	3	58.54	0	59.35
Total	**11,648**		**227**		**42**		**5**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10,414	89.40	158	69.52	14	32.85	1	20.45	0	0.00
Steel	408	3.50	15	6.64	5	11.64	0	8.89	0	3.09
Concrete	68	0.58	2	1.03	1	1.64	0	0.65	0	0.00
Precast	25	0.22	1	0.59	1	2.04	0	3.02	0	0.64
RM	96	0.82	3	1.34	2	3.68	0	4.19	0	0.00
URM	613	5.27	45	19.97	19	46.23	3	62.41	0	96.27
MH	24	0.21	2	0.91	1	1.93	0	0.39	0	0.00
Total	**11,648**		**227**		**42**		**5**		**0**	

*Note:

RM	Reinforced Masonry
URM	Unreinforced Masonry
MH	Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only 16 hospital beds (88.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 96.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	1
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	2	0	0	2
FireStations	1	0	0	1

Transportation Lifeline Damage

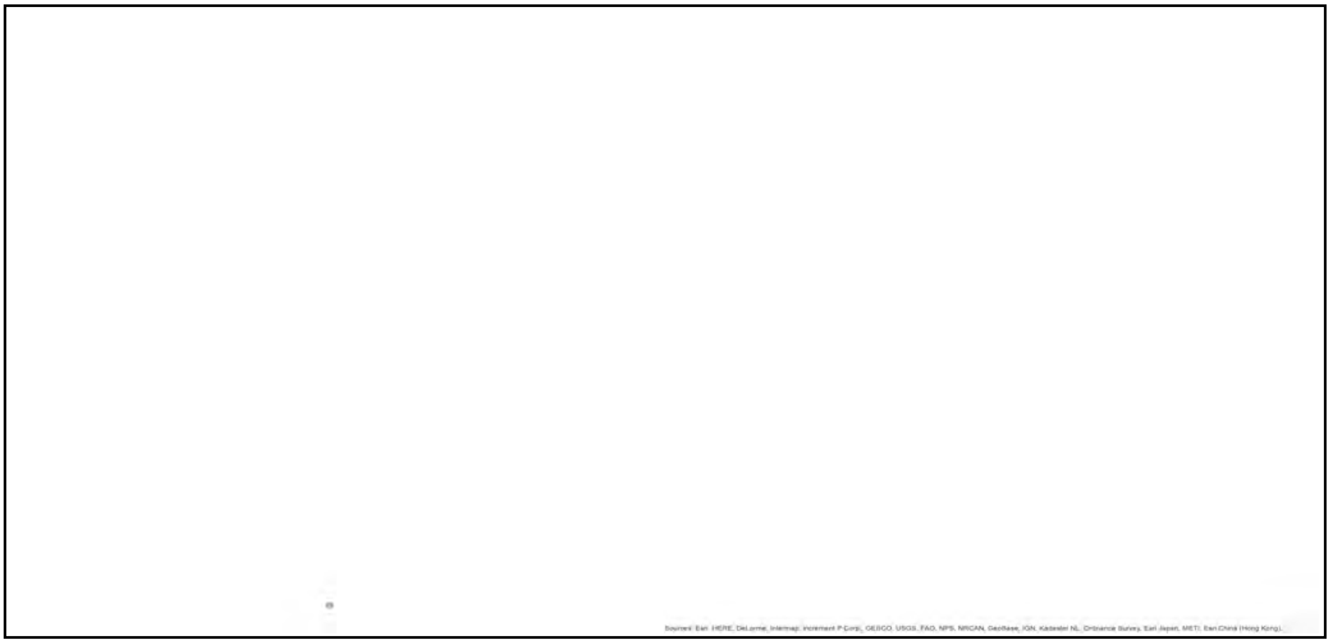


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	1	0	0	1	1
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	2	0	0	2	2

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	581	1	0
Waste Water	349	1	0
Natural Gas	233	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,229	0	0	0	0	0
Electric Power		0	0	0	0	0

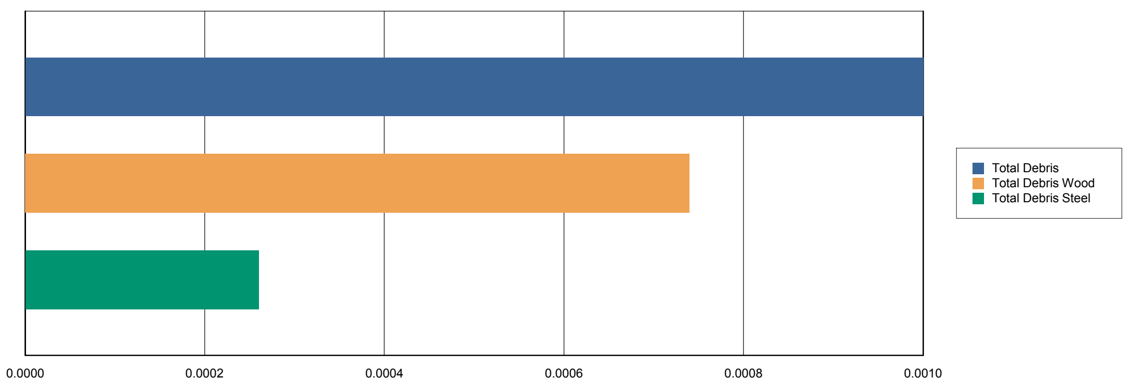
Induced Earthquake Damage

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 74.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 40 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



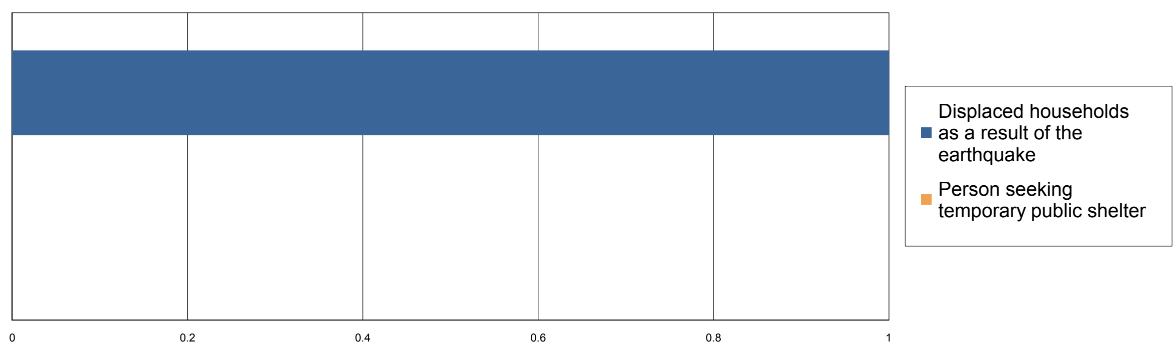
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	40 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
1	0

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

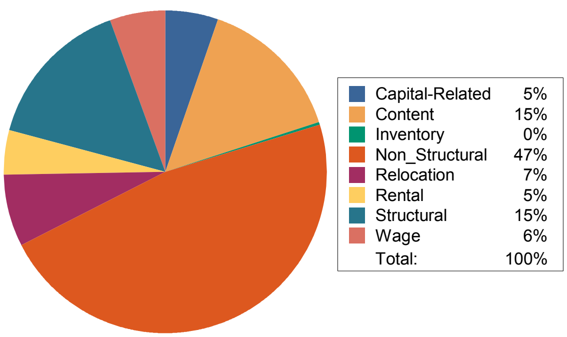
The total economic loss estimated for the earthquake is 7.82 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 6.82 (millions of dollars); 23 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 58 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

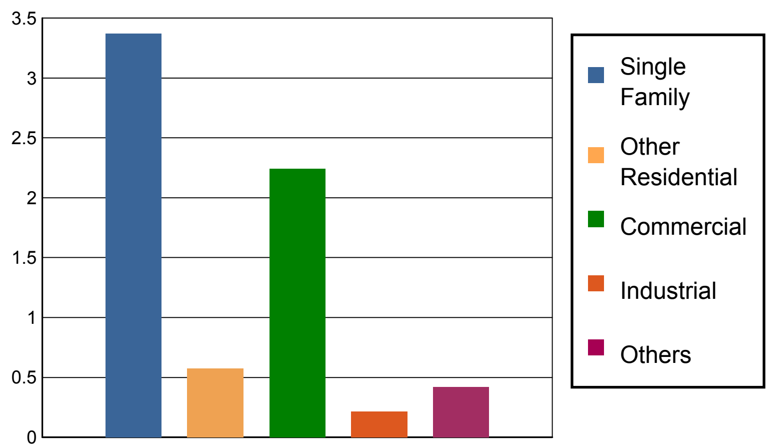


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.04	0.32	0.00	0.02	0.39
	Capital-Related	0.00	0.02	0.33	0.00	0.00	0.36
	Rental	0.06	0.08	0.15	0.00	0.01	0.31
	Relocation	0.19	0.03	0.19	0.01	0.06	0.49
	Subtotal	**0.26**	**0.18**	**1.00**	**0.02**	**0.09**	**1.54**
Capital Stock Losses							
	Structural	0.54	0.08	0.30	0.04	0.09	1.04
	Non_Structural	2.03	0.27	0.65	0.09	0.17	3.21
	Content	0.55	0.05	0.28	0.05	0.07	1.01
	Inventory	0.00	0.00	0.01	0.01	0.00	0.01
	Subtotal	**3.11**	**0.40**	**1.24**	**0.19**	**0.33**	**5.27**
	Total	**3.37**	**0.58**	**2.24**	**0.21**	**0.42**	**6.82**

Transportation and Utility Lifeline Losses

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

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	0.00	$0.00	0.00
	Bridges	6.58	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**7**	**0.00**	
Railways	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.03	2.21
	Subtotal	**1**	**0.00**	
Ferry	Facilities	1.33	$0.00	0.00
	Subtotal	**1**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	10.65	$0.22	2.03
	Runways	113.89	$0.00	0.00
	Subtotal	**125**	**0.20**	
	Total	**133.70**	**0.20**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	11.60	$0.01	0.05
	Subtotal	**11.63**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	7.00	$0.00	0.06
	Subtotal	**6.98**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.70	$0.00	0.03
	Subtotal	**4.65**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	255.20	$0.74	0.29
	Subtotal	**255.20**	**$0.74**	
Communication	Facilities	0.20	$0.00	0.30
	Subtotal	**0.23**	**$0.00**	
	Total	**278.69**	**$0.75**	

Appendix A: County Listing for the Region

Nantucket,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Nantucket	10,172	3,284	729	4,014
Total State		**10,172**	**3,284**	**729**	**4,014**
Total Region		**10,172**	**3,284**	**729**	**4,014**

Hazus-MH: Earthquake Global Risk Report

Region Name: Nantucket

Earthquake Scenario: 2500yr M-7

Print Date: December 07, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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

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

Table of Contents

General Description of the Region

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

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

Massachusetts

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

The geographical size of the region is 49.39 square miles and contains 5 census tracts. There are over 4 thousand households in the region which has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 (millions of dollars). Approximately 92.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 278 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 11 thousand buildings in the region which have an aggregate total replacement value of 4,014 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 411.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 2 bridges, 1,162 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

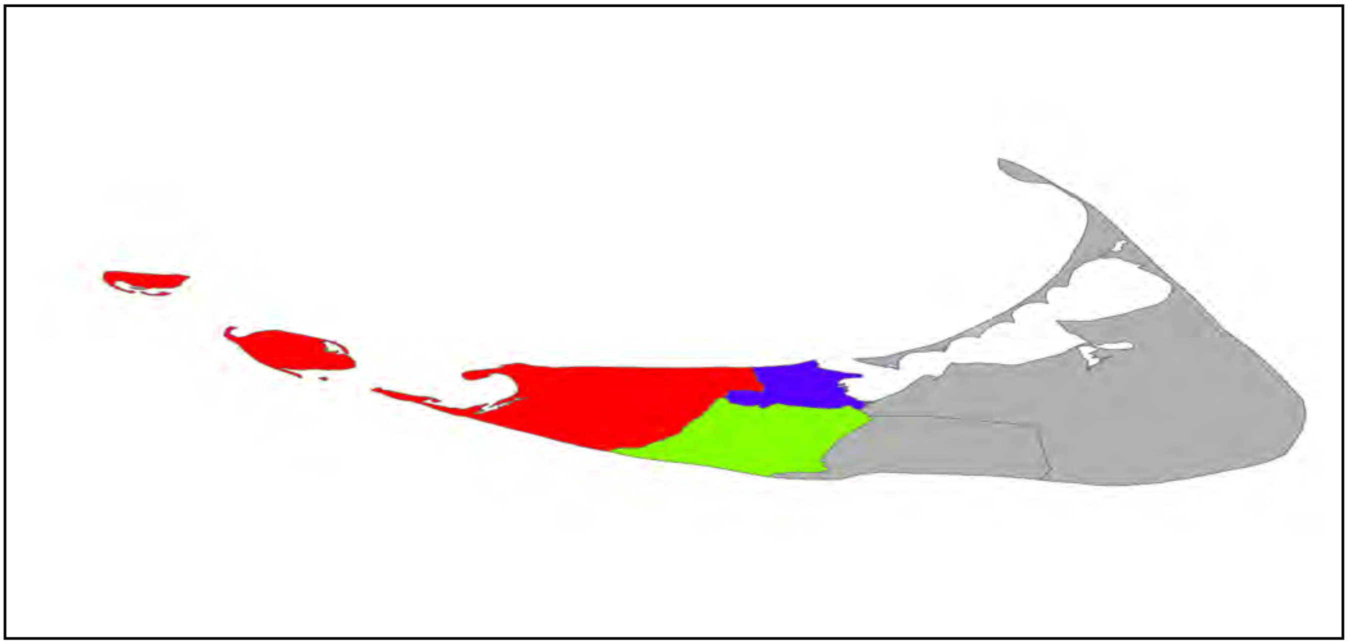
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	6.60
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**6.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	3	113.90
		Subtotal	**124.50**
		Total	**133.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	11.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**11.60**
Waste Water	Distribution Lines	NA	7.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**7.00**
Natural Gas	Distribution Lines	NA	4.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	255.20
		Subtotal	**255.20**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**278.70**

Earthquake Scenario

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



Scenario Name	2500yr M-7
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	2,500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 149 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 1 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

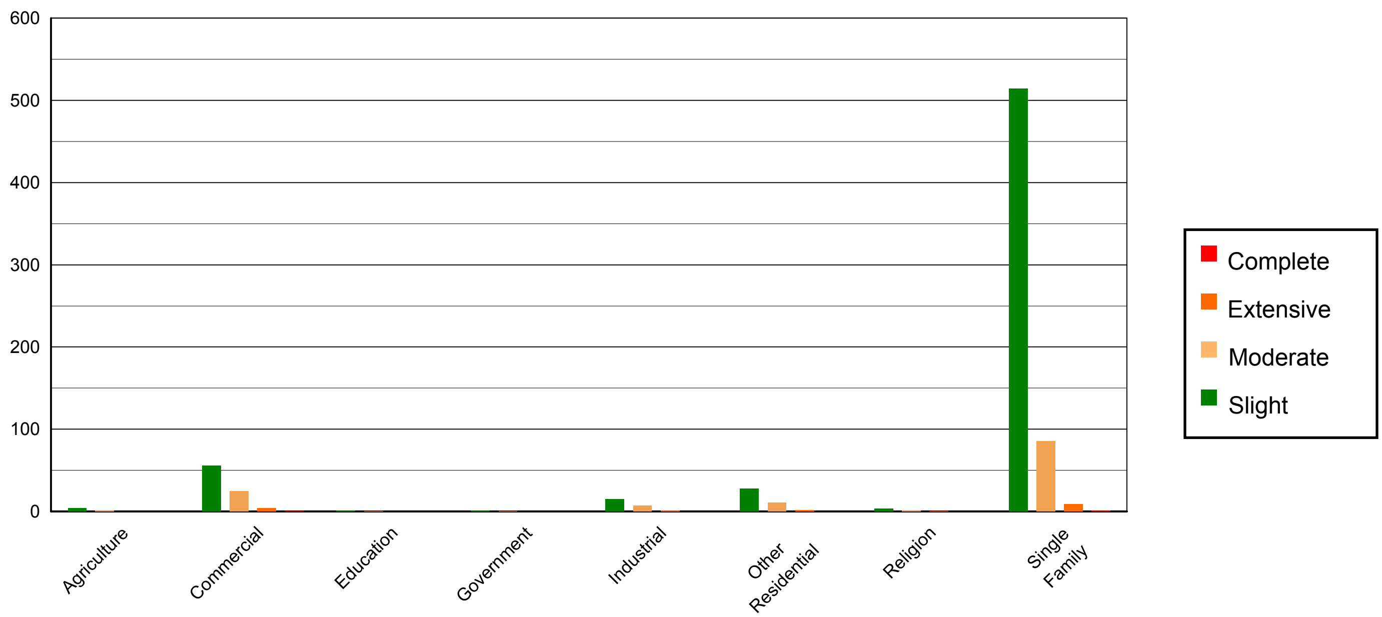


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	39	0.35	4	0.61	1	1.06	0	1.42	0	1.06
Commercial	545	4.88	56	9.00	25	18.88	4	24.42	0	25.02
Education	14	0.12	1	0.22	1	0.46	0	0.54	0	0.67
Government	13	0.12	1	0.21	1	0.46	0	0.51	0	0.54
Industrial	150	1.34	15	2.42	7	5.36	1	6.33	0	6.11
Other Residential	356	3.19	28	4.51	11	8.32	2	9.77	0	10.63
Religion	33	0.30	3	0.48	1	1.02	0	1.54	0	1.86
Single Family	10,001	89.69	514	82.54	86	64.45	9	55.48	1	54.13
Total	**11,151**		**622**		**133**		**16**		**1**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10,034	89.99	487	78.22	62	46.67	3	20.59	0	0.00
Steel	372	3.34	37	5.87	18	13.29	2	12.70	0	10.81
Concrete	62	0.55	6	0.96	3	2.15	0	1.32	0	0.84
Precast	23	0.21	2	0.38	2	1.44	0	2.92	0	0.50
RM	90	0.81	6	0.95	4	2.92	1	4.49	0	0.01
URM	548	4.92	81	12.99	42	31.86	9	57.27	1	87.57
MH	21	0.19	4	0.63	2	1.66	0	0.70	0	0.27
Total	**11,151**		**622**		**133**		**16**		**1**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only 14 hospital beds (77.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 90.00% of the beds will be back in service. By 30 days, 98.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	1	0	0	1
Schools	4	0	0	4
EOCs	0	0	0	0
PoliceStations	2	0	0	2
FireStations	1	0	0	1

Transportation Lifeline Damage

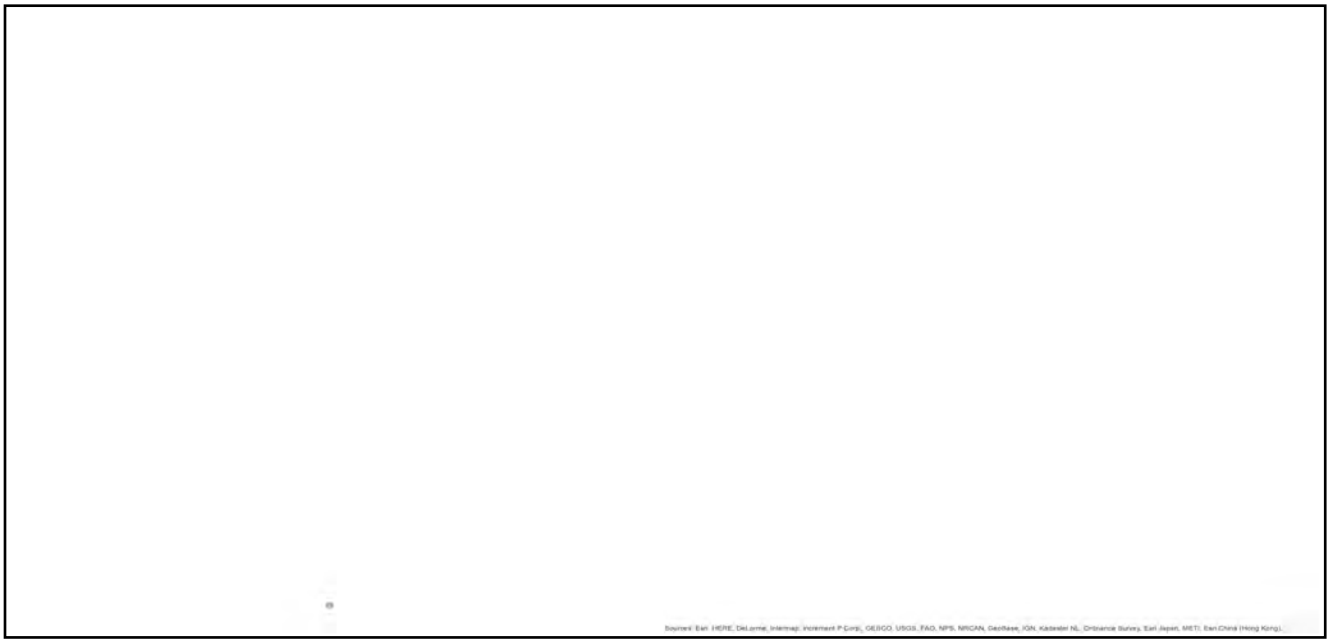


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	1	0	0	1	1
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	2	0	0	2	2

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	581	4	1
Waste Water	349	3	1
Natural Gas	233	1	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,229	0	0	0	0	0
Electric Power		0	0	0	0	0

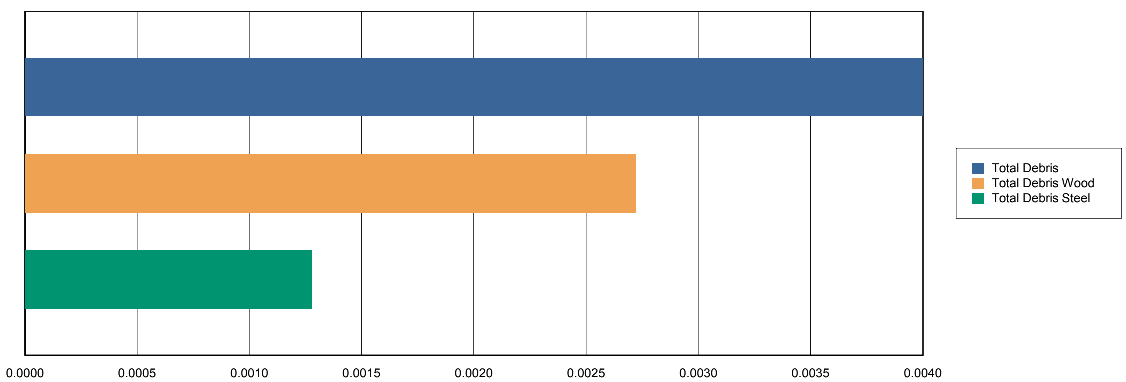
Induced Earthquake Damage

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 68.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 160 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



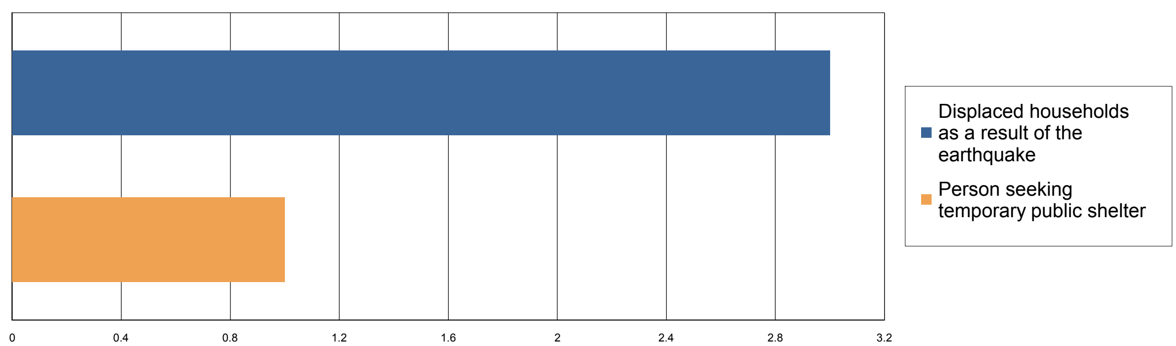
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	160 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 3 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



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

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	1	0	0	0
	Total	**1**	**0**	**0**	**0**
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**2**	**0**	**0**	**0**
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**

Economic Loss

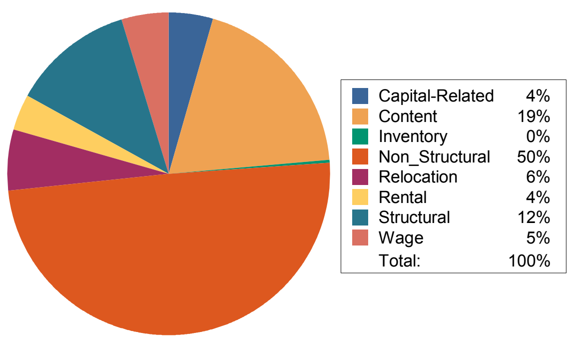
The total economic loss estimated for the earthquake is 30.02 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 25.16 (millions of dollars); 19 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 60 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

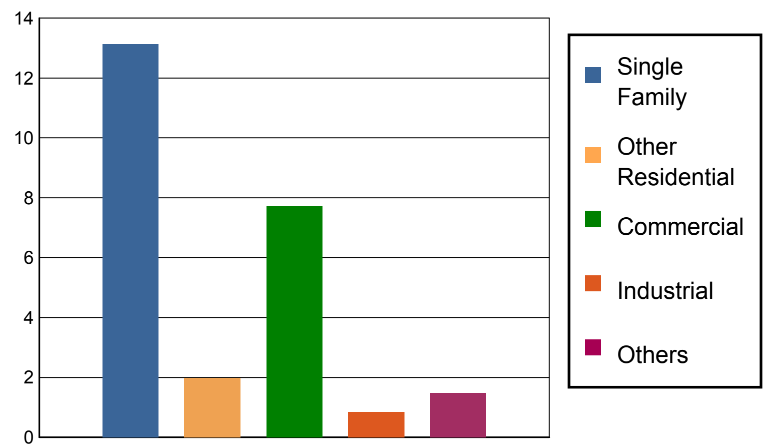


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.14	0.98	0.01	0.05	1.18
	Capital-Related	0.00	0.06	1.02	0.01	0.01	1.10
	Rental	0.20	0.24	0.43	0.01	0.02	0.89
	Relocation	0.64	0.08	0.58	0.05	0.19	1.53
	Subtotal	**0.84**	**0.52**	**3.01**	**0.07**	**0.27**	**4.70**
Capital Stock Losses							
	Structural	1.65	0.22	0.87	0.12	0.25	3.10
	Non_Structural	7.94	1.00	2.52	0.39	0.63	12.48
	Content	2.71	0.25	1.29	0.23	0.33	4.82
	Inventory	0.00	0.00	0.02	0.04	0.00	0.06
	Subtotal	**12.30**	**1.47**	**4.70**	**0.77**	**1.21**	**20.46**
	Total	**13.14**	**1.98**	**7.71**	**0.85**	**1.48**	**25.16**

Transportation and Utility Lifeline Losses

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	0.00	$0.00	0.00
	Bridges	6.58	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**7**	**0.00**	
Railways	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.07	5.92
	Subtotal	**1**	**0.10**	
Ferry	Facilities	1.33	$0.00	0.00
	Subtotal	**1**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	10.65	$0.59	5.50
	Runways	113.89	$0.00	0.00
	Subtotal	**125**	**0.60**	
	Total	**133.70**	**0.70**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	11.60	$0.02	0.14
	Subtotal	**11.63**	**$0.02**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	7.00	$0.01	0.17
	Subtotal	**6.98**	**$0.01**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.70	$0.00	0.08
	Subtotal	**4.65**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	255.20	$4.16	1.63
	Subtotal	**255.20**	**$4.16**	
Communication	Facilities	0.20	$0.00	1.77
	Subtotal	**0.23**	**$0.00**	
	Total	**278.69**	**$4.20**	

Appendix A: County Listing for the Region

Nantucket,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Nantucket	10,172	3,284	729	4,014
Total State		**10,172**	**3,284**	**729**	**4,014**
Total Region		**10,172**	**3,284**	**729**	**4,014**

Hazus-MH: Earthquake Global Risk Report

Region Name: Nantucket

Earthquake Scenario: NantucketAnnualized

Print Date: December 07, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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

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

Table of Contents

General Description of the Region

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

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

Massachusetts

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

The geographical size of the region is 49.39 square miles and contains 5 census tracts. There are over 4 thousand households in the region which has a total population of 10,172 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 11 thousand buildings in the region with a total building replacement value (excluding contents) of 4,014 (millions of dollars). Approximately 92.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 278 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 11 thousand buildings in the region which have an aggregate total replacement value of 4,014 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 4 schools, 1 fire stations, 2 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 411.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 2 bridges, 1,162 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

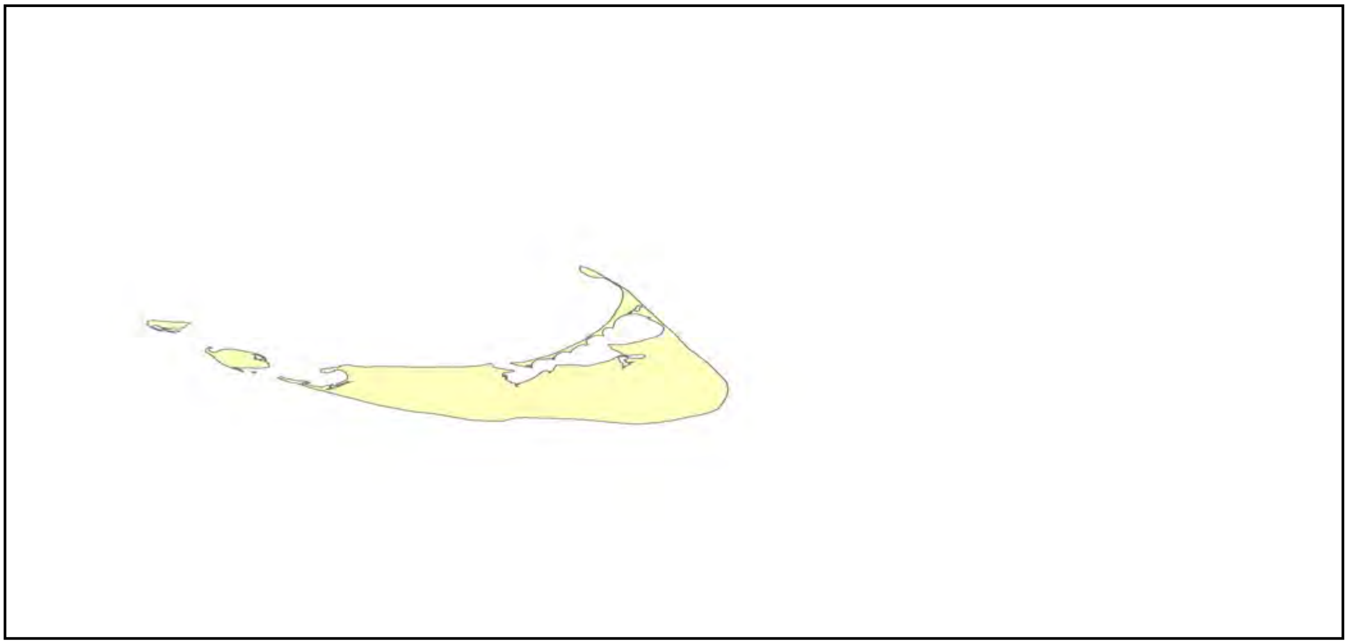
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	6.60
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**6.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	3	113.90
		Subtotal	**124.50**
		Total	**133.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	11.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**11.60**
Waste Water	Distribution Lines	NA	7.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**7.00**
Natural Gas	Distribution Lines	NA	4.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	255.20
		Subtotal	**255.20**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**278.70**

Earthquake Scenario

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



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

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

Complete
Extensive
Moderate
Slight

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Total										

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Total										

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	0
Schools	4	0	0	0
EOCs	0	0	0	0
PoliceStations	2	0	0	0
FireStations	1	0	0	0

Transportation Lifeline Damage

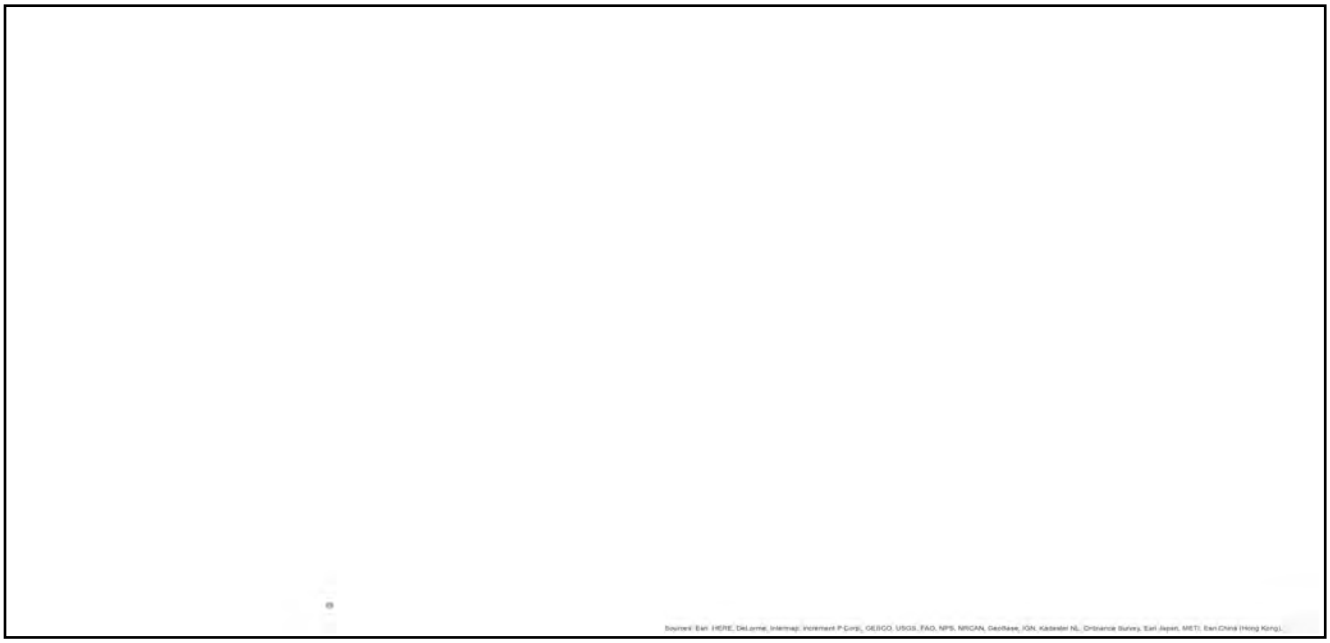


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	2	0	0	0	0
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	0	0
Ferry	Facilities	1	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	0	0
	Runways	3	0	0	0	0

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	0	0
Communication	2	0	0	0	0

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	581	0	0
Waste Water	349	0	0
Natural Gas	233	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

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

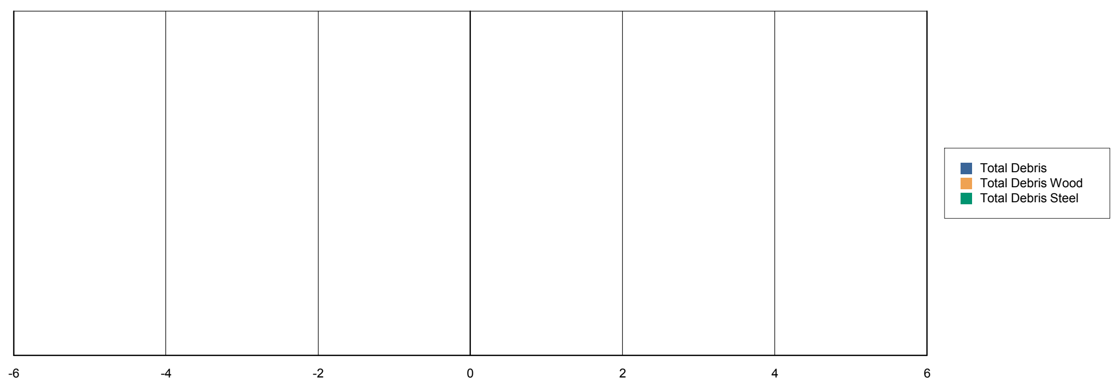
Induced Earthquake Damage

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
		0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 10,172) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

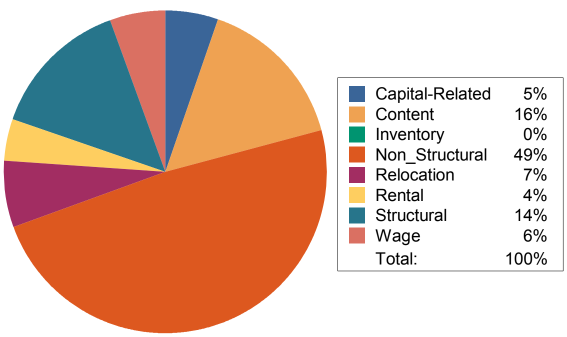
The total economic loss estimated for the earthquake is 0.03 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 0.03 (millions of dollars); 22 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 57 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

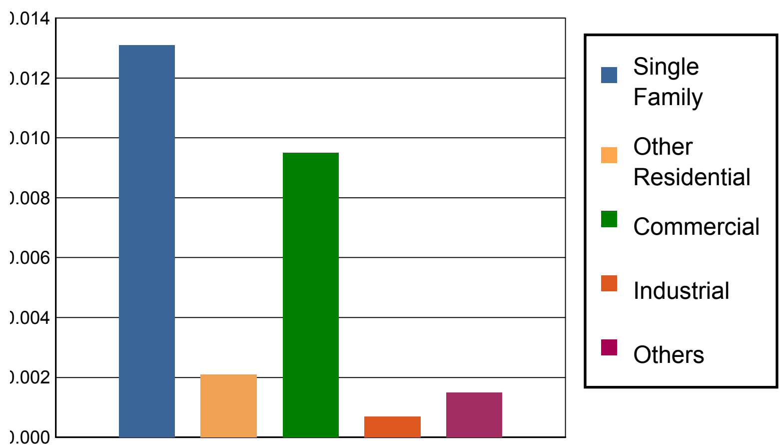


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

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

Transportation and Utility Lifeline Losses

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

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	0.00	$0.00	0.00
	Bridges	6.58	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**7**	**0.00**	
Railways	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.00	0.00
	Subtotal	**1**	**0.00**	
Ferry	Facilities	1.33	$0.00	0.00
	Subtotal	**1**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	10.65	$0.00	0.00
	Runways	113.89	$0.00	0.00
	Subtotal	**125**	**0.00**	
	Total	**133.70**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	11.60	$0.00	0.00
	Subtotal	**11.63**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	7.00	$0.00	0.00
	Subtotal	**6.98**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.70	$0.00	0.00
	Subtotal	**4.65**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	255.20	$0.00	0.00
	Subtotal	**255.20**	**$0.00**	
Communication	Facilities	0.20	$0.00	0.00
	Subtotal	**0.23**	**$0.00**	
	Total	**278.69**	**$0.00**	

Appendix A: County Listing for the Region

Nantucket,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Nantucket	10,172	3,284	729	4,014
Total State		**10,172**	**3,284**	**729**	**4,014**
Total Region		**10,172**	**3,284**	**729**	**4,014**

APPENDIX E: MITIGATION PROJECT WORKSHEET

Mitigation Action Progress Report Form

Progress Report Period	From Date:	To Date:
Action/Project Title		
Responsible Agency		
Contact Name		
Contact Phone/Email		
Project Status	❏ Project completed ❏ Project canceled ❏ Project on schedule ❏ Anticipated completion date:__________ ❏ Project delayed Explain __________	

Summary of Project Progress for this Report Period

1. What was accomplished for this project during this reporting period?

2. What obstacles, problems, or delays did the project encounter?

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments

Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?	
	Have any internal or external agencies been invaluable to the mitigation strategy?	
	Can any procedures (e.g., meeting announcements, plan updates) be done differently or more efficiently?	
	Has the Planning Team undertaken any public outreach activities?	
	How can public participation be improved?	
	Have there been any changes in public support and/or decision- maker priorities related to hazard mitigation?	
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?	
	Are there different or additional administrative, human, technical, and financial resources available for mitigation planning?	
	Are there different or new education and outreach programs and resources available for mitigation activities?	
	Has NFIP participation changed in the participating jurisdictions?	
Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?	
	Should the list of hazards addressed in the plan be modified?	
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?	
	Do any new critical facilities or infrastructure need to be added to the asset lists?	
	Have any changes in development trends occurred that could create additional risks?	
	Are there repetitive losses and/or severe repetitive losses to document?	

Worksheet 7.2

Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimates accurate?	
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or eliminated from the plan?	
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?	
	Are there new funding sources to consider?	
	Have elements of the plan been incorporated into other planning mechanisms?	
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?	
	What are needed improvements to the procedures?	

APPENDIX F: HISTORIC RESOURCE INVENTORY

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.A	Brant Point Light Station		
NAN.B	Lighthouses of Massachusetts		
NAN.C	Nantucket Historic District		
NAN.D	Nantucket Historic District		
NAN.E	Sankaty Head Light		
NAN.F	Tuckernuck Island		
NAN.G	Coffin Farmstead		
NAN.H	Chase Farm		
NAN.I	Higginbotham, Florence House		
NAN.J	Surfside Lifesaving Station		
NAN.K	Gardner, Richard Jr. House		
NAN.L	Coffin, Jethro House		
NAN.1067		3 A St	c 1938
NAN.1068		3 A St	c 1938
NAN.1069		4 A St	c 1940
NAN.1070		4 A St	c 1940
NAN.1050		Ames St	
NAN.1051	Millie's Boathouse	1 Ames St	
NAN.1052	Millie's	1 Ames St	c 1938
NAN.1037	Afterglow	4 Ames St	c 1940
NAN.1036		6 Ames St	c 1940
NAN.1019		7 Ames St	c 1945
NAN.1035	Hoffnagel	8 Ames St	c 1938
NAN.10	Pierce, Cyrus High School	Atlantic Ave	1931
NAN.2887	Mews, The	3 Auriga St	c 1910
NAN.2885		5 Auriga St	1981
NAN.2886	Beach Plum Cottage	5 Auriga St	c 1900
NAN.2861	Seabreeze	6 Auriga St	c 1895
NAN.1071	Boat Shop	Baltimore Ave	c 1938
NAN.1072	Grey Whale	Baltimore Ave	
NAN.1074		Baltimore Ave	c 1938
NAN.1075		Baltimore Ave	
NAN.1282		Baltimore Ave	
NAN.1286	Come Hither Boathouse	Baltimore Ave	c 1938
NAN.1066	Catydid	8 Baltimore Ave	c 1930
NAN.1280		14 Baltimore Ave	1988
NAN.1281	Weldon, Edward Fishing Shack	14 Baltimore Ave	c 1910
NAN.1073	Topside	16 Baltimore Ave	
NAN.1283	Come Hither	19 Baltimore Ave	c 1840
NAN.1284	Come Hither Shed	19 Baltimore Ave	c 1938
NAN.1285	Come Hither Shed	19 Baltimore Ave	c 1938
NAN.2326		1 Bank St	
NAN.2363		1 Bank St	
NAN.2327	Little One	5 Bank St	
NAN.2328	Little One Shed	5 Bank St	
NAN.2298	Slade Cottage	7 Bank St	c 1938
NAN.2329		8 Bank St	c 1930
NAN.2362		11 Bank St	c 1916
NAN.2364		11 Bank St	

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2361		13 Bank St	c 1916
NAN.2359	Belle Guesthouse	15 Bank St	
NAN.2360	Belle	15 Bank St	c 1898
NAN.2345		19 Bank St	c 1900
NAN.2346		19 Bank St	c 1938
NAN.2347		19 Bank St	c 1916
NAN.2348		19 Bank St	
NAN.2343		21 Bank St	c 1900
NAN.2344		21 Bank St	
NAN.2340		23 Bank St	c 1916
NAN.2341		23 Bank St	
NAN.2342		23 Bank St	
NAN.2339	Whale's Back	25 Bank St	
NAN.2337		27 Bank St	c 1938
NAN.2338		27 Bank St	
NAN.2335	Sea Ray	29 Bank St	c 1916
NAN.2336	Sea Ray Shed	29 Bank St	
NAN.160	Brant Point Bath House	Bathing Beach Rd	1890
NAN.161		Bathing Beach Rd	c 1930
NAN.162		Bathing Beach Rd	c 1915
NAN.163	Brant Point Tennis Club	Bathing Beach Rd	1950
NAN.909	Jetties Beach	Bathing Beach Rd	
NAN.2528		1 Baxter Rd	c 1916
NAN.2531		3 Baxter Rd	
NAN.2529		5 Baxter Rd	c 1885
NAN.2530		5 Baxter Rd	
NAN.2532	Idlemoor	11 Baxter Rd	1884
NAN.2533	Idlemoor Stable	11 Baxter Rd	c 1884
NAN.2534	Currier	12 Baxter Rd	c 1893
NAN.2535	Currier Garage	12 Baxter Rd	
NAN.2536		13 Baxter Rd	c 1930
NAN.2537		13 Baxter Rd	c 1885
NAN.2538		15 Baxter Rd	c 1916
NAN.2539		15 Baxter Rd	c 1916
NAN.2542		16 Baxter Rd	c 1938
NAN.2543		16 Baxter Rd	c 1975
NAN.2544		16 Baxter Rd	c 1938
NAN.2545	Sconset Beach Life Saving Station	18 Baxter Rd	
NAN.2546		18 Baxter Rd	1984
NAN.2540	Parsonage	19 Baxter Rd	c 1938
NAN.2541	Parsonage Garage	19 Baxter Rd	c 1938
NAN.2547		20 Baxter Rd	c 1938
NAN.2548		20 Baxter Rd	c 1938
NAN.2549		22 Baxter Rd	c 1975
NAN.2550		22 Baxter Rd	c 1975
NAN.2553		24 Baxter Rd	c 1904
NAN.2554		24 Baxter Rd	c 1930
NAN.2551	Braes, The - Streeter Cottage	25 Baxter Rd	c 1890
NAN.2552	Braes, The - Streeter Cottage Shed	25 Baxter Rd	c 1904

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2555	Captains Cabin Garage - Guesthouse	27 Baxter Rd	c 1949
NAN.2556	Captains Cabin	27 Baxter Rd	c 1904
NAN.2699	Windrush	28 Baxter Rd	c 1906
NAN.2557		29 Baxter Rd	c 1930
NAN.2558		29 Baxter Rd	c 1938
NAN.2559		31 Baxter Rd	c 1975
NAN.2700		31 Baxter Rd	c 1904
NAN.2702		32 Baxter Rd	c 1975
NAN.2701		33 Baxter Rd	1988
NAN.2704	Rose and Crown	34 Baxter Rd	c 1938
NAN.2703		35 Baxter Rd	c 1949
NAN.2705		36 Baxter Rd	c 1938
NAN.2707		39 Baxter Rd	c 1904
NAN.2708		39 Baxter Rd	
NAN.2706		40 Baxter Rd	1953
NAN.2711	Just Bluffing	41 Baxter Rd	c 1975
NAN.2709		42 Baxter Rd	c 1975
NAN.2710		44 Baxter Rd	c 1975
NAN.2712	Sea Acres	45 Baxter Rd	c 1930
NAN.2713	Summerset	47 Baxter Rd	c 1904
NAN.2714	Summerset Guesthouse	47 Baxter Rd	c 1916
NAN.2715	Summerset Shed	47 Baxter Rd	c 1916
NAN.2718	Thickly Settled	49 Baxter Rd	c 1904
NAN.2719	Thickly Settled Garage	49 Baxter Rd	c 1916
NAN.2716	Mea Culpa	50A Baxter Rd	c 1975
NAN.2720	Sunny Cliffe	51 Baxter Rd	1886
NAN.2721	Sunny Cliffe Garage	51 Baxter Rd	
NAN.2722	Sunny Cliffe Shed	51 Baxter Rd	
NAN.2717		52 Baxter Rd	c 1938
NAN.2723	Owl's Nest	53 Baxter Rd	c 1930
NAN.2724	Owl's Nest Garage	53 Baxter Rd	c 1930
NAN.2725	Flaggship, The	55 Baxter Rd	c 1890
NAN.2726		58 Baxter Rd	c 1938
NAN.2727		59 Baxter Rd	c 1923
NAN.2728		59 Baxter Rd	
NAN.2729	Mayflower	61 Baxter Rd	1893
NAN.2730	Mayflower Beach House	61 Baxter Rd	
NAN.2731	Mayflower Beach House	61 Baxter Rd	
NAN.2732	Mayflower Beach Garage	61 Baxter Rd	c 1923
NAN.2733	Mitchell House	63 Baxter Rd	c 1890
NAN.2734	Mitchell Stable	63 Baxter Rd	c 1923
NAN.2735	Mitchell Shed	63 Baxter Rd	c 1923
NAN.2736	Nelson House	65 Baxter Rd	c 1895
NAN.2737	Nelson Shed	65 Baxter Rd	
NAN.2738	Nelson Garage	65 Baxter Rd	
NAN.2740		67 Baxter Rd	c 1930
NAN.2741		67 Baxter Rd	
NAN.2739		68 Baxter Rd	c 1938
NAN.2742		69 Baxter Rd	c 1940

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2743		69 Baxter Rd	c 1940
NAN.2744	Bayberry	70 Baxter Rd	c 1940
NAN.2745	Bayberry Guesthouse	70 Baxter Rd	c 1940
NAN.2748		71 Baxter Rd	c 1932
NAN.2749		71 Baxter Rd	c 1932
NAN.2746		72 Baxter Rd	c 1940
NAN.2747		72 Baxter Rd	c 1940
NAN.2750	Russell, Rosalind House	73 Baxter Rd	c 1920
NAN.2751	Russell, Rosalind Garage	73 Baxter Rd	
NAN.2752		75 Baxter Rd	c 1923
NAN.2753		75 Baxter Rd	c 1923
NAN.2754		77 Baxter Rd	c 1940
NAN.2755		77 Baxter Rd	
NAN.2756	Twin Chimney	79 Baxter Rd	c 1923
NAN.2757	Twin Chimney Shed	79 Baxter Rd	
NAN.2759		81 Baxter Rd	c 1923
NAN.2758	Footlight	82 Baxter Rd	c 1923
NAN.2760		83 Baxter Rd	c 1940
NAN.2761		84 Baxter Rd	c 1940
NAN.2762		84 Baxter Rd	c 1940
NAN.2672	Ambrosia Guesthouse	85 Baxter Rd	c 1975
NAN.2673	Ambrosia	85 Baxter Rd	c 1940
NAN.2674	Ambrosia Garage	85 Baxter Rd	c 1940
NAN.2677	Windy Moor Garage	86 Baxter Rd	c 1975
NAN.2678	Windy Moor	86 Baxter Rd	c 1940
NAN.2676	Bluff House	87 Baxter Rd	
NAN.2675		92 Baxter Rd	c 1940
NAN.2682	Surf Hut	92 Baxter Rd	c 1940
NAN.2683	Eastward Garage	93 Baxter Rd	
NAN.2684	Eastward	93 Baxter Rd	1951
NAN.2680		96 Baxter Rd	c 1940
NAN.2681		96 Baxter Rd	c 1940
NAN.2679		97 Baxter Rd	c 1940
NAN.2686		97 Baxter Rd	c 1940
NAN.2685	Little Rip	98 Baxter Rd	c 1940
NAN.2687		99 Baxter Rd	c 1940
NAN.2688		99 Baxter Rd	c 1940
NAN.2689		100 Baxter Rd	c 1940
NAN.2690		100 Baxter Rd	c 1940
NAN.2691		101 Baxter Rd	c 1940
NAN.2693		105 Baxter Rd	c 1940
NAN.2692		106 Baxter Rd	c 1940
NAN.2763		109 Baxter Rd	c 1940
NAN.2764		113 Baxter Rd	c 1940
NAN.2765	Windswept	114 Baxter Rd	1984
NAN.2766		115 Baxter Rd	c 1923
NAN.2767		117 Baxter Rd	c 1923
NAN.2768		117 Baxter Rd	c 1923
NAN.2769		120 Baxter Rd	1983

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2302	Sternmost, The	1 Beach St	c 1938
NAN.2303		3 Beach St	c 1938
NAN.2304		3 Beach St	c 1938
NAN.2305		3 Beach St	c 1938
NAN.2306	All-Inn	5 Beach St	c 1938
NAN.2296		7 Beach St	c 1938
NAN.2330	Blue Heaven	9 Beach St	
NAN.2297		10 Beach St	c 1930
NAN.2295	Gone Native	11 Beach St	
NAN.2293		15 Beach St	c 1916
NAN.2294		15 Beach St	c 1916
NAN.1309	Lillicrapp House	4 Berkeley Ave	c 1920
NAN.1310	Lillicrapp Shed	4 Berkeley Ave	
NAN.1311	Lillicrapp Garage	4 Berkeley Ave	
NAN.1307	Windyway	9 Berkeley Ave	c 1920
NAN.1308	Windyway Garage	9 Berkeley Ave	c 1938
NAN.1334		10 Berkeley Ave	
NAN.503		1 Bloom St	1727
NAN.504	Macy, William E. House	4 Bloom St	c 1834
NAN.72	Brant Point Light Station Shed	Brant Point	
NAN.73	Brant Point Light Station Boathouse	Brant Point	1936
NAN.76	Brant Point Light Station Keepers House	Brant Point	1856
NAN.77	Madaket Lifesaving Station Equipment Building	Brant Point	
NAN.92	Brant Point Light Station Garage	Brant Point	
NAN.93	Brant Point Light Station	Brant Point	1934
NAN.901	Brant Point Lighthouse	Brant Point	1901
NAN.902	U. S. Coast Guard Range Tower	Brant Point	1908
NAN.903	Brant Point Light Station Boathouse	Brant Point	1936
NAN.904	U. S. Coast Guard Range Tower	Brant Point	1908
NAN.937	U. S. Coast Guard Range Tower	Brant Point	
NAN.390		4 Brant Point Rd	1984
NAN.391		4 Brant Point Rd	1984
NAN.386		6 Brant Point Rd	1984
NAN.387		6 Brant Point Rd	1984
NAN.389		8 Brant Point Rd	1985
NAN.388		10 Brant Point Rd	1985
NAN.385		12 Brant Point Rd	1985
NAN.380		14 Brant Point Rd	1986
NAN.382		16 Brant Point Rd	1986
NAN.379		18 Brant Point Rd	1987
NAN.381	Summer Heydt	20 Brant Point Rd	1987
NAN.383		22 Brant Point Rd	1986
NAN.2223		1 Bridge Rd	c 1907
NAN.2194	Casa Marina	1 Broadway St	
NAN.923	Folger, Lucreha Carport	2 Broadway St	
NAN.2196	Folger, Lucreha House	2 Broadway St	r 1820
NAN.2195	High Tide	3 Broadway St	c 1901
NAN.2197	Nauticon Lodge Guesthouse	4 Broadway St	c 1881
NAN.2198	Nauticon Lodge	4 Broadway St	c 1700

Massachusetts Cultural Resource Information System
MACRIS

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2199	Gardner, Prince House	5 Broadway St	c 1740
NAN.2200	Low Tide	5 Broadway St	c 1955
NAN.2201	Auld Lang Syne - Coffin, Hicah House	6 Broadway St	c 1682
NAN.2202	Dexioma - Hussey, Stephen House	7 Broadway St	c 1814
NAN.2205	General Quarters - Barnaby Lodge	8 Broadway St	c 1885
NAN.2203	Snug Harbor	9 Broadway St	c 1791
NAN.2206	Shaununga Guesthouse	10 Broadway St	
NAN.2207	Shaununga - Swain, Uriah House	10 Broadway St	c 1682
NAN.2204	Liberty Hall	11 Broadway St	r 1885
NAN.2208	Mizzentop - Joy House	13 Broadway St	c 1791
NAN.2210	Mitchell, Eliza House - Maples, The	14 Broadway St	c 1814
NAN.2209	House Of Lords - Drew, Gershorn House	15 Broadway St	c 1753
NAN.2839	Martin Box	16 Broadway St	c 1791
NAN.2212	Nonantum - Folger, Balzillai House	17 Broadway St	c 1791
NAN.2211	Clifton Cottage - Driftwood	18 Broadway St	c 1818
NAN.2243	Columbia Cottage - Willow Harp	19 Broadway St	r 1750
NAN.2214	Nonquit - Mitchell, Obed House	20 Broadway St	c 1800
NAN.2213	Hollyhock House - Bobcat - Seagull	21 Broadway St	c 1920
NAN.2216	Felicite	22 Broadway St	c 1750
NAN.2215	Eagle Cottage	23 Broadway St	c 1800
NAN.2217	None Too Big	24 Broadway St	c 1893
NAN.2218	Hope Chest, The	25 Broadway St	r 1820
NAN.2219	San Souci	26 Broadway St	c 1700
NAN.2221	Nawma - Joy, Reuben House	27 Broadway St	r 1750
NAN.2222	Mitchell, George F. Barn	27B Broadway St	c 1866
NAN.2220	Pitman, Frederick M. House	29 Broadway St	r 1820
NAN.575		1 Brooks Ct	c 1840
NAN.576		1 Brooks Ct	c 1949
NAN.577		1 Brooks Ct	c 1892
NAN.574		2 Brooks Ct	c 1940
NAN.2445		5 Bunker Hill Rd	c 1923
NAN.2446		5 Bunker Hill Rd	c 1938
NAN.2444	Smith, Solomon - Coleman, J. House	8 Bunker Hill Rd	
NAN.2797		8 Bunker Hill Rd	c 1975
NAN.2443		9 Bunker Hill Rd	c 1923
NAN.2793		4 Burnell St	c 1975
NAN.2792		5 Burnell St	c 1975
NAN.2791		9 Burnell St	c 1938
NAN.2790		11 Burnell St	c 1938
NAN.2789		13 Burnell St	c 1938
NAN.2787	Wild Tyme	17 Burnell St	c 1938
NAN.2788	Wild Tyme Garage	17 Burnell St	c 1975
NAN.2794	Moor House	24 Burnell St	c 1938
NAN.2795	Moor House Garage	24 Burnell St	c 1938
NAN.2796	Moor House Shed	24 Burnell St	c 1938
NAN.2525		4 Butterfly Ln	c 1893
NAN.2526		4 Butterfly Ln	
NAN.2527		4 Butterfly Ln	
NAN.1094	Summersnap	C St	

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Inv. No.	Property Name	Street	Year
NAN.1095	Summersnap Garage	C St	
NAN.1096	Summersnap Shed	C St	
NAN.1082	Humane House	1 C St	c 1898
NAN.1083		1 C St	
NAN.1084		5 C St	
NAN.1085		5 C St	
NAN.1087		6 C St	
NAN.1088		6 C St	1989
NAN.1090	Island Fever Garage	11 C St	
NAN.1091		12 C St	c 1938
NAN.1097		12 C St	
NAN.1089	Island Fever	13 C St	c 1974
NAN.1092	Sans Souci	15 C St	c 1938
NAN.1093	Sans Souci Garage	15 C St	c 1935
NAN.1599		2 Cabot Ln	c 1893
NAN.1600		2 Cabot Ln	
NAN.1601		2 Cabot Ln	
NAN.1604	Toy Box, The	3 Cabot Ln	1921
NAN.1605	You Are My Sunshine	5 Cabot Ln	1890
NAN.1602		6 Cabot Ln	
NAN.1603		6 Cabot Ln	c 1893
NAN.1606	Gibbs, James House	7 Cabot Ln	1880
NAN.1607	Wattwynne Garage - Guesthouse	7 Cabot Ln	
NAN.1608	Lane's End	7 Cabot Ln	1880
NAN.1023		California Ave	c 1960
NAN.1020	Smidgeon	5 California Ave	c 1955
NAN.1021		7 California Ave	c 1975
NAN.1022		9 California Ave	c 1975
NAN.2881		Canonicus St	c 1950
NAN.2882	Ayr	Canonicus St	c 1955
NAN.2883	Ayr Garage	Canonicus St	
NAN.1928		9 Capaum Pond Rd	1982
NAN.1927		15 Capaum Pond Rd	
NAN.1925		18 Capaum Pond Rd	
NAN.1926		18 Capaum Pond Rd	
NAN.1924		20 Capaum Pond Rd	
NAN.1923		22 Capaum Pond Rd	c 1965
NAN.1921		25 Capaum Pond Rd	1987
NAN.1922		25 Capaum Pond Rd	1980
NAN.1920	Capaum Lookout	29 Capaum Pond Rd	1979
NAN.1665		4 Capaum Rd	c 1930
NAN.1674		8 Capaum Rd	1960
NAN.1675		10 Capaum Rd	1983
NAN.1676		12 Capaum Rd	c 1950
NAN.2076		5 Carew Ln	1989
NAN.2077		5 Carew Ln	1989
NAN.2078		7 Carew Ln	1989
NAN.2079		9 Carew Ln	c 1916
NAN.2080		9 Carew Ln	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2081		11 Carew Ln	c 1896
NAN.2254	Takitezie - Hussey, Arietta House	2 Center St	1814
NAN.2255	Takitezie Guesthouse	2 Center St	c 1975
NAN.2253	Sunnyside - In And Out	6 Center St	r 1650
NAN.2252	Corners, The - Barnard, Shubael House	8 Center St	c 1814
NAN.2251	Utopia - Folger, Horace House	10 Center St	1814
NAN.2250	Roof Tree - Bunker, Capt. Obid House	12 Center St	c 1814
NAN.2249	Hearts Ease	14 Center St	r 1700
NAN.2248	Ivy Lodge - Jones, Asa P. House	18 Center St	c 1814
NAN.2246	Wanackmamack	20 Center St	c 1815
NAN.2247	Wanackmamack Garage	20 Center St	c 1938
NAN.3085	United Methodist Church of Nantucket	2 Centre St	1823
NAN.3087	First Congregational Church of Nantucket	62 Centre St	1834
NAN.1546	Nirvana	65 Centre St	1821
NAN.1548	Nirvana Garage	65 Centre St	
NAN.1544		67 Centre St	c 1930
NAN.1545		67 Centre St	c 1820
NAN.1547		67 Centre St	
NAN.1539	Folger, Thaddeus House	86 Centre St	1736
NAN.2375	Little Starbuck	1 Chapel St	c 1893
NAN.2609	Moorings, The	2 Chapel St	c 1888
NAN.2376	Second Wind	3 Chapel St	c 1906
NAN.2377	Where Away	4 Chapel St	c 1893
NAN.2378	Where Away Garage	4 Chapel St	
NAN.227		4 Charles St	c 1972
NAN.228		4 Charles St	1983
NAN.226		8 Charles St	1976
NAN.1550		1 Chester St	c 1810
NAN.1549		5 Chester St	c 1820
NAN.919	Proprietors Marker	Cliff Rd	
NAN.920	Gardner, John Grave Marker	Cliff Rd	
NAN.1521		2 Cliff Rd	1800
NAN.1522	Easton, Phebe House	3 Cliff Rd	1800
NAN.1523		3 Cliff Rd	
NAN.1520	Kindercute	5 Cliff Rd	c 1820
NAN.1519	Folger, Isaiah - Brooks, Capt. Richard House	6 Cliff Rd	1795
NAN.1517	Makay, The Captain House	8 Cliff Rd	c 1881
NAN.1518	Hills, Caroline Parker House	9 Cliff Rd	c 1800
NAN.1515	Century House, The	10 Cliff Rd	c 1810
NAN.1516	Century House, The Guest House	10 Cliff Rd	1900
NAN.1513	Innishail Garage	11 Cliff Rd	
NAN.1514	Innishail	11 Cliff Rd	1895
NAN.1510	Gibbs, Esther House - Grand Island	12 Cliff Rd	1749
NAN.1512		13 Cliff Rd	1903
NAN.1508		15 Cliff Rd	
NAN.1509		15 Cliff Rd	1900
NAN.1507	Folger, Jowen - Ary, Peleg House	16 Cliff Rd	c 1757
NAN.1538		16 Cliff Rd	c 1915
NAN.1506	Fitch, John G. House	17 Cliff Rd	1809

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Inv. No.	Property Name	Street	Year
NAN.1503	Folger House	18 Cliff Rd	c 1840
NAN.1502		20 Cliff Rd	1747
NAN.1504		21 Cliff Rd	c 1810
NAN.1505		21 Cliff Rd	1989
NAN.1500		22 Cliff Rd	1790
NAN.1501		23 Cliff Rd	
NAN.1499	Easton, Giles House	24 Cliff Rd	c 1810
NAN.1497	Hurry Up and Wait	27 Cliff Rd	c 1893
NAN.1498		28 Cliff Rd	c 1850
NAN.1849		28 Cliff Rd	1980
NAN.1494	Fair Winds	29 Cliff Rd	c 1850
NAN.1496		30 Cliff Rd	c 1820
NAN.1495	Fisher, Philander House	32 Cliff Rd	1851
NAN.1488		33 Cliff Rd	
NAN.1489		33 Cliff Rd	
NAN.1490		33 Cliff Rd	1982
NAN.1491		34 Cliff Rd	c 1875
NAN.1492		34R Cliff Rd	
NAN.1493		34R Cliff Rd	
NAN.1481		35 Cliff Rd	1960
NAN.1485		36R Cliff Rd	1976
NAN.1487		36 Cliff Rd	c 1835
NAN.1476		37 Cliff Rd	1911
NAN.1483		38 Cliff Rd	
NAN.1484		38 Cliff Rd	
NAN.1486		38 Cliff Rd	c 1840
NAN.1477		39 Cliff Rd	c 1881
NAN.1474	Broadleaf	41B Cliff Rd	1846
NAN.1475		41A Cliff Rd	c 1881
NAN.1482		42 Cliff Rd	c 1915
NAN.1472		43 Cliff Rd	1916
NAN.1473		43 Cliff Rd	c 1915
NAN.1479		44 Cliff Rd	
NAN.1480		44 Cliff Rd	c 1930
NAN.1470	Sanford, Judge Hugh House	45 Cliff Rd	1926
NAN.1471	Sanford, Judge Hugh Guesthouse - Garage	45 Cliff Rd	1926
NAN.1478		46 Cliff Rd	c 1780
NAN.1465		47B Cliff Rd	1986
NAN.1466		47B Cliff Rd	1965
NAN.1462	Gal Greine	49 Cliff Rd	c 1840
NAN.1468	Something Natural	50 Cliff Rd	1935
NAN.1469	Something Natural Shed	50 Cliff Rd	
NAN.1460		51 Cliff Rd	c 1840
NAN.1461		51 Cliff Rd	
NAN.1463		52 Cliff Rd	1926
NAN.1464		52 Cliff Rd	
NAN.1453		53 Cliff Rd	c 1893
NAN.1454		53 Cliff Rd	c 1893
NAN.1458		54 Cliff Rd	1976

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Inv. No.	Property Name	Street	Year
NAN.1459		54 Cliff Rd	
NAN.1451	Westwind	55 Cliff Rd	1899
NAN.1452	Westwind Garage	55 Cliff Rd	
NAN.1455		56 Cliff Rd	1930
NAN.1456		56 Cliff Rd	1987
NAN.1457		56 Cliff Rd	c 1930
NAN.1446	Figment Garage	60 Cliff Rd	1965
NAN.1447	Figment	60 Cliff Rd	c 1920
NAN.1448		61 Cliff Rd	1960
NAN.1443	Tooth Acres	62 Cliff Rd	1956
NAN.1444		63 Cliff Rd	1911
NAN.1445		63 Cliff Rd	
NAN.1442		64 Cliff Rd	1925
NAN.1439		65 Cliff Rd	
NAN.1440		65 Cliff Rd	
NAN.1441		65 Cliff Rd	1950
NAN.1437		67 Cliff Rd	1989
NAN.916		68 Cliff Rd	1965
NAN.1438		68 Cliff Rd	1900
NAN.1804		68 Cliff Rd	
NAN.1805		68 Cliff Rd	c 1940
NAN.1806		68 Cliff Rd	1950
NAN.1436		69 Cliff Rd	1974
NAN.1435		71 Cliff Rd	1951
NAN.1433		72 Cliff Rd	1956
NAN.1434		73 Cliff Rd	1987
NAN.1467		74 Cliff Rd	c 1904
NAN.1432		75 Cliff Rd	1985
NAN.1430	Cliffmore	76 Cliff Rd	1965
NAN.1431	Cliffmore Garage	76 Cliff Rd	
NAN.1428		77 Cliff Rd	1930
NAN.1429		77 Cliff Rd	
NAN.1427	Misty Meadow	78 Cliff Rd	1958
NAN.1426		81 Cliff Rd	1950
NAN.1425		83 Cliff Rd	1966
NAN.1422		84 Cliff Rd	1982
NAN.1423		87 Cliff Rd	1986
NAN.1421		94 Cliff Rd	1920
NAN.1419		100 Cliff Rd	1920
NAN.1420		100 Cliff Rd	
NAN.1417	Are You Happy Now	102 Cliff Rd	1920
NAN.1418	Are You Happy Now Garage	102 Cliff Rd	1975
NAN.1414		104 Cliff Rd	1965
NAN.1403		108 Cliff Rd	1920
NAN.1404		108 Cliff Rd	1950
NAN.1400	Windrush	111 Cliff Rd	1960
NAN.1399		113 Cliff Rd	1940
NAN.1397	Middle Bear	114 Cliff Rd	1947
NAN.1398	Middle Bear Garage	114 Cliff Rd	

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Inv. No.	Property Name	Street	Year
NAN.1395		115 Cliff Rd	1920
NAN.1396		115 Cliff Rd	
NAN.1416		116 Cliff Rd	1980
NAN.1415	Nantucket Conservation Foundation Office	118 Cliff Rd	c 1950
NAN.1337		123 Cliff Rd	1900
NAN.1338		124 Cliff Rd	1947
NAN.1974		125 Cliff Rd	c 1920
NAN.1336		134 Cliff Rd	1964
NAN.922		141 Cliff Rd	
NAN.1973		141 Cliff Rd	1970
NAN.1961		142 Cliff Rd	1975
NAN.1962		144 Cliff Rd	1977
NAN.1960		150 Cliff Rd	1940
NAN.1958		152 Cliff Rd	1975
NAN.1959		154 Cliff Rd	1974
NAN.1972		154 Cliff Rd	1977
NAN.921		157 Cliff Rd	
NAN.1951		157 Cliff Rd	
NAN.1954		157 Cliff Rd	
NAN.1953		165 Cliff Rd	
NAN.1956		166 Cliff Rd	1977
NAN.1957		166 Cliff Rd	
NAN.1955		174 Cliff Rd	1985
NAN.1952		178 Cliff Rd	1980
NAN.1949		182 Cliff Rd	1980
NAN.1950		182 Cliff Rd	
NAN.1930		200 Cliff Rd	1970
NAN.1931		200 Cliff Rd	
NAN.918	Nantucket Water Tower	211 Cliff Rd	
NAN.1929		211 Cliff Rd	
NAN.2591		5 Clifton St	
NAN.2289	Sea Foam Laundry	4 Codfish Park Rd	c 1906
NAN.2290		7 Codfish Park Rd	1989
NAN.2291		12 Codfish Park Rd	
NAN.2292		12 Codfish Park Rd	c 1906
NAN.2299	Cuckoos Nest	16 Codfish Park Rd	1983
NAN.2300	Cuckoos Nest Shed	16 Codfish Park Rd	
NAN.2301	Cuckoos Nest Guesthouse	16 Codfish Park Rd	c 1938
NAN.2307		21 Codfish Park Rd	c 1938
NAN.2311	Sandyshack	24 Codfish Park Rd	c 1938
NAN.2308		25 Codfish Park Rd	c 1938
NAN.2309		25 Codfish Park Rd	
NAN.2310		25 Codfish Park Rd	
NAN.2312	King	26 Codfish Park Rd	
NAN.2313		30 Codfish Park Rd	c 1938
NAN.2318		31 Codfish Park Rd	c 1938
NAN.2319		31 Codfish Park Rd	
NAN.2314		32 Codfish Park Rd	c 1938
NAN.2315		32 Codfish Park Rd	

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Inv. No.	Property Name	Street	Year
NAN.2320		33 Codfish Park Rd	c 1939
NAN.2316	Suits Us	34 Codfish Park Rd	1938
NAN.2317	Suits Us Shed	34 Codfish Park Rd	c 1938
NAN.2323	Petrel's Rest Shed	36 Codfish Park Rd	c 1975
NAN.2324	Petrel's Rest Guesthouse	36 Codfish Park Rd	
NAN.2325	Petrel's Rest	36 Codfish Park Rd	
NAN.2669		4 Coffin St	c 1975
NAN.2840		4 Coffin St	1963
NAN.2523		5 Coffin St	c 1930
NAN.2524		5 Coffin St	c 1930
NAN.2510		9 Coffin St	c 1938
NAN.2511	Island Home	9 Coffin St	c 1938
NAN.2506	Murray Garage	14 Coffin St	c 1938
NAN.2507	Murray House	14 Coffin St	c 1953
NAN.2508	Habetrot	15 Coffin St	c 1938
NAN.2509	Habetrot Garage	15 Coffin St	c 1938
NAN.2512		22 Coffin St	c 1938
NAN.2781	Summer Salt	25 Coffin St	c 1975
NAN.2782	Summer Salt Garage	25 Coffin St	c 1975
NAN.2783		29 Coffin St	c 1975
NAN.2784	Windy Knoll	30 Coffin St	c 1938
NAN.2785	Windy Knoll Garage	30 Coffin St	c 1938
NAN.747	James, Francis - Randall, Gideon House	1 Copper Ln	c 1796
NAN.744		2 Copper Ln	c 1930
NAN.745		2 Copper Ln	c 1930
NAN.746		3 Copper Ln	c 1975
NAN.742		7 Copper Ln	c 1938
NAN.743		7 Copper Ln	c 1930
NAN.741		8 Copper Ln	c 1938
NAN.15		1 Cornish St	1950
NAN.344		5 Cornish St	1933
NAN.2186		4 Cottage Ave	c 1938
NAN.2188	Dinghy, The	5 Cottage Ave	c 1942
NAN.2165		8 Cottage Ave	c 1873
NAN.2162	Bryndham	10 Cottage Ave	c 1880
NAN.2164		11 Cottage Ave	c 1975
NAN.2180		11 Cottage Ave	c 1975
NAN.2160	Grand Central	12 Cottage Ave	c 1880
NAN.2161	Grand Central Garage	12 Cottage Ave	c 1938
NAN.2158	Bedlam	14 Cottage Ave	c 1909
NAN.2159	Bedlam Garage	14 Cottage Ave	c 1938
NAN.1963		1 Crooked Ln	1950
NAN.1964		1 Crooked Ln	
NAN.1965		7 Crooked Ln	1950
NAN.1966		7 Crooked Ln	
NAN.1967		8 Crooked Ln	1950
NAN.1968		9 Crooked Ln	1974
NAN.1969		11 Crooked Ln	1973
NAN.1971		11 Crooked Ln	1965

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Inv. No.	Property Name	Street	Year
NAN.1970		14 Crooked Ln	1940
NAN.3003	Hornbeam	1 Crows Nest Way	c 1985
NAN.3004		1 Crows Nest Way	c 1957
NAN.3002	House, The	3 Crows Nest Way	
NAN.3001	Sand Dollar	5 Crows Nest Way	
NAN.2999		6 Crows Nest Way	
NAN.3000		6 Crows Nest Way	
NAN.2996		7 Crows Nest Way	1988
NAN.2997		7 Crows Nest Way	c 1876
NAN.2998		8 Crows Nest Way	
NAN.2987	Tholepin	9 Crows Nest Way	
NAN.2988	Forestan	9 Crows Nest Way	
NAN.2989	Wauwinet Hotel Garage	10 Crows Nest Way	
NAN.2990	Crows Nest Cottages - Gudgeon	10 Crows Nest Way	
NAN.2991	Crows Nest Cottages - Tack	10 Crows Nest Way	
NAN.2992	Crows Nest Cottages - Capstan	10 Crows Nest Way	
NAN.2993	Crows Nest Cottages - Clew	10 Crows Nest Way	
NAN.2994	Crows Nest Cottage	10 Crows Nest Way	
NAN.2995	Crows Nest Cottages - Reefpoint	10 Crows Nest Way	
NAN.2986		13 Crows Nest Way	
NAN.2984		15 Crows Nest Way	
NAN.2983		17-19 Crows Nest Way	
NAN.2985		18 Crows Nest Way	
NAN.2981	Captains Quarters	23 Crows Nest Way	
NAN.2982	Sea Shell	23 Crows Nest Way	
NAN.2884	Trackside	7 Curve St	1978
NAN.1100		D St	c 1938
NAN.1101		D St	
NAN.1102		D St	c 1938
NAN.1103		D St	c 1938
NAN.1104		D St	c 1938
NAN.1098		6 D St	c 1938
NAN.1099		6 D St	c 1938
NAN.1108		7 D St	
NAN.1107		9 D St	
NAN.1106		11 D St	
NAN.1105		18 D St	
NAN.1819		2 Delaney Rd	1963
NAN.1820		2 Delaney Rd	1963
NAN.1837	Brig, The	3 Delaney Rd	1966
NAN.1839	Captain's Gig Garage	3 Delaney Rd	
NAN.1836		4 Delaney Rd	1949
NAN.1838		4 Delaney Rd	
NAN.1842		5 Delaney Rd	1966
NAN.1843	Yours Mine Garage	5 Delaney Rd	
NAN.1840		6 Delaney Rd	1940
NAN.1841		6 Delaney Rd	
NAN.1844		7 Delaney Rd	1962
NAN.1847	Nantucket Quarter	9 Delaney Rd	1968

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Inv. No.	Property Name	Street	Year
NAN.1809		10 Delaney Rd	1965
NAN.1845		10 Delaney Rd	1962
NAN.1846	Four Seasons	10 Delaney Rd	1962
NAN.1848		12 Delaney Rd	1950
NAN.1810		1 Derry Ln	1963
NAN.1812		2 Derry Ln	1978
NAN.1811		6 Derry Ln	1971
NAN.1813		8 Derry Ln	1969
NAN.1814		10 Derry Ln	1971
NAN.1833		1 Derrymore Rd	1920
NAN.1834		2 Derrymore Rd	1928
NAN.1835		2 Derrymore Rd	
NAN.1829		3 Derrymore Rd	1920
NAN.1830		3 Derrymore Rd	
NAN.1831	Nantucket	4 Derrymore Rd	1930
NAN.1832	Nantucket Garage	4 Derrymore Rd	
NAN.1826		5 Derrymore Rd	1977
NAN.1827		6 Derrymore Rd	c 1925
NAN.1828		6 Derrymore Rd	
NAN.1825	Hungry Whale, The	8 Derrymore Rd	1924
NAN.1824		10 Derrymore Rd	1961
NAN.1821		12 Derrymore Rd	1982
NAN.1822		12 Derrymore Rd	1956
NAN.1823		13 Derrymore Rd	1968
NAN.1816	Big E Nuf	15 Derrymore Rd	1968
NAN.1818		16 Derrymore Rd	1890
NAN.1815		20 Derrymore Rd	1970
NAN.1817		20 Derrymore Rd	1986
NAN.1807		25 Derrymore Rd	1986
NAN.1808		28 Derrymore Rd	1968
NAN.1802		29 Derrymore Rd	1960
NAN.1803		29 Derrymore Rd	
NAN.1800		31 Derrymore Rd	1978
NAN.1801		34 Derrymore Rd	1970
NAN.1799		38 Derrymore Rd	1963
NAN.1118	Recess Garage	9 E St	c 1938
NAN.1119	Recess	9 E St	c 1938
NAN.1116		11 E St	
NAN.1117		11 E St	
NAN.1355	Sachem Corner	1 East Hallowell Ln	1925
NAN.1356	Sachem Corner Garage - Guesthouse	1 East Hallowell Ln	
NAN.1357	Sachem Knoll	3 East Hallowell Ln	c 1930
NAN.1358	Sachem Knoll Garage - Guesthouse	3 East Hallowell Ln	c 1930
NAN.1359		11 East Hallowell Ln	1927
NAN.317		1 East Lincoln Ave	c 1930
NAN.318	Green Shutters	3 East Lincoln Ave	c 1930
NAN.321		4 East Lincoln Ave	c 1880
NAN.322		4 East Lincoln Ave	c 1930
NAN.320		5 East Lincoln Ave	c 1930

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Inv. No.	Property Name	Street	Year
NAN.323	Weather Or Not	7 East Lincoln Ave	c 1930
NAN.325	Easy Does It	11 East Lincoln Ave	c 1930
NAN.324		12 East Lincoln Ave	1948
NAN.326		13 East Lincoln Ave	1921
NAN.327	Nice 'N Easy	14 East Lincoln Ave	1948
NAN.328	Seasons Four	16 East Lincoln Ave	1985
NAN.329	Carpe Diem	17 East Lincoln Ave	c 1915
NAN.330	Carpe Diem Garage	17 East Lincoln Ave	
NAN.331		19 East Lincoln Ave	c 1930
NAN.332		19 East Lincoln Ave	
NAN.335		20 East Lincoln Ave	c 1880
NAN.336		20 East Lincoln Ave	
NAN.337		21 East Lincoln Ave	1979
NAN.338		25 East Lincoln Ave	1951
NAN.252	Sunny Port	26 East Lincoln Ave	c 1930
NAN.339	Outhouse, The	26 East Lincoln Ave	c 1930
NAN.340	Thistle Dane	27 East Lincoln Ave	1949
NAN.1915		3 East Tristam Ave	1929
NAN.1916		3 East Tristam Ave	1929
NAN.1917		3 East Tristam Ave	
NAN.1918		3 East Tristam Ave	
NAN.1919		3 East Tristam Ave	
NAN.71		1 Easton St	1890
NAN.74	Gaylor House	2 Easton St	c 1893
NAN.69		3 Easton St	1890
NAN.70		3 Easton St	1986
NAN.75	Brant Point Light Station Boathouse	6 Easton St	c 1915
NAN.68		7 Easton St	1930
NAN.66		11 Easton St	c 1915
NAN.67		11 Easton St	1900
NAN.94	Driftwood	16 Easton St	1954
NAN.95	Driftwood Garage	16 Easton St	
NAN.96		22 Easton St	
NAN.97		26 Easton St	
NAN.98		26 Easton St	1954
NAN.99		28 Easton St	
NAN.100		28 Easton St	1938
NAN.101		30 Easton St	
NAN.102		30 Easton St	1901
NAN.103		32 Easton St	1948
NAN.104		32 Easton St	1960
NAN.111		34 Easton St	1965
NAN.109		36 Easton St	1896
NAN.105		40 Easton St	1893
NAN.25		41 Easton St	1926
NAN.26	Jib	41 Easton St	c 1930
NAN.107		42 Easton St	1973
NAN.23		45 Easton St	1985
NAN.24		45 Easton St	1975

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Inv. No.	Property Name	Street	Year
NAN.106	Auburn Cottage - Coleman, Dr. Ellenwood House	46 Easton St	c 1760
NAN.108	Cuddy, The	46 Easton St	1947
NAN.368		46 Easton St	1947
NAN.21	Twin Holly	47 Easton St	1913
NAN.22	Twin Holly Shed	47 Easton St	
NAN.110		50 Easton St	1930
NAN.363	White Elephant Guesthouse	50 Easton St	1962
NAN.364	White Elephant Guesthouse	50 Easton St	1962
NAN.365	White Elephant Guesthouse	50 Easton St	1962
NAN.366	White Elephant Guesthouse	50 Easton St	1962
NAN.367	White Elephant Guesthouse	50 Easton St	1965
NAN.20		53 Easton St	1912
NAN.18		55 Easton St	1912
NAN.19		55 Easton St	
NAN.16	White Elephant Cottage	57 Easton St	1950
NAN.17	White Elephant Cottage	57 Easton St	1950
NAN.14		59 Easton St	1933
NAN.407	White Elephant Guesthouse	60 Easton St	
NAN.408	White Elephant Guesthouse	60 Easton St	
NAN.409	White Elephant Guesthouse	60 Easton St	
NAN.410	White Elephant Guesthouse	60 Easton St	
NAN.411	White Elephant Guesthouse	60 Easton St	
NAN.412	White Elephant Guesthouse	60 Easton St	
NAN.405		66 Easton St	1920
NAN.406		66 Easton St	
NAN.265	Northwind	71 Easton St	1945
NAN.266	Northwind Guesthouse	71 Easton St	c 1945
NAN.267	Northwind Guesthouse	71 Easton St	c 1945
NAN.1525	Gordon Folger Hotel, The	71 Easton St	1903
NAN.1526	Whaler Restaurant	71 Easton St	c 1930
NAN.1533	Gordon Folger, The Hotel Staff Dormitory	71 Easton St	c 1930
NAN.1524	Grouard, Dr. John House	89 Easton St	1897
NAN.2231	Morris, Capt. John House	2 Elbow Ln	r 1820
NAN.2232	Haviland Shed	2 Elbow Ln	
NAN.2224	Compass, The Guesthouse	3 Elbow Ln	
NAN.2225	Compass, The	3 Elbow Ln	c 1890
NAN.2233	Phase II	4 Elbow Ln	c 1916
NAN.2226	Svargaloka Guesthouse	5 Elbow Ln	
NAN.2227	Svargaloka - Folger, Charles C. Farm Building	5 Elbow Ln	c 1877
NAN.2234	Coffin, Nathaniel - Bernard, Eben Shed	6 Elbow Ln	
NAN.2235	Coffin, Nathaniel - Bernard, Eben House	6 Elbow Ln	c 1750
NAN.2244	Coffin, Nathaniel - Bernard, Eben Shed	6 Elbow Ln	c 1938
NAN.2228	Big Sunflower - Too Big - Big Enough	7 Elbow Ln	c 1800
NAN.2229	Too Big Shed	7 Elbow Ln	c 1938
NAN.2230	Too Big Shed	7 Elbow Ln	c 1901
NAN.2697		3 Emily St	1985
NAN.2698		3 Emily St	1988
NAN.2694	Ocean Peek	4 Emily St	c 1938
NAN.2695	Ocean Peek Garage	4 Emily St	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2696	Ocean Peek Shed	4 Emily St	
NAN.2118	Norcote Garage	1 Evelyn St	c 1938
NAN.2119	Norcote	1 Evelyn St	c 1885
NAN.2145	Fo'cas'le	2 Evelyn St	c 1885
NAN.2146	Anchorage, The	4 Evelyn St	1884
NAN.2147	Anchorage, The Garage	4 Evelyn St	c 1938
NAN.2116	Snuggery	5 Evelyn St	c 1885
NAN.2117	Very Snug	5 Evelyn St	c 1938
NAN.2148	Helm, The	6 Evelyn St	c 1892
NAN.2149	Doll House	10 Evelyn St	1886
NAN.2115	Lee Winds	11 Evelyn St	c 1893
NAN.2113	Little House, The Shed	14 Evelyn St	
NAN.2150	Little House, The	14 Evelyn St	1885
NAN.2114		15 Evelyn St	c 1938
NAN.2086	Sea Dog	4 Everett Ln	c 1896
NAN.2087	Sea Dog Garage	4 Everett Ln	c 1949
NAN.2082		5 Everett Ln	c 1906
NAN.2084	Norma	10 Everett Ln	c 1907
NAN.2085	Norma Garage	10 Everett Ln	c 1949
NAN.2083		11 Everett Ln	c 1975
NAN.1128		F St	
NAN.1129		F St	
NAN.4	Fair Street Museum	7 Fair St	1904
NAN.6	Quaker Meeting House	7 Fair St	c 1838
NAN.2356		1 Fawcett Way	
NAN.2357		1 Fawcett Way	
NAN.2354		3 Fawcett Way	
NAN.2355		3 Fawcett Way	
NAN.2358		7 Fawcett Way	c 1938
NAN.9	U. S. Post Office - Nantucket Main Branch	5 Federal St	1935
NAN.2365	Siasconset Public Restrooms	1 Folgers Ct	c 1949
NAN.2366		3 Folgers Ct	c 1949
NAN.2259		5 Folgers Ct	c 1916
NAN.2261	Eastward	6 Folgers Ct	c 1938
NAN.2262	Eastward Shed	6 Folgers Ct	c 1938
NAN.1536		Folgers Ln	1989
NAN.1537		1 Folgers Ln	1930
NAN.413		1 Franklin St	c 1938
NAN.414		1A Franklin St	c 1938
NAN.415		1A Franklin St	c 1975
NAN.416	The Whit-Coff	3 Franklin St	c 1938
NAN.417		3 Franklin St	c 1938
NAN.418		3 Franklin St	c 1975
NAN.419	Spout Off	5R Franklin St	c 1938
NAN.420		5 Franklin St	c 1940
NAN.421		5 Franklin St	c 1940
NAN.2245		3 Front St	c 1938
NAN.2242	Eastward Look - Hop Cottage	7 Front St	r 1650
NAN.2241	Mizzentop Boathouse	11 Front St	1881

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Inv. No.	Property Name	Street	Year
NAN.2240	Bluff Cottage	13 Front St	c 1880
NAN.2239	Gull's Wing	15 Front St	c 1916
NAN.2238	Seaward - Hangover House	19 Front St	c 1898
NAN.2237	Nickanoose	21 Front St	r 1800
NAN.2236	Robinson House	23 Front St	r 1800
NAN.303	Little Spouter	1 Galen Ave	c 1930
NAN.305		3 Galen Ave	1966
NAN.304	Black Shutters	4 Galen Ave	1946
NAN.307	Whale Of A Tale	5 Galen Ave	1966
NAN.306	Capella	8 Galen Ave	1976
NAN.308		12 Galen Ave	1985
NAN.333		16 Galen Ave	1970
NAN.334		16 Galen Ave	1970
NAN.540		2 Gardner St	c 1938
NAN.541	Allen, Caleb House	4 Gardner St	1824
NAN.542	Willard Hall - Women's Christian Temperance Union	4 Gardner St	c 1887
NAN.543	Sweet Pea	5 Gardner St	c 1940
NAN.544		7 Gardner St	c 1834
NAN.545		7 Gardner St	c 1915
NAN.550	Fire Hose Cart House #7 and #10	8 Gardner St	1887
NAN.546		9 Gardner St	c 1930
NAN.551	Coleman, Jonathan - Riddell, Samuel House	10 Gardner St	c 1771
NAN.552		10 Gardner St	c 1930
NAN.547		11 Gardner St	c 1887
NAN.548		11 Gardner St	c 1930
NAN.553		12 Gardner St	c 1938
NAN.554		12 Gardner St	c 1915
NAN.555		12 Gardner St	c 1892
NAN.557	Cartwright, Capt. William House	13 Gardner St	c 1800
NAN.537		14 Gardner St	c 1975
NAN.556		14 Gardner St	c 1834
NAN.558	Folger, Gideon - Smith, Allen House	15 Gardner St	1807
NAN.559	Gardner, Eliza C. H. Shed	15 Gardner St	c 1915
NAN.560	Coffin, Reuben House	18 Gardner St	1831
NAN.561	Joy, Capt. Robert House	18 Gardner St	1837
NAN.590	Gardner, Josiah House	19 Gardner St	c 1776
NAN.562		20 Gardner St	c 1938
NAN.563		23 Gardner St	c 1938
NAN.1339		14 Gosnold Rd	1965
NAN.1340		18 Gosnold Rd	1986
NAN.1343		20 Gosnold Rd	
NAN.1344	Rabbit Run	24 Gosnold Rd	c 1985
NAN.1345		26 Gosnold Rd	1920
NAN.2172	Ocean View House, The	3 Grand Ave	1876
NAN.2173		5 Grand Ave	c 1938
NAN.2174		7 Grand Ave	c 1938
NAN.2190	Yawl	8 Grand Ave	c 1949
NAN.2189	Gray Lady	10 Grand Ave	c 1942
NAN.1609	Margaret's Folly	1 Grant Ave	1870

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Inv. No.	Property Name	Street	Year
NAN.1610	Margaret's Folly Garage	1 Grant Ave	
NAN.1611		3 Grant Ave	c 1880
NAN.1612		3 Grant Ave	c 1893
NAN.1618		4 Grant Ave	c 1893
NAN.1619	Mooers, Charles C. - Gibbs, James H. House	5 Grant Ave	c 1870
NAN.1620	Lynn's Whim	6 Grant Ave	c 1893
NAN.1621		7 Grant Ave	1930
NAN.1622		9 Grant Ave	
NAN.738		5 Green Ln	c 1915
NAN.740	Starbuck, Simon Cooperage Shed - Barn	6 Green Ln	c 1890
NAN.625		1 Grove Ln	c 1922
NAN.626		3 Grove Ln	c 1922
NAN.627	Mill Pond Apartments	5 Grove Ln	c 1940
NAN.635		6 Grove Ln	c 1940
NAN.628		7A Grove Ln	c 1940
NAN.629		7B Grove Ln	c 1975
NAN.630		9 Grove Ln	c 1975
NAN.931	Bridge On Sconset Bank	Gully Rd	c 1870
NAN.2286	Down Bank Shed	3 Gully Rd	c 1975
NAN.2288	Down Bank	3 Gully Rd	c 1975
NAN.2285	Blue Peter Shed	5 Gully Rd	c 1975
NAN.2287	Blue Peter	5 Gully Rd	c 1975
NAN.1143	Nest	H St	
NAN.1147	Beach Plum	1 H St	
NAN.1146		3 H St	c 1940
NAN.1144		5 H St	
NAN.1145		5 H St	c 1950
NAN.1142	Harris Lodge	11 H St	c 1940
NAN.1353	Seaward	5 Hallowell Ln	1920
NAN.1354	Seaward Garage	5 Hallowell Ln	
NAN.1351		9 Hallowell Ln	1929
NAN.1352		9 Hallowell Ln	
NAN.1349		11 Hallowell Ln	1989
NAN.1350		11 Hallowell Ln	1989
NAN.1347	High Water Mark	13 Hallowell Ln	1928
NAN.1348	High Water Mark Guesthouse	13 Hallowell Ln	1928
NAN.1346		15 Hallowell Ln	1920
NAN.394	Safe Harbor	2 Harbor View Way	
NAN.395	Nantucket Landfall	4 Harbor View Way	
NAN.396		6 Harbor View Way	1940
NAN.397		8 Harbor View Way	c 1920
NAN.398		8 Harbor View Way	c 1930
NAN.399	Beachside	12 Harbor View Way	1940
NAN.402		12 Harbor View Way	1940
NAN.400		14 Harbor View Way	1930
NAN.401		14 Harbor View Way	1979
NAN.1669		2 Highland Ave	1970
NAN.1670		2 Highland Ave	
NAN.1634		5 Highland Ave	c 1915

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Inv. No.	Property Name	Street	Year
NAN.1632		7 Highland Ave	c 1930
NAN.1633		7 Highland Ave	
NAN.1401	Last Resort, The	2 Hinckley Ln	1900
NAN.1402	Last Resort, The Garage	2 Hinckley Ln	
NAN.914		5 Hinckley Ln	1965
NAN.1391		5 Hinckley Ln	1965
NAN.1392		5 Hinckley Ln	1965
NAN.1394	Whim House	6 Hinckley Ln	1948
NAN.1393		8 Hinckley Ln	1930
NAN.1387		10B Hinckley Ln	c 1920
NAN.1390		12 Hinckley Ln	1950
NAN.1388	Outback	14 Hinckley Ln	1918
NAN.1389	Outback Shed	14 Hinckley Ln	
NAN.1383		15 Hinckley Ln	1921
NAN.1384		15 Hinckley Ln	
NAN.1385		15 Hinckley Ln	
NAN.1386		16 Hinckley Ln	1840
NAN.1370		17 Hinckley Ln	1948
NAN.1371		17 Hinckley Ln	1948
NAN.1379		18 Hinckley Ln	
NAN.1380		18 Hinckley Ln	1971
NAN.1381	Sand Castle, The	20 Hinckley Ln	1920
NAN.1382	Sand Castle, The Garage	20 Hinckley Ln	c 1920
NAN.1375		21 Hinckley Ln	1960
NAN.1376		21 Hinckley Ln	c 1950
NAN.1377		21 Hinckley Ln	
NAN.1378		21 Hinckley Ln	
NAN.1368	Sachem Pines	22 Hinckley Ln	1927
NAN.1369	Sachem Pines Garage	22 Hinckley Ln	
NAN.1373		23 Hinckley Ln	1960
NAN.1374		23 Hinckley Ln	1960
NAN.1360	Lucy's Locket	24 Hinckley Ln	1971
NAN.1366	Sea Horse	25 Hinckley Ln	1950
NAN.1367	Sea Horse Shed	25 Hinckley Ln	1960
NAN.1365		27 Hinckley Ln	
NAN.1361		28 Hinckley Ln	1971
NAN.1362		28 Hinckley Ln	
NAN.1372	Unicorn, The	29 Hinckley Ln	1967
NAN.1363		31 Hinckley Ln	
NAN.1364		31 Hinckley Ln	
NAN.533	Holland, William Carriage House	1 Howard Ct	c 1881
NAN.534		2 Howard Ct	c 1930
NAN.535		2 Howard Ct	c 1938
NAN.536		8 Howard Ct	c 1930
NAN.524		1 Howard St	c 1930
NAN.525		3 Howard St	c 1840
NAN.526		6 Howard St	c 1840
NAN.527		7 Howard St	c 1930
NAN.528		7 Howard St	c 1915

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Inv. No.	Property Name	Street	Year
NAN.532	Monaghan, Hanna and Gertrude House - Greater Light	8 Howard St	c 1790
NAN.529	Macy, Zaccheus II House	9 Howard St	c 1750
NAN.530	Hosier Homestead Garage	9 Howard St	c 1915
NAN.167		Hulbert Ave	
NAN.206	Brant Point Pumphouse	Hulbert Ave	c 1930
NAN.88		3 Hulbert Ave	1960
NAN.89		3 Hulbert Ave	1913
NAN.90		4 Hulbert Ave	1893
NAN.91		4 Hulbert Ave	c 1985
NAN.86		5 Hulbert Ave	1985
NAN.87		5 Hulbert Ave	c 1915
NAN.84		9 Hulbert Ave	1920
NAN.85		9 Hulbert Ave	1930
NAN.81		10 Hulbert Ave	c 1904
NAN.82		10 Hulbert Ave	c 1940
NAN.83		11 Hulbert Ave	1920
NAN.79		12 Hulbert Ave	1984
NAN.64		18 Hulbert Ave	c 1945
NAN.80		19 Hulbert Ave	1900
NAN.63		20 Hulbert Ave	
NAN.78		21 Hulbert Ave	1900
NAN.62		22 Hulbert Ave	1972
NAN.65		23 Hulbert Ave	1900
NAN.56		24 Hulbert Ave	1950
NAN.57		26 Hulbert Ave	1950
NAN.58		26 Hulbert Ave	
NAN.60	Wellington - Merrill Garage	27 Hulbert Ave	1910
NAN.61	Wellington - Merrill House	27 Hulbert Ave	1898
NAN.59		28B Hulbert Ave	1977
NAN.54		29 Hulbert Ave	1906
NAN.55		29 Hulbert Ave	
NAN.53		31 Hulbert Ave	1970
NAN.50		32B Hulbert Ave	1950
NAN.51		32B Hulbert Ave	
NAN.52		33 Hulbert Ave	1950
NAN.114		34 Hulbert Ave	1900
NAN.115		36 Hulbert Ave	c 1930
NAN.49		37 Hulbert Ave	1900
NAN.3073		37 Hulbert Ave	
NAN.118		38 Hulbert Ave	1890
NAN.119		38 Hulbert Ave	c 1930
NAN.112		39 Hulbert Ave	c 1904
NAN.113	Time Flies	39 Hulbert Ave	1983
NAN.121	Channel View	42 Hulbert Ave	c 1904
NAN.116	Sea Plum	43 Hulbert Ave	1980
NAN.117		45 Hulbert Ave	1936
NAN.120		47 Hulbert Ave	1986
NAN.123		48 Hulbert Ave	1982
NAN.122		49 Hulbert Ave	1985

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Inv. No.	Property Name	Street	Year
NAN.125		50 Hulbert Ave	1915
NAN.126		50 Hulbert Ave	
NAN.124		51 Hulbert Ave	1900
NAN.127		53 Hulbert Ave	c 1930
NAN.128		54 Hulbert Ave	c 1915
NAN.129		55 Hulbert Ave	c 1915
NAN.130		55 Hulbert Ave	
NAN.132	Revival	56 Hulbert Ave	1984
NAN.133	Revival Garage	56 Hulbert Ave	
NAN.131	Blue Waters	57 Hulbert Ave	1937
NAN.134		60 Hulbert Ave	1900
NAN.281		60 Hulbert Ave	
NAN.135		61 Hulbert Ave	1924
NAN.136		61 Hulbert Ave	1987
NAN.137	Think Twice	62 Hulbert Ave	1982
NAN.277		62R Hulbert Ave	1982
NAN.138		63 Hulbert Ave	c 1915
NAN.139		63 Hulbert Ave	c 1915
NAN.140		63 Hulbert Ave	c 1915
NAN.141		64 Hulbert Ave	c 1910
NAN.275	Il Palazzo	64 Hulbert Ave	c 1930
NAN.276		64 Hulbert Ave	c 1915
NAN.144		65 Hulbert Ave	
NAN.142		66 Hulbert Ave	1922
NAN.143		66 Hulbert Ave	
NAN.145		67 Hulbert Ave	
NAN.146	Sin Bin	67 Hulbert Ave	1940
NAN.158		68 Hulbert Ave	1940
NAN.159		68 Hulbert Ave	
NAN.147		69 Hulbert Ave	1926
NAN.148		69 Hulbert Ave	1930
NAN.157		70 Hulbert Ave	
NAN.155		72 Hulbert Ave	1930
NAN.156		72 Hulbert Ave	c 1930
NAN.149	Sandandweede - Hulbert, Edwin J. House	73 Hulbert Ave	1881
NAN.150	Sandandweede Guesthouse	73 Hulbert Ave	1975
NAN.905	Sandandweede Gazebo	73 Hulbert Ave	c 1975
NAN.151	Duneover Guesthouse	75 Hulbert Ave	1928
NAN.152	Duneover Guesthouse - Garage	75 Hulbert Ave	1928
NAN.153	Duneover Boathouse	75 Hulbert Ave	1928
NAN.154	Duneover	75 Hulbert Ave	1928
NAN.202	Shoe, The	92 Hulbert Ave	1950
NAN.203		92 Hulbert Ave	1840
NAN.907		92 Hulbert Ave	c 1840
NAN.199		94 Hulbert Ave	1960
NAN.200		94A Hulbert Ave	1960
NAN.201		94A Hulbert Ave	1962
NAN.164		100 Hulbert Ave	
NAN.165		100 Hulbert Ave	

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Inv. No.	Property Name	Street	Year
NAN.166		100 Hulbert Ave	
NAN.168		100 Hulbert Ave	
NAN.169		100 Hulbert Ave	
NAN.1160	Madaket West	4 I St	
NAN.1161	Madaket West Garage	4 I St	
NAN.1157	Marsh Rose	7 I St	c 1938
NAN.1158	Marsh Rose Garage	7 I St	
NAN.1159	Marsh Rose Shed	7 I St	
NAN.1156		9 I St	
NAN.3076	Nantucket Atheneum	1 India St	
NAN.3088	Horsfield, Timothy House	17 India St	c 1800
NAN.2353	Beach Plum View	1 Jackson St	
NAN.2352	King and I, The	5 Jackson St	
NAN.2351		7 Jackson St	
NAN.2350	Eventide	8 Jackson St	c 1906
NAN.2841	Dew East	8 Jackson St	
NAN.2349		9 Jackson St	
NAN.207		6 Jefferson Ave	1950
NAN.208		6 Jefferson Ave	c 1950
NAN.209		6 Jefferson Ave	c 1950
NAN.210		6 Jefferson Ave	c 1940
NAN.186		7 Jefferson Ave	c 1970
NAN.195		7 Jefferson Ave	1986
NAN.196		7 Jefferson Ave	1986
NAN.194		9 Jefferson Ave	c 1930
NAN.193		10 Jefferson Ave	1909
NAN.205	Turnstiles	10 Jefferson Ave	
NAN.192		11 Jefferson Ave	c 1915
NAN.188		12 Jefferson Ave	1980
NAN.185		15 Jefferson Ave	1929
NAN.190		16 Jefferson Ave	1920
NAN.191		16 Jefferson Ave	c 1920
NAN.184	Dinghy, The	17 Jefferson Ave	c 1950
NAN.189		17 Jefferson Ave	c 1980
NAN.187		18 Jefferson Ave	1920
NAN.181		19 Jefferson Ave	1976
NAN.176		20 Jefferson Ave	1980
NAN.177		20 Jefferson Ave	1941
NAN.182	It'll Do	20 Jefferson Ave	c 1930
NAN.183	It'll Do Garage	20 Jefferson Ave	
NAN.180		21 Jefferson Ave	1955
NAN.171		26 Jefferson Ave	c 1930
NAN.172		26 Jefferson Ave	1924
NAN.173		26 Jefferson Ave	c 1930
NAN.174		26 Jefferson Ave	c 1930
NAN.175		26 Jefferson Ave	c 1930
NAN.178		26 Jefferson Ave	1984
NAN.179	Shack, The	26 Jefferson Ave	1930
NAN.906		26 Jefferson Ave	

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Inv. No.	Property Name	Street	Year
NAN.170		28 Jefferson Ave	1924
NAN.215		70 Jefferson Ave	1923
NAN.216		70 Jefferson Ave	
NAN.217		70 Jefferson Ave	1923
NAN.908	West Jetty	Jetties Beach	1881
NAN.1691		1 Kimball Ave	1907
NAN.1707	A Drop More	4 Kimball Ave	1964
NAN.1692		5 Kimball Ave	1946
NAN.1694		5 Kimball Ave	1946
NAN.1695		9 Kimball Ave	1983
NAN.1696		11 Kimball Ave	1989
NAN.1699		17 Kimball Ave	
NAN.1701		17 Kimball Ave	1924
NAN.1697	Windswept	18 Kimball Ave	1965
NAN.1698	Windswept Garage	18 Kimball Ave	
NAN.1700	Shiel, The Garage	19 Kimball Ave	
NAN.1702		21 Kimball Ave	1965
NAN.1703	Shiel, The	23 Kimball Ave	1984
NAN.1704	Shieling, The	25 Kimball Ave	1924
NAN.1705	Shieling, The Shed	25 Kimball Ave	
NAN.1706	Little Heather	29 Kimball Ave	1972
NAN.2417	Silver Shingles	2 King St	c 1906
NAN.2418		4 King St	c 1893
NAN.2419	Sidy By	6 King St	c 1916
NAN.2420	Side	6 King St	c 1916
NAN.2412	Coffin, Edward House	7 King St	c 1893
NAN.2413		7 King St	c 1936
NAN.2414		7 King St	c 1916
NAN.2415	Coffin, Edward Stable	7 King St	c 1893
NAN.2416	Coffin, Edward Shed	7 King St	c 1893
NAN.2423		8 King St	c 1893
NAN.2424		8 King St	c 1975
NAN.2425		8 King St	c 1949
NAN.2421	Second Time Around	9 King St	c 1938
NAN.2422	Second Time Around Garage	9 King St	c 1938
NAN.2457		10 King St	c 1916
NAN.2458		10 King St	c 1916
NAN.2426	Johnson, Fred House	11 King St	c 1916
NAN.2427	Johnson, Fred Guesthouse	11 King St	
NAN.2459	Scallop Shell	12 King St	c 1938
NAN.2460	Scallop Shell Guesthouse	12 King St	c 1938
NAN.2428	Rock-A-Bye Baby Shed	15 King St	c 1975
NAN.2429	Rock-A-Bye Baby Shed	15 King St	c 1938
NAN.2430	Rock-A-Bye Baby	15 King St	c 1938
NAN.2461		16 King St	c 1923
NAN.2462		18 King St	c 1938
NAN.2838	Clisby House	18 King St	c 1925
NAN.2463	C'rst Lci	21 King St	c 1938
NAN.2464	C'rst Lci Garage	21 King St	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2465	Cuckoo's Nest	22 King St	c 1975
NAN.2466	Cuckoo's Nest Shed	22 King St	c 1975
NAN.2467	Egan, James Shop	24 King St	
NAN.2468		24 King St	c 1975
NAN.2471		25 King St	c 1923
NAN.2472		25 King St	
NAN.2469		26 King St	
NAN.2470		26 King St	c 1923
NAN.2456		29 King St	c 1938
NAN.2454		30 King St	1938
NAN.2455		30 King St	c 1975
NAN.2451		32 King St	c 1975
NAN.2837		34 King St	c 1975
NAN.2452		35 King St	c 1938
NAN.2453		35 King St	c 1938
NAN.2450	Tunble In	36 King St	c 1975
NAN.2449		39 King St	c 1938
NAN.2447	Ship's Knee	40 King St	c 1938
NAN.2448	Wanderer	40 King St	c 1938
NAN.1424		1 Kings Way	1969
NAN.1798		3 Kings Way	1950
NAN.1797		5 Kings Way	1970
NAN.1511		1 Kite Hill Ln	c 1893
NAN.1534		3 Kite Hill Ln	1890
NAN.2	Macy, Nathaniel House	12 Liberty St	c 1745
NAN.564	Robb, Ann House	34 Liberty St	1939
NAN.565	Robb, Ann Garage	34 Liberty St	c 1939
NAN.569		36 Liberty St	c 1915
NAN.572		36 Liberty St	c 1810
NAN.566		37 Liberty St	c 1834
NAN.567		39 Liberty St	c 1834
NAN.573		40 Liberty St	c 1831
NAN.568	Nicholson, John B. House	41 Liberty St	c 1834
NAN.570		42 Liberty St	c 1950
NAN.571		42 Liberty St	c 1938
NAN.591		43 Liberty St	c 1887
NAN.2128		1 Lily St	c 1885
NAN.2163		1 Lily St	c 1938
NAN.2156	Bo'sn's Bunt, The	2 Lily St	c 1885
NAN.2129	Dinghy, The	5 Lily St	c 1938
NAN.2155	Observatory, The	6 Lily St	c 1893
NAN.2157	Observatory, The Shed	6 Lily St	
NAN.2130	Crow's Nest	7 Lily St	c 1885
NAN.2154	Observatory, The Garage - Guesthouse	8 Lily St	c 1938
NAN.2131		9 Lily St	c 1938
NAN.2153		10 Lily St	c 1975
NAN.2132	First Mate	11 Lily St	c 1938
NAN.2133	First Mate Shed	11 Lily St	
NAN.2152	Rambler, The	14 Lily St	1882

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Inv. No.	Property Name	Street	Year
NAN.2134	Underhill Cottage	15 Lily St	c 1885
NAN.2151	Captain Ebenezer	16 Lily St	c 1975
NAN.1623		1 Lincoln Ave	c 1893
NAN.1624	Crossways, The	2 Lincoln Ave	c 1893
NAN.1625	Crossways, The Guesthouse	2 Lincoln Ave	1960
NAN.1629		3 Lincoln Ave	c 1893
NAN.1630	Twin Decks	4 Lincoln Ave	c 1915
NAN.1631	Twin Decks Garage	4 Lincoln Ave	
NAN.1635		5 Lincoln Ave	1894
NAN.1637	White Chimneys	6 Lincoln Ave	c 1930
NAN.1638	White Chimneys Guest House	6 Lincoln Ave	c 1930
NAN.1639	White Chimneys Garage	6 Lincoln Ave	
NAN.1641	White Chimneys Garage	6 Lincoln Ave	
NAN.1636	Bonbright, George D. B. House	7 Lincoln Ave	c 1916
NAN.1640	Green Chimneys Guest House	8 Lincoln Ave	
NAN.1642	Green Chimneys	8 Lincoln Ave	c 1900
NAN.1643	Kimball - Gordon, George C. House	10 Lincoln Ave	1902
NAN.1646	Proudfit, Isabel Garage	10 Lincoln Ave	
NAN.1644		11 Lincoln Ave	c 1922
NAN.1645		11 Lincoln Ave	
NAN.1649	Kimball - Gordon, George C. House	12 Lincoln Ave	1902
NAN.1650	Proudfit, Isabel Garage	12 Lincoln Ave	
NAN.1647		13 Lincoln Ave	1921
NAN.1648		13 Lincoln Ave	1921
NAN.1663	Kimball House Ballroom - Gordon, George C. House	14 Lincoln Ave	1902
NAN.1664	Proudfit, Isabel Garage	14 Lincoln Ave	
NAN.1651		15 Lincoln Ave	1921
NAN.1652		15 Lincoln Ave	1921
NAN.1653		17 Lincoln Ave	
NAN.1654		17 Lincoln Ave	1909
NAN.1662		18 Lincoln Ave	1900
NAN.1655	Dolphin Bay	21 Lincoln Ave	1975
NAN.1656	Dolphin Bay Garage	21 Lincoln Ave	
NAN.1657	Oversea Garage	21 Lincoln Ave	c 1930
NAN.1658	Oversea	21 Lincoln Ave	c 1915
NAN.1659		23 Lincoln Ave	
NAN.1660		23 Lincoln Ave	c 1915
NAN.1661	Beach House	23 Lincoln Ave	
NAN.2496		4 Lincoln St	c 1938
NAN.2670		4 Lincoln St	c 1938
NAN.2671		4 Lincoln St	
NAN.2494		6 Lincoln St	c 1938
NAN.2495		6 Lincoln St	c 1938
NAN.2490		10 Lincoln St	c 1938
NAN.2491		10 Lincoln St	c 1938
NAN.2487		14 Lincoln St	1938
NAN.2488		14 Lincoln St	c 1938
NAN.2486		18 Lincoln St	c 1975
NAN.2484	Orkorwaw	22 Lincoln St	c 1975

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Inv. No.	Property Name	Street	Year
NAN.2786		22 Lincoln St	c 1975
NAN.2485		24 Lincoln St	c 1975
NAN.2595		10 Lindburg Ave	c 1938
NAN.2593		16 Lindburg Ave	c 1938
NAN.2594		16 Lindburg Ave	c 1938
NAN.2596		16 Lindburg Ave	c 1938
NAN.2592		18 Lindburg Ave	c 1938
NAN.1259		1 Little Neck Way	
NAN.1260		1 Little Neck Way	
NAN.1261	Pearly Gates	5 Little Neck Way	
NAN.2823	Port Of Call	1 Low Beach Rd	c 1923
NAN.2821	Cross Rip	3 Low Beach Rd	c 1923
NAN.2822	Cross Rip Garage	3 Low Beach Rd	c 1975
NAN.2820		7 Low Beach Rd	c 1930
NAN.2818		9 Low Beach Rd	c 1930
NAN.2819		9 Low Beach Rd	c 1930
NAN.2824		19 Low Beach Rd	c 1975
NAN.2825		29 Low Beach Rd	c 1938
NAN.2826		29 Low Beach Rd	c 1975
NAN.2817		30 Low Beach Rd	c 1975
NAN.2816	1863	31 Low Beach Rd	c 1938
NAN.2815	Ye Olde Fogfactorie	33 Low Beach Rd	c 1940
NAN.2813		35 Low Beach Rd	c 1940
NAN.2814		35 Low Beach Rd	c 1975
NAN.2812	Waterwitch	37 Low Beach Rd	c 1940
NAN.2810		39 Low Beach Rd	c 1975
NAN.2811		39 Low Beach Rd	c 1975
NAN.2836		41 Low Beach Rd	c 1975
NAN.2827	U. S. Coast Guard - Loran C Station Garage	54 Low Beach Rd	1961
NAN.2828	U. S. Coast Guard - Loran C Station Dormitory	54 Low Beach Rd	1961
NAN.2829	U. S. Coast Guard - Loran C Station Shed	54 Low Beach Rd	1961
NAN.2830	U. S. Coast Guard - Loran C Station	54 Low Beach Rd	1961
NAN.2831	U. S. Coast Guard - Loran C Station Shed	54 Low Beach Rd	1961
NAN.2835	U. S. Coast Guard - Loran C Station Bus Stop	54 Low Beach Rd	
NAN.2832	U. S. Coast Guard - Loran C Station Double Housing	74 Low Beach Rd	1961
NAN.2833	U. S. Coast Guard - Loran C Station Double Housing	74 Low Beach Rd	1961
NAN.2834	U. S. Coast Guard - Loran C Station Housing	74 Low Beach Rd	1961
NAN.656		1 Lowell Pl	c 1940
NAN.654		4 Lowell Pl	c 1940
NAN.655		4 Lowell Pl	c 1933
NAN.653		6 Lowell Pl	c 1933
NAN.763	Gardner, Charles - Lowell House	7 Lowell Pl	c 1740
NAN.764	Gardner, Charles - Lowell Shed	7 Lowell Pl	c 1938
NAN.765	Gardner, Charles - Lowell Guesthouse	7 Lowell Pl	r 1930
NAN.650		8 Lowell Pl	c 1940
NAN.651	8 Back	8 Lowell Pl	c 1940
NAN.648		10 Lowell Pl	c 1933
NAN.649		10 Lowell Pl	c 1933
NAN.646		12 Lowell Pl	c 1933

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Inv. No.	Property Name	Street	Year
NAN.647		12 Lowell Pl	c 1933
NAN.644		14 Lowell Pl	c 1940
NAN.645		14 Lowell Pl	c 1940
NAN.1205	Jus One T	6 M St	1979
NAN.1204		8 M St	
NAN.1209		8 M St	c 1938
NAN.1210		8 M St	c 1938
NAN.1044	End House	Madaket Rd	
NAN.1047	Taylor House	Madaket Rd	c 1940
NAN.1048	Jib	Madaket Rd	c 1940
NAN.1049	Skipper	Madaket Rd	c 1940
NAN.1055		Madaket Rd	c 1938
NAN.1172	On The Road	Madaket Rd	
NAN.3068	Chase Farm Barn	8 Madaket Rd	c 1870
NAN.3069	Chase Farm House	8 Madaket Rd	c 1920
NAN.3070	Chase Farm Henhouse	8 Madaket Rd	
NAN.3071	Chase Farm Storage Building	8 Madaket Rd	
NAN.1201		216 Madaket Rd	
NAN.1264		250 Madaket Rd	
NAN.1262		252 Madaket Rd	
NAN.1242		253 Madaket Rd	
NAN.1263	Moor Wind	254 Madaket Rd	
NAN.1207		255 Madaket Rd	1989
NAN.1202		259 Madaket Rd	
NAN.1265	1957 House, The	262 Madaket Rd	1957
NAN.1197	Seneca Garage	265 Madaket Rd	c 1938
NAN.1198	Seneca	265 Madaket Rd	
NAN.1199	Seneca Shed	265 Madaket Rd	c 1935
NAN.1266		266 Madaket Rd	
NAN.1268	Pasedont	270 Madaket Rd	
NAN.1191		271 Madaket Rd	c 1938
NAN.1267		274 Madaket Rd	
NAN.1269		277 Madaket Rd	
NAN.1270		282 Madaket Rd	
NAN.1271		284 Madaket Rd	
NAN.1162	Riding Light	291 Madaket Rd	1986
NAN.1163	Madaket Fire Station	293 Madaket Rd	
NAN.1272		300 Madaket Rd	
NAN.1164	Thalatta	301 Madaket Rd	c 1945
NAN.1165	Thalatta Shed	301 Madaket Rd	1989
NAN.1166		305 Madaket Rd	1984
NAN.1167	Sankaty Light Station Radar Shed	305 Madaket Rd	
NAN.1168	Sankaty Light Station Paint Locker	305 Madaket Rd	
NAN.1169		305 Madaket Rd	
NAN.1170	Admiralty Club Shed	305 Madaket Rd	
NAN.1171	Nantucket Airport Gate House	305 Madaket Rd	
NAN.1273		306 Madaket Rd	
NAN.1274		306 Madaket Rd	
NAN.1125		307 Madaket Rd	c 1938

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Inv. No.	Property Name	Street	Year
NAN.1275		308 Madaket Rd	
NAN.1276		310 Madaket Rd	
NAN.1173	Kosy Korner	311 Madaket Rd	
NAN.1174	Kosy Korner Guesthouse - Garage	311R Madaket Rd	
NAN.1277	Seawall	312 Madaket Rd	
NAN.1175	Sunbeam	313 Madaket Rd	
NAN.1176	Sunbeam Guesthouse - Garage	313 Madaket Rd	c 1975
NAN.1278		316 Madaket Rd	
NAN.1177	High and Dry	317 Madaket Rd	
NAN.1287		318 Madaket Rd	
NAN.1288		320 Madaket Rd	
NAN.1180		324 Madaket Rd	
NAN.1179	Westender	326 Madaket Rd	c 1940
NAN.1060		328 Madaket Rd	
NAN.1061		328 Madaket Rd	
NAN.1057	Spindrift	330 Madaket Rd	c 1940
NAN.1058	Spindrift Garage	330 Madaket Rd	
NAN.1059	Spindrift Shed	330 Madaket Rd	
NAN.1053	Seagull	332 Madaket Rd	
NAN.1054	Seagull Shed	332 Madaket Rd	
NAN.1062		333 Madaket Rd	c 1938
NAN.1045	Windsong	334 Madaket Rd	
NAN.1046	Windsong Garage	334 Madaket Rd	
NAN.1043	Edgewater	336B Madaket Rd	
NAN.1056		343 Madaket Rd	
NAN.2181	Sconset Inn - Moby Dick	1 Magnolia Ave	c 1916
NAN.2166	Terntoo	2 Magnolia Ave	c 1893
NAN.2138	Wild Goose, The	3 Magnolia Ave	c 1880
NAN.2167		4 Magnolia Ave	c 1893
NAN.2137		5 Magnolia Ave	c 1880
NAN.2168		6 Magnolia Ave	c 1916
NAN.2169	Good Tern, The	8 Magnolia Ave	c 1880
NAN.2170	Good Tern, The Shed	8 Magnolia Ave	
NAN.2135		9 Magnolia Ave	c 1880
NAN.2136		9 Magnolia Ave	c 1938
NAN.2171		10 Magnolia Ave	c 1880
NAN.932	Siasconset Flagpole Monument	Main St	1929
NAN.933	Larson Park	2 Main St	1979
NAN.2601	Siasconset Market	4 Main St	c 1949
NAN.2602		5 Main St	c 1949
NAN.2600	U. S. Post Office - Siasconset Branch	6 Main St	c 1890
NAN.2599	Siasconset Package Goods Store	8 Main St	c 1893
NAN.2597	East Wind	10 Main St	c 1938
NAN.2598	Claudette's	10 Main St	c 1930
NAN.2603	Road's End	12 Main St	c 1938
NAN.2604		16 Main St	c 1938
NAN.2607	Gardner, Thomas M. - Starbuck, Matthew Cottage	19 Main St	c 1848
NAN.2608	Starbuck Cottage Barn	19 Main St	c 1888
NAN.2606	Green Chimneys	20 Main St	1838

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Inv. No.	Property Name	Street	Year
NAN.2614		22 Main St	c 1838
NAN.2615		22 Main St	c 1938
NAN.2616		22 Main St	c 1938
NAN.2617		22 Main St	c 1938
NAN.2610	Rogers, George W. House	23 Main St	c 1893
NAN.2611	Rogers, George W. Guesthouse	23 Main St	c 1938
NAN.2618	Not To Worry	26 Main St	c 1838
NAN.2619	Not To Worry Shed	26 Main St	c 1906
NAN.2620	Not To Worry Shed	26 Main St	c 1906
NAN.2621	Not To Worry Shed	26 Main St	c 1916
NAN.2622	Carriage House	26 Main St	c 1888
NAN.2612	Atlantic House	27 Main St	1848
NAN.2613		27 Main St	c 1916
NAN.2624		28 Main St	c 1833
NAN.2625		28 Main St	c 1890
NAN.2626		28 Main St	c 1890
NAN.2623	Rosemary	29 Main St	1848
NAN.2627	McCreary House	30 Main St	c 1916
NAN.2628	McCreary Garage	30 Main St	c 1923
NAN.2629	Edgemoor - Laughing Gull	31 Main St	c 1848
NAN.2630	Edgemoor - Laughing Gull Barn - Garage	31 Main St	c 1916
NAN.2631	Hill Top	33 Main St	c 1848
NAN.2632	Hill Top Barn - Garage	33 Main St	c 1923
NAN.2633	Bunker Hill Farm	34 Main St	c 1837
NAN.2634	Pitman, Samuel Shed	34 Main St	c 1938
NAN.2635	Pitman, Samuel Garage	34 Main St	c 1938
NAN.2636	Top O The Hill	35 Main St	c 1888
NAN.2637	Top O The Hill Garage	35 Main St	c 1938
NAN.2639		36 Main St	c 1900
NAN.2640		36 Main St	
NAN.2638	New England Telephone Company Building	37 Main St	c 1944
NAN.2641	High Steaks Garage	38 Main St	
NAN.2642	High Steaks	38 Main St	c 1888
NAN.2644		39 Main St	c 1938
NAN.2658		39 Main St	c 1975
NAN.2643		40 Main St	c 1938
NAN.2645		42 Main St	c 1938
NAN.2646	Anchorage, The	43 Main St	c 1938
NAN.2647		46 Main St	c 1975
NAN.2648		48 Main St	c 1975
NAN.2659	Siasconset Water Department Office	50 Main St	c 1925
NAN.2660	Siasconset Water Department Office	50 Main St	c 1925
NAN.2661	Siasconset Water Department Office Shed	50 Main St	c 1938
NAN.2662	Siasconset Water Department Office Shed	50 Main St	c 1938
NAN.3077	Bunker, Jabez House	85 Main St	c 1724
NAN.3080	Bunker, Benjamin House	89 Main St	c 1748
NAN.3086	Wright - Hadwen House	94 Main St	
NAN.5	Hadwen, William House	96 Main St	1844
NAN.7	Macy, Thomas House	99 Main St	c 1770

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Inv. No.	Property Name	Street	Year
NAN.538	Starbuck, Christopher House	105 Main St	c 1690
NAN.539	Brockenridge Garage	105 Main St	c 1930
NAN.658	Monument Store	106 Main St	c 1875
NAN.520	Macy, Zaccheus - Joy, Reuben House	107 Main St	c 1748
NAN.521	Whittmore, Sarah Gardner House	108 Main St	c 1899
NAN.522	Crowell, Thomas Garage	108 Main St	c 1975
NAN.519	Joy, Capt. Reuben II House	109 Main St	c 1834
NAN.523		109 Main St	c 1881
NAN.587	Folger, Isaac H. House	110 Main St	c 1853
NAN.588		110 Main St	c 1938
NAN.515	Daggett, Margaret Gardner House	111 Main St	1746
NAN.517		112 Main St	c 1915
NAN.586		112 Main St	c 1791
NAN.514	Paddack, Capt. David House	113 Main St	1834
NAN.511		114 Main St	c 1836
NAN.512		114 Main St	c 1887
NAN.513		114 Main St	c 1887
NAN.518		114 Main St	c 1938
NAN.510	Perry, Edward House	115 Main St	c 1881
NAN.508	Cary, Edward House	117 Main St	r 1795
NAN.516	Cary, Edward Garage	117 Main St	c 1949
NAN.505		118 Main St	c 1938
NAN.507	Barnard, Capt. Thomas House	118 Main St	1805
NAN.502	Coleman, Thomas House	119 Main St	1836
NAN.506		120 Main St	c 1806
NAN.501	Coleman, Benjamin House	121 Main St	1836
NAN.499		122 Main St	c 1816
NAN.500		122 Main St	c 1938
NAN.489	Macy, George Wendell - Clasby, Elizabeth House	123 Main St	c 1834
NAN.509	Richmond, Dr. George D. House	123R Main St	c 1922
NAN.657		123 Main St	c 1975
NAN.759		123R Main St	c 1922
NAN.498		124 Main St	c 1840
NAN.762		125 Main St	
NAN.496		126 Main St	c 1750
NAN.497		126 Main St	c 1915
NAN.486	Folger, John II House	127 Main St	r 1810
NAN.487	Bunker, Albert C. Barn	127 Main St	c 1887
NAN.760		127 Main St	c 1887
NAN.761		127 Main St	
NAN.493		128 Main St	c 1938
NAN.494		128 Main St	c 1938
NAN.495		128 Main St	c 1840
NAN.485		129 Main St	c 1840
NAN.481		130 Main St	c 1938
NAN.490		130 Main St	c 1938
NAN.491		130 Main St	c 1938
NAN.492		130 Main St	c 1938
NAN.478	Lowell, Nathaniel E. Shop	131 Main St	c 1905

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Inv. No.	Property Name	Street	Year
NAN.480	Cady, Walter W. House	132 Main St	c 1925
NAN.484		132A Main St	c 1930
NAN.479		134 Main St	c 1834
NAN.482		134 Main St	c 1898
NAN.483	Johnston, Walter House	134 Main St	c 1938
NAN.732		134 Main St	c 1915
NAN.471	Hussey Garage	138 Main St	c 1938
NAN.474	Barker House	138 Main St	c 1817
NAN.589	Lowell, Nathaniel Shed	138 Main St	
NAN.476	Gardner, Richard II House	139 Main St	c 1690
NAN.477	Wood, Gladys Garage	139 Main St	c 1927
NAN.472		140 Main St	c 1940
NAN.473		140 Main St	c 1834
NAN.475	Gardner, George C. House	141 Main St	1834
NAN.469		144 Main St	c 1980
NAN.470		144 Main St	c 1825
NAN.462		145 Main St	c 1840
NAN.468		146 Main St	c 1915
NAN.488		146 Main St	c 1940
NAN.460		147 Main St	c 1900
NAN.463		147 Main St	c 1940
NAN.465	Morris, William R. Garage	148 Main St	c 1930
NAN.466		148 Main St	c 1975
NAN.467	Bunker, Thaddeus House	148 Main St	1808
NAN.455		149 Main St	c 1915
NAN.464		149 Main St	c 1940
NAN.461	Gorham, Davis II - Gardner, Andrew House	150 Main St	c 1830
NAN.459		152 Main St	c 1840
NAN.454		153 Main St	c 1915
NAN.458	Calder, Love House	154 Main St	c 1820
NAN.453	Gardner, Barnabas House	155 Main St	c 1725
NAN.456		156 Main St	c 1840
NAN.457		156 Main St	c 1900
NAN.446	Twin Castle	157 Main St	c 1940
NAN.451	Russell, W. House	158 Main St	1809
NAN.452	Russell Homestead Garage	158 Main St	c 1940
NAN.447		159 Main St	c 1940
NAN.450		160 Main St	c 1840
NAN.449		162 Main St	c 1840
NAN.448		164 Main St	c 1985
NAN.1025	Saltaway	Maine Ave	c 1975
NAN.1027		Maine Ave	
NAN.1030	Eelskin Inn	Maine Ave	c 1910
NAN.1024		6 Maine Ave	c 1975
NAN.1026	Brigadoon	8 Maine Ave	c 1975
NAN.1028		14 Maine Ave	c 1975
NAN.1029		14 Maine Ave	c 1975
NAN.770	Deux Mers	Massachusetts Ave	c 1964
NAN.771	Nest	Massachusetts Ave	c 1964

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Inv. No.	Property Name	Street	Year
NAN.776	Breaking Away	Massachusetts Ave	c 1975
NAN.777		Massachusetts Ave	c 1975
NAN.779	Be Well	Massachusetts Ave	
NAN.1011		7 Massachusetts Ave	
NAN.1012		7 Massachusetts Ave	c 1938
NAN.1010	Winter Talk	9 Massachusetts Ave	c 1955
NAN.1009	Wagon Wheels	11 Massachusetts Ave	c 1975
NAN.1007	Wheel House, The	13 Massachusetts Ave	c 1938
NAN.1008	Wheel House, The Garage	13 Massachusetts Ave	c 1975
NAN.1005		15 Massachusetts Ave	c 1938
NAN.1006		15 Massachusetts Ave	
NAN.1003	Cross Rip	17 Massachusetts Ave	c 1938
NAN.1004	Samoset	17 Massachusetts Ave	
NAN.1002		19 Massachusetts Ave	c 1938
NAN.1279		19 Massachusetts Ave	
NAN.1000	O'er the Creek	21 Massachusetts Ave	c 1938
NAN.1001	O'er the Creek Garage	21 Massachusetts Ave	
NAN.784	Jet San	22 Massachusetts Ave	c 1938
NAN.799	Oaks, The - Acorn	23 Massachusetts Ave	c 1938
NAN.783	Flotsam	24 Massachusetts Ave	
NAN.782	Windblown	26 Massachusetts Ave	
NAN.780	Coffin, Henry House	33 Massachusetts Ave	c 1938
NAN.781	Coffin, Henry Garage	33 Massachusetts Ave	
NAN.774	Westwind	36 Massachusetts Ave	c 1938
NAN.775	Westwind Garage	36 Massachusetts Ave	
NAN.772	Duck Inn	37 Massachusetts Ave	c 1938
NAN.773	Duck Inn Shed	37 Massachusetts Ave	
NAN.768	Sandcastle	45 Massachusetts Ave	c 1938
NAN.769	Sandcastle Shed	45 Massachusetts Ave	
NAN.767	Restless Sands	47 Massachusetts Ave	c 1975
NAN.404		1 McKay Way	1985
NAN.2120	Two If By Sea	1 McKinley Ave	c 1916
NAN.2121	Two If By Sea Guesthouse	1 McKinley Ave	c 1938
NAN.2122	Two If By Sea Garage	1 McKinley Ave	c 1938
NAN.2123		2 McKinley Ave	c 1930
NAN.2124		2 McKinley Ave	c 1975
NAN.2127	La Serre	4 McKinley Ave	c 1938
NAN.2125	Broadside	5 McKinley Ave	c 1938
NAN.2126	Broadside Garage	5 McKinley Ave	c 1975
NAN.2088	Buckingham Palace	15 McKinley Ave	c 1888
NAN.2074		17 McKinley Ave	c 1880
NAN.2075		18 McKinley Ave	
NAN.2073	Admiral Benbow, The	19 McKinley Ave	c 1938
NAN.2071	Davy Jones' Locker	20 McKinley Ave	c 1880
NAN.2072	Davy Jones' Locker Garage	20 McKinley Ave	c 1938
NAN.2070	Betide	21 McKinley Ave	c 1892
NAN.1038	Sea Breeze	Midland St	c 1938
NAN.1039	Sea Breeze Shed	Midland St	
NAN.1040	Scallop	Midland St	

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Inv. No.	Property Name	Street	Year
NAN.1041	Madaket Beach Privy	Midland St	
NAN.1042		Midland St	
NAN.11	Coffin Farm House	Milestone Rd	r 1880
NAN.12	Coffin Farm House	Milestone Rd	c 1822
NAN.3061	Coffin Sheep Farm Grain Storage Building	Milestone Rd	
NAN.3062	Coffin Farm Generator House	Milestone Rd	
NAN.3063	Coffin Dairy Farm Milk Can Processing Building	Milestone Rd	
NAN.3064	Coffin Farm Storage Shed	Milestone Rd	
NAN.3065	Coffin Farm Cow Barn	Milestone Rd	
NAN.3066	Coffin Farm Garage	Milestone Rd	c 1940
NAN.3067	Coffin Farm Garage	Milestone Rd	c 1972
NAN.2663	Bloomingdale Farm Guesthouse	315 Milestone Rd	c 1938
NAN.2664	Bloomingdale Farm	315 Milestone Rd	c 1950
NAN.2665		324 Milestone Rd	c 1975
NAN.2666		326 Milestone Rd	c 1975
NAN.910	Nantucket Civil War Soldiers Monument	Milk St	1874
NAN.666	Swain, Mary Starbuck House	1 Milk St	c 1815
NAN.667	Bennett Garage	1 Milk St	c 1938
NAN.668	Bennett Shed	1 Milk St	c 1938
NAN.659	Marden, Walter B. House and Plumbing Shop	2 Milk St	c 1895
NAN.664	Marden, Walter B. Plumbing Shop Garage	2 Milk St	c 1938
NAN.665		2 Milk St	c 1915
NAN.669		3 Milk St	c 1875
NAN.660		4 Milk St	c 1966
NAN.661		4 Milk St	c 1938
NAN.670	Swain, Alexander House	5 Milk St	c 1795
NAN.671	Easton Shed	5 Milk St	c 1875
NAN.673	Coffin, Thomas - Baker, David II House	7 Milk St	r 1805
NAN.662		8 Milk St	c 1938
NAN.663		8 Milk St	c 1895
NAN.674	Gardner, Prince House	9 Milk St	c 1740
NAN.675		9 Milk St	c 1915
NAN.676	Pinkham, James - Macy, Zaccheus House	10 Milk St	c 1788
NAN.680	Starbuck, Thomas II House	11 Milk St	c 1761
NAN.677	Coleman, John - Starbuck, Tristram House	12 Milk St	c 1784
NAN.678		12 Milk St	c 1938
NAN.679	Myrick, Matthew House	14 Milk St	c 1750
NAN.683		15 Milk St	c 1820
NAN.684		17 Milk St	c 1940
NAN.685		17 Milk St	c 1938
NAN.739		17 Milk St	c 1975
NAN.681	Allen, Shubael House	18 Milk St	c 1780
NAN.682	Allen, Shubael Shed	18 Milk St	c 1938
NAN.687		20 Milk St	c 1930
NAN.689		20 Milk St	c 1930
NAN.686	Gardner, Silas House	21 Milk St	c 1780
NAN.694	Fosbinder, Russel Garage	21 Milk St	c 1930
NAN.688		22 Milk St	c 1930
NAN.690	Swain, Micajah House	23 Milk St	c 1745

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Inv. No.	Property Name	Street	Year
NAN.691	Gibbs Garage	23 Milk St	c 1938
NAN.695	Bernard, Jonathan House	25 Milk St	c 1740
NAN.696		25 Milk St	c 1975
NAN.692		26 Milk St	c 1915
NAN.693	Folger, Isaiah House	26 Milk St	c 1790
NAN.697		27 Milk St	c 1904
NAN.700		28 Milk St	c 1840
NAN.701		28 Milk St	c 1904
NAN.698		29 Milk St	c 1915
NAN.699		29 Milk St	c 1930
NAN.8	1800 House	4 Mill St	r 1805
NAN.1289		31 Monomoy Rd	
NAN.1290		31 Monomoy Rd	
NAN.1294	Maury, Christopher House	33 Monomoy Rd	1988
NAN.1291	Dinsmore, Frank House	34 Monomoy Rd	1970
NAN.1292	Dinsmore, Frank Garage	34 Monomoy Rd	
NAN.1293	Aiken House	36 Monomoy Rd	1975
NAN.1295		38 Monomoy Rd	1988
NAN.1296	Kindertucket	39 Monomoy Rd	c 1920
NAN.1297	Kindertucket Garage	39 Monomoy Rd	
NAN.1302	Cross Creek	42 Monomoy Rd	c 1928
NAN.1303	Cross Creek Garage - Guesthouse	42 Monomoy Rd	c 1938
NAN.1298		45 Monomoy Rd	c 1938
NAN.1299		45 Monomoy Rd	
NAN.1300	Dead End Barn	45 Monomoy Rd	
NAN.1301		45 Monomoy Rd	c 1938
NAN.1304	Mistover	46 Monomoy Rd	c 1913
NAN.1306		48 Monomoy Rd	1986
NAN.1305	Amanda	50 Monomoy Rd	c 1913
NAN.1312	Longevity	52 Monomoy Rd	1959
NAN.1314	Longevity Garage - Guesthouse	52 Monomoy Rd	c 1959
NAN.1313	Seawinds	54 Monomoy Rd	c 1938
NAN.1315	Seawinds Garage	54 Monomoy Rd	
NAN.1316		56 Monomoy Rd	c 1960
NAN.1317		60 Monomoy Rd	c 1950
NAN.1318		61 Monomoy Rd	
NAN.1327		62 Monomoy Rd	c 1975
NAN.1328		62 Monomoy Rd	
NAN.1319		64 Monomoy Rd	c 1938
NAN.1329		64 Monomoy Rd	
NAN.1330		64 Monomoy Rd	
NAN.1320	Waters Edge	66 Monomoy Rd	c 1970
NAN.1322	Ramken	67 Monomoy Rd	c 1975
NAN.1321	Hillside	68 Monomoy Rd	c 1975
NAN.1333		69 Monomoy Rd	
NAN.1331		72 Monomoy Rd	
NAN.1323		73 Monomoy Rd	c 1938
NAN.1332		74 Monomoy Rd	c 1920
NAN.1324		76 Monomoy Rd	c 1940

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Inv. No.	Property Name	Street	Year
NAN.1325	Thomas, Moreton House	78 Monomoy Rd	c 1920
NAN.1326	Thomas, Moreton Garage	78 Monomoy Rd	c 1938
NAN.1628		7 Mooers Ave	c 1915
NAN.1627		8 Mooers Ave	c 1893
NAN.2041	Inchdarnie	3 Morey Ln	c 1930
NAN.2042		3 Morey Ln	c 1930
NAN.2043	Aloha Garage	5 Morey Ln	c 1975
NAN.2044	Aloha Guesthouse	5 Morey Ln	c 1938
NAN.2045	Aloha	5 Morey Ln	1903
NAN.2046		8 Morey Ln	c 1923
NAN.2047		8 Morey Ln	c 1923
NAN.2048		9 Morey Ln	c 1975
NAN.2049		15 Morey Ln	c 1906
NAN.2050		15 Morey Ln	c 1906
NAN.2051	Mooracre	23 Morey Ln	c 1916
NAN.2053	Mooracre Garage	23 Morey Ln	c 1916
NAN.2052		25 Morey Ln	c 1975
NAN.2057	Blissful	28 Morey Ln	c 1906
NAN.2058	Blissful Garage	28 Morey Ln	c 1916
NAN.2054		29 Morey Ln	c 1901
NAN.2055		29 Morey Ln	c 1901
NAN.2059	Rose Cottage, The	30 Morey Ln	c 1880
NAN.2056		31 Morey Ln	c 1938
NAN.2060		32 Morey Ln	c 1975
NAN.2061	Breezes, The	34 Morey Ln	c 1892
NAN.2062	Breezes, The Garage	34 Morey Ln	c 1938
NAN.2063	Pilots' House, The Garage	44 Morey Ln	
NAN.2064	Pilots' House, The	44 Morey Ln	c 1880
NAN.2065		45 Morey Ln	c 1923
NAN.2066	Ponemah	47 Morey Ln	c 1923
NAN.2067	Les Muerttes	51 Morey Ln	1908
NAN.2068	Les Muerttes Playhouse	51 Morey Ln	c 1935
NAN.2069	Les Muerttes Garage	51 Morey Ln	
NAN.1615	Islandia	3 Nantucket Ave	c 1904
NAN.1616		4 Nantucket Ave	c 1880
NAN.1617		4 Nantucket Ave	c 1930
NAN.1613	Kate's Fall	5 Nantucket Ave	c 1893
NAN.1614	Kate's Fall Shed	5 Nantucket Ave	
NAN.1626		6 Nantucket Ave	1920
NAN.939	Nantucket Sound	Nantucket Sound	
NAN.797		30 New Hampshire Ave	1975
NAN.796	Corrys	33 New Hampshire Ave	1975
NAN.1031	Bailin' Out	8 New Jersey Ave	c 1975
NAN.1032	Bailin' Out Shed	8 New Jersey Ave	
NAN.1033		9 New Jersey Ave	c 1938
NAN.1034		9 New Jersey Ave	c 1938
NAN.445		3 New Ln	c 1930
NAN.442		4 New Ln	c 1940
NAN.443		4 New Ln	c 1940

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Inv. No.	Property Name	Street	Year
NAN.440		5 New Ln	c 1930
NAN.441		6 New Ln	c 1930
NAN.436		7 New Ln	c 1932
NAN.437		7 New Ln	1932
NAN.438		7 New Ln	c 1940
NAN.435		9 New Ln	c 1940
NAN.444		9 New Ln	c 1940
NAN.433		11 New Ln	c 1940
NAN.434		11 New Ln	c 1975
NAN.439		12 New Ln	c 1975
NAN.429		14 New Ln	c 1940
NAN.430		14 New Ln	c 1940
NAN.431		15 New Ln	c 1940
NAN.432		15 New Ln	c 1975
NAN.428		18 New Ln	c 1940
NAN.426		24A New Ln	c 1940
NAN.427		24B New Ln	c 1940
NAN.801	Nantucket Old North Cemetery	26 New Ln	1746
NAN.800	Nantucket Old North Cemetery	27 New Ln	c 1858
NAN.1721	Moonbeam	30 New Ln	c 1970
NAN.1722	Moonbeam Garage	30 New Ln	
NAN.1723	Moonbeam Shed	30 New Ln	
NAN.425		31 New Ln	c 1940
NAN.748		2 New Mill St	c 1975
NAN.749		2 New Mill St	c 1975
NAN.750	Myrick, Matthew House	4 New Mill St	c 1790
NAN.755	Folger, Tristam II - Barnard, Tristram House	5 New Mill St	c 1799
NAN.756		7 New Mill St	c 1834
NAN.751		8 New Mill St	c 1980
NAN.757	Palmer, Rescom and Elizabeth House	9 New Mill St	c 1760
NAN.752		10 New Mill St	c 1825
NAN.753		12 New Mill St	c 1900
NAN.754		14 New Mill St	c 1900
NAN.924	Sconset Pump - Pump Square Monument	New St	1776
NAN.2367		1 New St	c 1838
NAN.2368		1 New St	c 1975
NAN.2370	Wood, David Store	2 New St	c 1850
NAN.2369	Srail Club	3 New St	c 1893
NAN.2373	Aldrich, Ichabod - Coffin, Capt. George W. House	5 New St	c 1835
NAN.2380	Chanticleer Inn	9 New St	c 1835
NAN.2381	Chanticleer Inn Garage	9 New St	c 1930
NAN.2382	Chanticleer Inn Office	9 New St	c 1930
NAN.2383	Chanticleer Inn Guesthouse	9 New St	c 1975
NAN.2374	Siasconset Casino	10 New St	1899
NAN.2605		10 New St	c 1916
NAN.2384	Casino Bowling Alley	11 New St	1909
NAN.2386	Spinnaker	13 New St	c 1938
NAN.2387	Spun Yarn	13 New St	c 1938
NAN.2388	Fallow	13 New St	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2385	Folger, Franklin H. - Coffin, George F. House	15 New St	c 1850
NAN.2389	Lone Maple	17 New St	
NAN.2390	Drillin' N Fillin'	17 New St	c 1938
NAN.2391		17 New St	c 1938
NAN.2379	Siaconset Union Chapel	18-20 New St	1883
NAN.2392	Sherwood	19 New St	c 1888
NAN.2396	Folger, Oscar Express Company Garage	20 New St	c 1906
NAN.2397	Folger, Oscar Express Company Garage	20 New St	c 1916
NAN.2398	Folger, Oscar Express Company Stable	20 New St	c 1906
NAN.2399	Coffin, George F. House	20 New St	c 1888
NAN.2393		21 New St	c 1888
NAN.2394	Coffin, George Frederick House	23 New St	
NAN.2395	Fluke, The Garage	23 New St	c 1938
NAN.2400		24 New St	c 1938
NAN.2409	Vollens, George A. Garage	25 New St	c 1983
NAN.2410	Nantucket Railroad Coach Shed	25 New St	c 1900
NAN.2411	Sconset School - Sconset Woodman Firewood	25 New St	c 1838
NAN.2401	Etc.	26 New St	c 1938
NAN.2402	Zinnia	26 New St	c 1938
NAN.2407		27 New St	c 1923
NAN.2408		27 New St	c 1984
NAN.2403	Hedgehog	28 New St	c 1938
NAN.2406		29 New St	c 1975
NAN.2404	Ottoldgate, Frank House	30 New St	
NAN.2405	Coffin, Ernest House	31 New St	1939
NAN.2440	Govin, M. E. Stable	32 New St	c 1923
NAN.925	Nantucket Water Tower	33 New St	1925
NAN.2441		35 New St	c 1930
NAN.2442		35 New St	c 1938
NAN.2798		40 New St	c 1975
NAN.2799		44 New St	c 1938
NAN.2808	Outer Marker, The	45 New St	1988
NAN.2809	Outer Marker, The Shed	45 New St	1988
NAN.2806		47 New St	c 1938
NAN.2807		47 New St	c 1975
NAN.2802	Eldridge, Dick House	49 New St	c 1984
NAN.2803		53 New St	1979
NAN.2804		53 New St	1989
NAN.2805		53 New St	c 1975
NAN.2800		55 New St	1989
NAN.2801		55 New St	1989
NAN.927	Broughton, William Horse Stall	59 New St	
NAN.928	Broughton, William Greenhouse	59 New St	c 1975
NAN.929	Broughton, William Greenhouse	59 New St	c 1975
NAN.2651	Broughton, William Studio - Shed	59 New St	c 1938
NAN.2652	Straight Wharf Ticket Office	59 New St	
NAN.2653	Broughton, William House	59 New St	c 1960
NAN.2654	Broughton, William Shed	59 New St	c 1938
NAN.2655	Broughton, William Shed	59 New St	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2656	Broughton, William Garage	59 New St	c 1975
NAN.2657	Broughton, William Greenhouse - Shed	59 New St	c 1989
NAN.2649	Some Nice	63 New St	c 1938
NAN.2650	Some Nice Shed	63 New St	c 1938
NAN.2667		63 New St	c 1975
NAN.2668		63 New St	c 1975
NAN.2892		3 Nobadeer Ave	
NAN.2893	Easy Corner	4 Nobadeer Ave	
NAN.2894	Easy Corner Shed	4 Nobadeer Ave	
NAN.2891		5 Nobadeer Ave	
NAN.934		8 Nobadeer Ave	
NAN.2910		Nonantum Ave	
NAN.2888		3 Nonantum Ave	
NAN.2889		6 Nonantum Ave	
NAN.2896	Tashima	10 Nonantum Ave	
NAN.935	Mannering, Mary - Wadsworth, Mary Shed	17 Nonantum Ave	
NAN.936	Mannering, Mary - Wadsworth, Mary Well House	17 Nonantum Ave	
NAN.2898	Mannering, Mary - Wadsworth, Mary Garage	17 Nonantum Ave	c 1940
NAN.2899		17 Nonantum Ave	c 1940
NAN.2900	Mannering, Mary - Wadsworth, Mary House	17 Nonantum Ave	c 1940
NAN.2901	Mannering, Mary - Wadsworth, Mary Staff Housing	17 Nonantum Ave	c 1940
NAN.2902	Mannering, Mary - Wadsworth, Mary Shed	17 Nonantum Ave	
NAN.2903	Mannering, Mary - Wadsworth, Mary Shed	17 Nonantum Ave	
NAN.2907		25 Nonantum Ave	
NAN.2908	Blue Yonder	29 Nonantum Ave	
NAN.2909	Blue Yonder Garage	29 Nonantum Ave	
NAN.2926		30 Nonantum Ave	
NAN.2911	Seagate	31 Nonantum Ave	
NAN.2912	Seagate Shed	31 Nonantum Ave	
NAN.2925		32 Nonantum Ave	
NAN.2924		34 Nonantum Ave	
NAN.2923		38 Nonantum Ave	
NAN.2913		39 Nonantum Ave	
NAN.2914		39 Nonantum Ave	
NAN.2915		41 Nonantum Ave	
NAN.2922		44 Nonantum Ave	
NAN.2916	Southwind	45 Nonantum Ave	
NAN.2920		46 Nonantum Ave	
NAN.2919		48 Nonantum Ave	
NAN.2917	Egg, The	49 Nonantum Ave	
NAN.2921		49 Nonantum Ave	
NAN.2918		50 Nonantum Ave	
NAN.1531	Springfield House Guest Boarding Stable	3 North Ave	1882
NAN.1532		3 North Ave	
NAN.1527	Russell, Samuel Jr. House	4 North Ave	1777
NAN.1528	Homestead, The	5 North Ave	c 1840
NAN.1529	Grover Garage	9 North Ave	
NAN.1530	Grover House	9 North Ave	c 1930
NAN.261	Brant Point Inn	North Beach St	1947

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Inv. No.	Property Name	Street	Year
NAN.384		North Beach St	1989
NAN.13		1 North Beach St	1980
NAN.264	West Wind - Folger Guest House	2 North Beach St	1947
NAN.270	Beachway Guesthouse	3 North Beach St	1930
NAN.346		3 North Beach St	
NAN.347		5 North Beach St	1930
NAN.268	Point Breeze	6 North Beach St	1984
NAN.269		6 North Beach St	1984
NAN.262		7 North Beach St	1930
NAN.342		7 North Beach St	
NAN.258	Atlantic Mainstay	8 North Beach St	1987
NAN.259		8 North Beach St	1987
NAN.260		9 North Beach St	
NAN.263		9 North Beach St	
NAN.341	One Board	9 North Beach St	1950
NAN.255		10 North Beach St	
NAN.256		10R North Beach St	1983
NAN.257		10 North Beach St	
NAN.250		18 North Beach St	
NAN.251	Wally's Club House	18 North Beach St	
NAN.254		19 North Beach St	c 1930
NAN.253		23 North Beach St	1937
NAN.249		27 North Beach St	1970
NAN.238	Beachside Resort Motel	30 North Beach St	1955
NAN.239		30 North Beach St	
NAN.240	Beachside Resort Motel	30 North Beach St	
NAN.241	Beachside Resort Motel	30 North Beach St	c 1985
NAN.392		35 North Beach St	1985
NAN.393		35 North Beach St	1985
NAN.236		44 North Beach St	1983
NAN.232	Sea Cliff Tennis Club Shed	48 North Beach St	
NAN.233	Sea Cliff Tennis Club Shed	48 North Beach St	
NAN.234	Sea Cliff Tennis Club Shed	48 North Beach St	
NAN.235	Sea Cliff Tennis Club	48 North Beach St	1977
NAN.231		50 North Beach St	1985
NAN.271	Mellons Place	51R North Beach St	1983
NAN.272	Mellons Place Shed	51R North Beach St	
NAN.230	Connor Sur	52 North Beach St	1986
NAN.229	Another Season	54B North Beach St	1979
NAN.237		54A North Beach St	1985
NAN.225		55 North Beach St	1950
NAN.214	East Wind	68 North Beach St	c 1920
NAN.211		72 North Beach St	1983
NAN.212		74 North Beach St	1983
NAN.213		74 North Beach St	1983
NAN.1241		2 North Cambridge St	
NAN.1239		8 North Cambridge St	c 1970
NAN.1240		8 North Cambridge St	
NAN.1238	Out-Whitted	10 North Cambridge St	c 1970

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Inv. No.	Property Name	Street	Year
NAN.1237		12 North Cambridge St	
NAN.1236	Super Shack	14 North Cambridge St	
NAN.1247		17 North Cambridge St	
NAN.1248		17 North Cambridge St	
NAN.911	M Marine Boat Yard Boat Storage	20 North Cambridge St	
NAN.912	M Marine Boat Yard Boat Storage	20 North Cambridge St	
NAN.913	M Marine Boat Yard Boat Storage	20 North Cambridge St	
NAN.1244	M Marine Boat Yard Office	20 North Cambridge St	
NAN.1245	M Marine Boat Yard Boathouse	20 North Cambridge St	
NAN.1246	M Marine Boat Yard Boathouse	20 North Cambridge St	
NAN.1249	M Marine Boat Yard Shed	20 North Cambridge St	
NAN.1250	Jog Along	21 North Cambridge St	
NAN.1251	Jog Along Garage	21 North Cambridge St	
NAN.1252	Jog Along Chicken Coop	21 North Cambridge St	
NAN.1253	Jog Along Stable	21 North Cambridge St	
NAN.1258		26 North Cambridge St	
NAN.1254		27 North Cambridge St	1976
NAN.1255		27 North Cambridge St	1927
NAN.1256	Smith, Dwight House	29 North Cambridge St	1951
NAN.1257	Smith, Dwight Shed	29 North Cambridge St	
NAN.1148		North Carolina Way	
NAN.1558		8R North Chester St	
NAN.2331		1 North Gulley Rd	
NAN.2332		1 North Gulley Rd	
NAN.2322		3 North Gulley Rd	
NAN.2321		4 North Gulley Rd	c 1939
NAN.2333		8 North Gulley Rd	
NAN.2334		8 North Gulley Rd	
NAN.1871		North Liberty St	1989
NAN.1872		North Liberty St	1989
NAN.578		2 North Liberty St	c 1916
NAN.579		2 North Liberty St	c 1916
NAN.581	Chase, Capt. Reuben II House	3 North Liberty St	r 1820
NAN.582		5 North Liberty St	c 1930
NAN.580		6 North Liberty St	c 1840
NAN.583	Spar Shed	7 North Liberty St	c 1930
NAN.584	Spar Shed Shed	7 North Liberty St	c 1938
NAN.592		8 North Liberty St	c 1892
NAN.585		9 North Liberty St	c 1938
NAN.593		11 North Liberty St	c 1915
NAN.594		13 North Liberty St	c 1930
NAN.595		13 North Liberty St	c 1930
NAN.596		13 North Liberty St	c 1938
NAN.597		15 North Liberty St	c 1915
NAN.598		16 North Liberty St	c 1935
NAN.599		19 North Liberty St	c 1834
NAN.602		24 North Liberty St	c 1938
NAN.603		24 North Liberty St	c 1938
NAN.604	Ray, Seth Cooper Shop	27 North Liberty St	c 1798

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Inv. No.	Property Name	Street	Year
NAN.600		28 North Liberty St	c 1938
NAN.605	Ray, Seth House	29 North Liberty St	1798
NAN.606	Ray, Seth Barn	29 North Liberty St	c 1938
NAN.601		30 North Liberty St	c 1938
NAN.607	Maitino, Val Antique Shop	31 North Liberty St	c 1938
NAN.608		32 North Liberty St	c 1840
NAN.613		32 North Liberty St	c 1938
NAN.610		33 North Liberty St	c 1938
NAN.611		33 North Liberty St	c 1938
NAN.609		34 North Liberty St	c 1938
NAN.612		36 North Liberty St	c 1938
NAN.614		37 North Liberty St	c 1938
NAN.615		38 North Liberty St	c 1938
NAN.616		38 North Liberty St	c 1920
NAN.624		38 North Liberty St	c 1938
NAN.617		39 North Liberty St	c 1840
NAN.621		39 North Liberty St	c 1938
NAN.619		40 North Liberty St	c 1938
NAN.618		41 North Liberty St	c 1938
NAN.620		42 North Liberty St	c 1938
NAN.1584		43 North Liberty St	c 1930
NAN.622		44 North Liberty St	c 1938
NAN.623		44 North Liberty St	c 1938
NAN.1583		45 North Liberty St	1950
NAN.1711		46 North Liberty St	c 1922
NAN.1914	Tucked In	48 North Liberty St	
NAN.1912		50 North Liberty St	1920
NAN.1913		50 North Liberty St	
NAN.1890	Berry Quaint	51 North Liberty St	r 1925
NAN.1889		53 North Liberty St	c 1920
NAN.1892		53 North Liberty St	
NAN.1891		55 North Liberty St	1920
NAN.1893		56 North Liberty St	c 1923
NAN.1885		57 North Liberty St	1925
NAN.1887		58 North Liberty St	1905
NAN.1869		60 North Liberty St	c 1925
NAN.1888		60 North Liberty St	1989
NAN.1881		61 North Liberty St	1920
NAN.1886		62 North Liberty St	1912
NAN.1880		63 North Liberty St	1950
NAN.1879		65 North Liberty St	c 1929
NAN.1873		67A North Liberty St	1930
NAN.1874		67 North Liberty St	c 1930
NAN.1882		68 North Liberty St	
NAN.1883		68 North Liberty St	
NAN.1884		68 North Liberty St	
NAN.1870		69 North Liberty St	1958
NAN.1875		70 North Liberty St	c 1920
NAN.1866		71 North Liberty St	

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Inv. No.	Property Name	Street	Year
NAN.1867		71 North Liberty St	
NAN.1876		72 North Liberty St	1924
NAN.1877		72 North Liberty St	
NAN.1878		72 North Liberty St	
NAN.1868		74 North Liberty St	1920
NAN.1864		75 North Liberty St	1982
NAN.1865		75 North Liberty St	
NAN.1861		77 North Liberty St	c 1928
NAN.1862		77 North Liberty St	c 1930
NAN.1863		77 North Liberty St	1982
NAN.1856		79 North Liberty St	1927
NAN.1857		79 North Liberty St	c 1930
NAN.1860		80 North Liberty St	1900
NAN.1853	Massachusetts State Police Barracks	83 North Liberty St	1927
NAN.1854	Massachusetts State Police Barracks Garage	83 North Liberty St	1927
NAN.1858		84 North Liberty St	1987
NAN.1859		84 North Liberty St	1900
NAN.1855		86 North Liberty St	c 1930
NAN.1852		87 North Liberty St	c 1830
NAN.1850		89 North Liberty St	1954
NAN.1851		89 North Liberty St	
NAN.1449	Gardner, Herbert Garage	90 North Liberty St	c 1930
NAN.1450	Coffin, Maj. Josiah House	90 North Liberty St	1724
NAN.1666		1 North Star Ln	1984
NAN.1668		4 North Star Ln	c 1930
NAN.1667		6 North Star Ln	1970
NAN.1671		11 North Star Ln	c 1983
NAN.1672		13 North Star Ln	
NAN.1673		13 North Star Ln	1983
NAN.2566		1 Nosegay Ln	c 1975
NAN.2565		2 Nosegay Ln	
NAN.2567		3 Nosegay Ln	c 1888
NAN.2568		3 Nosegay Ln	
NAN.2569		4 Nosegay Ln	c 1944
NAN.2570		4 Nosegay Ln	c 1938
NAN.2571		5 Nosegay Ln	c 1944
NAN.1194	Hard Ground	Oakland St	
NAN.1190		3 Oakland St	1931
NAN.1192		3 Oakland St	1931
NAN.1193	Tomtebo	7 Oakland St	
NAN.1195		12 Oakland St	
NAN.2176	Bird - Finnell Garage	1 Ocean Ave	1920
NAN.2177	Bird - Finnell Barn - Guesthouse	1 Ocean Ave	c 1930
NAN.2178	Barque	7 Ocean Ave	c 1944
NAN.2191		7R Ocean Ave	c 1942
NAN.2179	Sloop	9 Ocean Ave	c 1944
NAN.2187	Chantilly	9R Ocean Ave	c 1942
NAN.2175	Bird - Finnell House	10 Ocean Ave	c 1920
NAN.2184	Sconset Inn Guesthouse	11 Ocean Ave	c 1942

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Inv. No.	Property Name	Street	Year
NAN.2185	Sconset Inn Guesthouse	13 Ocean Ave	c 1942
NAN.2192		16 Ocean Ave	c 1938
NAN.2843	Summer House	16 Ocean Ave	c 1938
NAN.2183	Sconset Inn Guesthouse	17 Ocean Ave	c 1942
NAN.2182	Sconset Inn Cottages	19 Ocean Ave	c 1938
NAN.2111	Flying Bridge	20 Ocean Ave	c 1938
NAN.2110		21 Ocean Ave	c 1893
NAN.2109	Ye Doubbel Decker	23 Ocean Ave	c 1885
NAN.2193		24 Ocean Ave	c 1938
NAN.2107		29 Ocean Ave	c 1938
NAN.2106		33 Ocean Ave	c 1938
NAN.2104		37 Ocean Ave	c 1892
NAN.2105		37 Ocean Ave	
NAN.2101	Sheiling, The Garage	41 Ocean Ave	c 1938
NAN.2102	Sheiling, The	41 Ocean Ave	c 1896
NAN.2103	Sheiling, The Shed	41 Ocean Ave	
NAN.2099	Swallow's Nest	49 Ocean Ave	c 1880
NAN.2100	Swallow's Nest Guesthouse	49 Ocean Ave	c 1938
NAN.2842	Bird - Finnell Garage - Guesthouse	50 Ocean Ave	c 1930
NAN.2098	Windsong	51 Ocean Ave	1880
NAN.1947		8 Old Harbor Rd	1987
NAN.1948		10 Old Harbor Rd	1989
NAN.3059	Mitchell - Andrews, James S. Fish House	4 Old North Wharf	c 1847
NAN.3079	Hodges, Silvester Carpenter Shop	8 Old North Wharf	c 1861
NAN.3078	Second Congregational Meeting House	11 Orange St	1809
NAN.2371	Right Bank	7 Park Ln	c 1930
NAN.2372	Telegraph House	9 Park Ln	c 1930
NAN.198		3 Pawguet Ln	1920
NAN.197	Summer Salt	6 Pawguet Ln	1930
NAN.204		3R Pawguvet Ln	1930
NAN.1766		1 Pilgrim Rd	1960
NAN.1767		1 Pilgrim Rd	1955
NAN.1768		1 Pilgrim Rd	
NAN.1769		5 Pilgrim Rd	1974
NAN.1773		8 Pilgrim Rd	1969
NAN.1770		9 Pilgrim Rd	1975
NAN.1771		10 Pilgrim Rd	
NAN.1784		12 Pilgrim Rd	c 1950
NAN.1783		14 Pilgrim Rd	1975
NAN.1785		16 Pilgrim Rd	1989
NAN.1786		17 Pilgrim Rd	1973
NAN.1787		17 Pilgrim Rd	
NAN.1788	Summer Heath	21 Pilgrim Rd	1975
NAN.1789	Summer Heath Garage	21 Pilgrim Rd	
NAN.1790		24 Pilgrim Rd	1979
NAN.1791		24 Pilgrim Rd	1980
NAN.1792		25 Pilgrim Rd	1960
NAN.1793		26 Pilgrim Rd	1977
NAN.1794		30 Pilgrim Rd	1978

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Inv. No.	Property Name	Street	Year
NAN.1795		31 Pilgrim Rd	1975
NAN.1796		35 Pilgrim Rd	1984
NAN.2514	Allo, Victor House	4 Pitman St	c 1928
NAN.2516	Allo, Victor Greenhouse	6 Pitman St	c 1928
NAN.2518	Allo, Victor Garage - Apartment	6 Pitman St	c 1938
NAN.2515	Allo, Victor Barn	8 Pitman St	c 1938
NAN.2519		11 Pitman St	1987
NAN.2520		11 Pitman St	1987
NAN.2513	Muri-Tai	12 Pitman St	c 1982
NAN.2517	Muri-Tai Shed	12 Pitman St	c 1975
NAN.2522	A Carpenter's Awl	12 Pitman St	1973
NAN.2521		13 Pitman St	1987
NAN.2097	Barnacle	1 Pochick Ave	c 1916
NAN.2095	Nippontucket	3 Pochick Ave	c 1885
NAN.2096	Nippontucket Guesthouse	3 Pochick Ave	c 1975
NAN.2108		4 Pochick Ave	c 1893
NAN.2094	Ospray	5 Pochick Ave	c 1885
NAN.2844	House That Jack Built	6 Pochick Ave	1883
NAN.2144		8 Pochick Ave	c 1938
NAN.2092	Main Top	9 Pochick Ave	c 1885
NAN.2093	Main Top Guesthouse - Shed	9 Pochick Ave	c 1975
NAN.2090	Cockpit, The Garage	11 Pochick Ave	c 1938
NAN.2091	Cockpit, The	11 Pochick Ave	c 1930
NAN.2141	Natocket	12 Pochick Ave	c 1885
NAN.2142	Natocket Shed	12 Pochick Ave	
NAN.2143	Natocket Guesthouse	12 Pochick Ave	c 1075
NAN.2139	Quarter Deck	14 Pochick Ave	1884
NAN.2140	Quarter Deck Shed	14 Pochick Ave	
NAN.2089	Sleepy Hollow	15 Pochick Ave	c 1885
NAN.2112	Sleepy Hollow Shed	15 Pochick Ave	c 1898
NAN.2897	Sea Moor	3 Poplar St	
NAN.631		3 Powderhouse Ln	c 1940
NAN.632		5 Powderhouse Ln	c 1975
NAN.633		5 Powderhouse Ln	c 1975
NAN.634		9 Powderhouse Ln	c 1940
NAN.1772		5 Priscilla Ln	1976
NAN.1776		6 Priscilla Ln	1963
NAN.1777		6 Priscilla Ln	
NAN.1778		6 Priscilla Ln	1977
NAN.1774		7 Priscilla Ln	1967
NAN.1780		8 Priscilla Ln	1975
NAN.1781		8 Priscilla Ln	
NAN.1775	Point O View	9 Priscilla Ln	1972
NAN.1782		10 Priscilla Ln	1975
NAN.1779		11 Priscilla Ln	1979
NAN.900	Windy Hill Old Mill	50 Prospect St	1746
NAN.758		Quarter Mile Hill	c 1900
NAN.2028		50 Quidnet Rd	c 1920
NAN.2029		50 Quidnet Rd	

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Inv. No.	Property Name	Street	Year
NAN.2025		52 Quidnet Rd	
NAN.2026		52 Quidnet Rd	
NAN.2027		52 Quidnet Rd	
NAN.2024		57 Quidnet Rd	c 1938
NAN.2005		59 Quidnet Rd	
NAN.2023	Butlerege	59 Quidnet Rd	1985
NAN.2018		64 Quidnet Rd	1963
NAN.2019		64 Quidnet Rd	
NAN.2021	Quidnet Humane House Life-saving Station #56	66 Quidnet Rd	1906
NAN.2022	Hagedorn, Heman - Kimball, William L. Garage	66 Quidnet Rd	
NAN.2008	Small Change	67 Quidnet Rd	1967
NAN.2009	Small Change Shed	67 Quidnet Rd	1967
NAN.2017		68 Quidnet Rd	
NAN.2020		68 Quidnet Rd	c 1955
NAN.2015		80 Quidnet Rd	c 1938
NAN.2016		80 Quidnet Rd	
NAN.2013		84 Quidnet Rd	c 1900
NAN.2014		84 Quidnet Rd	c 1938
NAN.2011	Rickerson House	86 Quidnet Rd	c 1900
NAN.2012	Rickerson Garage	86 Quidnet Rd	c 1938
NAN.2010		88 Quidnet Rd	
NAN.3058	Rickerson House	88 Quidnet Rd	c 1900
NAN.2006		90 Quidnet Rd	1988
NAN.2007		90 Quidnet Rd	1988
NAN.2003	Pease House	94 Quidnet Rd	1909
NAN.2004		94 Quidnet Rd	1962
NAN.2001	Chimney, The	102 Quidnet Rd	c 1920
NAN.2002	Chimney, The Garage	102 Quidnet Rd	c 1938
NAN.3075	Strong, Austin House	5 Quince St	
NAN.1017		Rhode Island Ave	c 1975
NAN.1016		5 Rhode Island Ave	c 1975
NAN.1015	Tuckamotan	11 Rhode Island Ave	c 1975
NAN.1013		15 Rhode Island Ave	c 1975
NAN.1014	View Point	16 Rhode Island Ave	
NAN.1018	Pedlars Hole	17 Rhode Island Ave	c 1945
NAN.785	Next Island	23A Rhode Island Ave	
NAN.786	Beachcomber	23B Rhode Island Ave	
NAN.787	Windswept	23C Rhode Island Ave	
NAN.788		24 Rhode Island Ave	
NAN.789	Cozens	28 Rhode Island Ave	c 1975
NAN.790		29 Rhode Island Ave	
NAN.795	But-An-Ben	30 Rhode Island Ave	1975
NAN.791		31 Rhode Island Ave	
NAN.794	Key Post	32 Rhode Island Ave	c 1975
NAN.792		34 Rhode Island Ave	c 1975
NAN.778	Crotzters West	35 Rhode Island Ave	
NAN.793		36 Rhode Island Ave	c 1975
NAN.798	Ichi Ban	38 Rhode Island Ave	1975
NAN.2582	Forever Wild Garage	1 Rosaly Ln	c 1938

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Inv. No.	Property Name	Street	Year
NAN.2583		1 Rosaly Ln	c 1938
NAN.2584	Forever Wild	3 Rosaly Ln	c 1930
NAN.1341	Swamp's End	14 Sachem Rd	1920
NAN.1342	Swamp's End Garage	14 Sachem Rd	
NAN.930	Sankaty Head Lighthouse	Sankaty Head Rd	1849
NAN.2770	Sankaty Head Light Keeper's House	Sankaty Head Rd	c 1949
NAN.2574	Brig	1 Sankaty Rd	c 1916
NAN.2560		2 Sankaty Rd	c 1888
NAN.2561		2 Sankaty Rd	c 1923
NAN.2572	Brigantine	3 Sankaty Rd	c 1975
NAN.2573	Brigantine Garage	3 Sankaty Rd	c 1938
NAN.2562	Sallimac	4 Sankaty Rd	c 1923
NAN.2563		6 Sankaty Rd	c 1923
NAN.2564		6 Sankaty Rd	c 1923
NAN.926	No Doubt Greenhouse	10 Sankaty Rd	c 1975
NAN.2575	No Doubt	10 Sankaty Rd	c 1923
NAN.2576	Hedged About Garage	10 Sankaty Rd	c 1923
NAN.2577	Hedged About	10 Sankaty Rd	c 1923
NAN.2578		11 Sankaty Rd	c 1975
NAN.2579		11 Sankaty Rd	c 1975
NAN.2585	Wheel House, The	18 Sankaty Rd	c 1938
NAN.2586	Wheel House, The Garage	18 Sankaty Rd	c 1938
NAN.2580	Multiflora	19 Sankaty Rd	c 1890
NAN.2581	Multiflora Garage	19 Sankaty Rd	c 1930
NAN.2589	Keepsake	20 Sankaty Rd	c 1938
NAN.2590		22 Sankaty Rd	
NAN.2771		22 Sankaty Rd	c 1927
NAN.2587	Paddy Go Wack	23 Sankaty Rd	c 1930
NAN.2588	Paddy Go Wack Guesthouse	23 Sankaty Rd	c 1938
NAN.2773		24 Sankaty Rd	c 1938
NAN.2774		24 Sankaty Rd	c 1975
NAN.2777		24 Sankaty Rd	c 1975
NAN.2772		25 Sankaty Rd	c 1938
NAN.2778		26 Sankaty Rd	c 1938
NAN.2775		27 Sankaty Rd	c 1938
NAN.2776		27 Sankaty Rd	c 1938
NAN.2779	Widdoes Walk	31 Sankaty Rd	c 1938
NAN.2780	Widdoes Walk Garage	31 Sankaty Rd	
NAN.1975	Albright, Ralph N. Jr. House	1 Sesachacha Rd	1984
NAN.2031		2 Sesachacha Rd	c 1900
NAN.1976	Gardner, William L. House	3 Sesachacha Rd	1988
NAN.1977	Gardner, William L. Garage	3 Sesachacha Rd	1988
NAN.1978	Tuck-A-Way	6 Sesachacha Rd	c 1970
NAN.1979	1960 House	7 Sesachacha Rd	1940
NAN.1980		8 Sesachacha Rd	c 1900
NAN.1981		8 Sesachacha Rd	
NAN.1982		8 Sesachacha Rd	c 1985
NAN.1983	Homestead	9 Sesachacha Rd	c 1825
NAN.1984		11 Sesachacha Rd	c 1900

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Inv. No.	Property Name	Street	Year
NAN.1988		12 Sesachacha Rd	c 1954
NAN.1989		12 Sesachacha Rd	
NAN.1990	Woodvine	14 Sesachacha Rd	c 1850
NAN.1985	Norcross Sesachacha Trust Beach House	15 Sesachacha Rd	1968
NAN.1986	Norcross Sesachacha Trust Beach House	15 Sesachacha Rd	1963
NAN.1987		17 Sesachacha Rd	c 1985
NAN.1991		18 Sesachacha Rd	c 1900
NAN.1992		24 Sesachacha Rd	c 1938
NAN.1993		24 Sesachacha Rd	c 1900
NAN.1994		28 Sesachacha Rd	c 1900
NAN.1995		28 Sesachacha Rd	
NAN.1996		28 Sesachacha Rd	
NAN.1997		30 Sesachacha Rd	c 1900
NAN.1998	Sea Mist	34 Sesachacha Rd	c 1950
NAN.1999	Ray, Bert House	36 Sesachacha Rd	c 1880
NAN.2000	Seagull	36 Sesachacha Rd	c 1880
NAN.2040	Ray, Bert House	36 Sesachacha Rd	c 1880
NAN.2256		4 Shell St	c 1930
NAN.2257		4 Shell St	
NAN.2258		6 Shell St	c 1890
NAN.2260	Just The Ticket	14 Shell St	c 1898
NAN.2263	Castle Bandbox	16 Shell St	1814
NAN.2264	Castle Bandbox Shed	16 Shell St	1962
NAN.2265		18 Shell St	c 1907
NAN.2280		18 Shell St	c 1916
NAN.2268	Aurora Villa	25 Shell St	c 1824
NAN.2266	Little Red House, The	26 Shell St	r 1820
NAN.2269		27 Shell St	c 1930
NAN.2267	La Petite Cottage	28 Shell St	c 1898
NAN.2272	Mine	31 Shell St	c 1930
NAN.2273	Wade Cottage	33 Shell St	c 1930
NAN.2274		35 Shell St	c 1930
NAN.2270	Robin's Nest	36 Shell St	c 1975
NAN.2275		37 Shell St	c 1930
NAN.2271		38 Shell St	c 1975
NAN.2276		39 Shell St	c 1930
NAN.2281		40 Shell St	c 1944
NAN.2277		41 Shell St	c 1930
NAN.2282	Quirk Works	42 Shell St	c 1930
NAN.2283	Sea Breeze	44 Shell St	c 1888
NAN.2284	Sea Breeze Guesthouse	44 Shell St	
NAN.2278		45 Shell St	c 1888
NAN.2279		45 Shell St	c 1930
NAN.1677		2 Sherburne Tpk	1951
NAN.1678	Ocean Peek	4 Sherburne Tpk	1951
NAN.1679	Ocean Peek Shed	4 Sherburne Tpk	
NAN.1680	Ocean Peek Guesthouse	4 Sherburne Tpk	1930
NAN.1682		5 Sherburne Tpk	r 1920
NAN.1681	Point De Vue	6 Sherburne Tpk	1985

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Inv. No.	Property Name	Street	Year
NAN.1708	Wireless Cottage	7 Sherburne Tpk	1920
NAN.1710		12 Sherburne Tpk	1989
NAN.1709	Beach Gables	14 Sherburne Tpk	1957
NAN.1683		1 Sherburne Way	
NAN.1684	Sea Crest	3 Sherburne Way	
NAN.1685	Sea Crest Beach House	3 Sherburne Way	
NAN.1686		5 Sherburne Way	
NAN.1687		5 Sherburne Way	
NAN.915	Windyside Gazebo	7 Sherburne Way	
NAN.1688	Windyside	7 Sherburne Way	c 1930
NAN.1689		9 Sherburne Way	1940
NAN.1690	High Priory	11 Sherburne Way	1905
NAN.403		8 South Beach St	1920
NAN.2030		2 Squam Rd	c 1955
NAN.2034		11 Squam Rd	c 1940
NAN.2035		11 Squam Rd	c 1940
NAN.2036		11 Squam Rd	
NAN.2037		11 Squam Rd	c 1920
NAN.2032		13 Squam Rd	c 1975
NAN.2033		13 Squam Rd	
NAN.2038		17 Squam Rd	c 1940
NAN.2039		17 Squam Rd	c 1940
NAN.3006	Sea Fields	104 Squam Rd	
NAN.3007	Sea Fields Garage	104 Squam Rd	
NAN.3005		105 Squam Rd	
NAN.3008		106 Squam Rd	
NAN.2856	Surfside Lifesaving Station Captain's House	1 Station St	c 1938
NAN.2857		1 Station St	
NAN.2858		3 Station St	1929
NAN.2859		3 Station St	1935
NAN.2860		5 Station St	c 1965
NAN.3	Macy, Thomas Warehouse	10 Straight Wharf	1846
NAN.224		4 Stuarts Way	1985
NAN.218	Stone Barn	5 Stuarts Way	1889
NAN.223		6 Stuarts Way	1956
NAN.222		8 Stuarts Way	1985
NAN.219		9 Stuarts Way	1985
NAN.220		11 Stuarts Way	1985
NAN.221	Evergreen	12 Stuarts Way	1985
NAN.1586		1 Sunset Hill Ln	c 1858
NAN.1587		4 Sunset Hill Ln	c 1930
NAN.1589		6 Sunset Hill Ln	c 1930
NAN.1588		8 Sunset Hill Ln	1850
NAN.1590		8 Sunset Hill Ln	c 1930
NAN.1591		12 Sunset Hill Ln	
NAN.1592		12 Sunset Hill Ln	
NAN.1593		12 Sunset Hill Ln	
NAN.1594		12 Sunset Hill Ln	1948
NAN.1595	Coffin, Jethro House	16 Sunset Hill Ln	1686

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Inv. No.	Property Name	Street	Year
NAN.1596	Coffin, Jethro House Museum Utility Shed	16 Sunset Hill Ln	1929
NAN.1905		19 Sunset Hill Ln	c 1915
NAN.1907		19 Sunset Hill Ln	
NAN.1597		22 Sunset Hill Ln	c 1930
NAN.1598		22 Sunset Hill Ln	c 1930
NAN.1906		24 Sunset Hill Ln	c 1820
NAN.2895		154 Surfside Rd	
NAN.2890		157 Surfside Rd	
NAN.362		1 Swain St	1960
NAN.360		3 Swain St	1948
NAN.361		4 Swain St	1983
NAN.359		6 Swain St	1984
NAN.357		7 Swain St	1960
NAN.358		8 Swain St	1850
NAN.355		9 Swain St	1948
NAN.356		9 Swain St	
NAN.353		11 Swain St	1955
NAN.343		14 Swain St	c 1930
NAN.345		14 Swain St	
NAN.348	Brant Point Courtyard	14 Swain St	c 1940
NAN.354		14 Swain St	1960
NAN.349		15 Swain St	c 1930
NAN.350		15 Swain St	
NAN.351		15 Swain St	
NAN.352	Brant Point Courtyard	15 Swain St	
NAN.242	Basket Case	1 Sylvia Ln	1940
NAN.243	Basket Case Shed	1 Sylvia Ln	
NAN.248		1 Sylvia Ln	1988
NAN.245		2 Sylvia Ln	
NAN.244		3 Sylvia Ln	c 1940
NAN.246		5 Sylvia Ln	
NAN.247		5 Sylvia Ln	
NAN.1120		Tennessee Ave	
NAN.1130		Tennessee Ave	c 1938
NAN.1131	Boathouse, The	Tennessee Ave	
NAN.1140		Tennessee Ave	c 1945
NAN.1141		Tennessee Ave	
NAN.1135		9 Tennessee Ave	
NAN.1136		9 Tennessee Ave	
NAN.1132	Holiday House	10 Tennessee Ave	c 1938
NAN.1133	Hither Creek House	12 Tennessee Ave	c 1938
NAN.1134		15 Tennessee Ave	c 1938
NAN.1138		16 Tennessee Ave	c 1938
NAN.1139		16 Tennessee Ave	
NAN.1150	Anta	23 Tennessee Ave	
NAN.1149		24 Tennessee Ave	
NAN.1153		25 Tennessee Ave	c 1988
NAN.1151		26 Tennessee Ave	
NAN.1152		26 Tennessee Ave	

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Inv. No.	Property Name	Street	Year
NAN.1154		28 Tennessee Ave	
NAN.1155		28 Tennessee Ave	
NAN.1184		35 Tennessee Ave	
NAN.1185		35 Tennessee Ave	
NAN.1196		36 Tennessee Ave	c 1938
NAN.1219	Up The Creek	41 Tennessee Ave	
NAN.1220		42 Tennessee Ave	c 1938
NAN.1221		42 Tennessee Ave	1989
NAN.1222		42 Tennessee Ave	
NAN.1218	Lindsay	43 Tennessee Ave	
NAN.1211	Hither and Yon	45 Tennessee Ave	
NAN.1212	Hither and Yon Shed	45 Tennessee Ave	
NAN.1216	Casa Logo	46 Tennessee Ave	
NAN.1217	Casa Logo Shed	46 Tennessee Ave	
NAN.1213		48 Tennessee Ave	c 1936
NAN.1214	Herring Run	50 Tennessee Ave	
NAN.1215	Herring Run Shed	50 Tennessee Ave	
NAN.1208		51 Tennessee Ave	1970
NAN.1226	Whits End Garage	51 Tennessee Ave	
NAN.1223		52 Tennessee Ave	c 1920
NAN.1224		52 Tennessee Ave	
NAN.1225	Lewis, Chris Boathouse	52 Tennessee Ave	
NAN.1227		54 Tennessee Ave	
NAN.1228		54 Tennessee Ave	c 1930
NAN.1229		54 Tennessee Ave	
NAN.1232		54 Tennessee Ave	c 1920
NAN.1230		55 Tennessee Ave	c 1975
NAN.1231		55 Tennessee Ave	c 1938
NAN.1235	Small Craft	60 Tennessee Ave	c 1938
NAN.1243	B	60 Tennessee Ave	
NAN.1233	Far Out	61 Tennessee Ave	
NAN.1234		63 Tennessee Ave	c 1938
NAN.3072	Bunker, Peleg House	4 Traders Ln	c 1750
NAN.938	Hancock, Old John Building Gargoyle	Tuckernuck Island	
NAN.3009	Tuckernuck Humane Society Lifesaving Station	Tuckernuck Island	1872
NAN.3010	Norton, The House	Tuckernuck Island	c 1775
NAN.3011	Pepper Pot	Tuckernuck Island	1990
NAN.3012	Pot Luck	Tuckernuck Island	1924
NAN.3013	Smith, Edwin House	Tuckernuck Island	1880
NAN.3014	Smith, Edwin Shed	Tuckernuck Island	c 1880
NAN.3015	Smith, James Farmhouse	Tuckernuck Island	r 1825
NAN.3016	Smith, James Farmhouse Shed	Tuckernuck Island	c 1940
NAN.3017	Dunham, James Cochran - Fisher, Joseph House	Tuckernuck Island	c 1815
NAN.3018	Robinson, John Outhouse	Tuckernuck Island	c 1940
NAN.3019	Dunham, James Cochrane Eelshed	Tuckernuck Island	r 1850
NAN.3020	Dunham, James Cochrane Shop	Tuckernuck Island	r 1870
NAN.3021	Band Box, The - LaFarge, John Louis Bancel House	Tuckernuck Island	r 1850
NAN.3022	Band Box, The Outhouse	Tuckernuck Island	c 1950
NAN.3023	Chapel, Erastus House	Tuckernuck Island	1893

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Inv. No.	Property Name	Street	Year
NAN.3024	Chapel, Erastus Shed	Tuckernuck Island	r 1893
NAN.3025	Chapel, Erastus Outhouse	Tuckernuck Island	
NAN.3026	Dunham, Arthur Preston House	Tuckernuck Island	c 1898
NAN.3027	Dunham, Arthur Preston Outhouse	Tuckernuck Island	c 1898
NAN.3028	Dunham, Arthur Preston Shed	Tuckernuck Island	c 1898
NAN.3029	Sandsbury, Capt. Thomas - Alley, Capt. James House	Tuckernuck Island	c 1820
NAN.3030	Sandsbury, Capt. Thomas F. Outhouse	Tuckernuck Island	r 1850
NAN.3031	Bartlett, Franklin Generator Shed	Tuckernuck Island	2000
NAN.3032	Bartlett, Franklin Garage - Barn	Tuckernuck Island	2000
NAN.3033	Bartlett, Franklin Shed	Tuckernuck Island	c 1968
NAN.3034	North Head House, The	Tuckernuck Island	c 1820
NAN.3035	North Head House, The Shed	Tuckernuck Island	c 1924
NAN.3036	Meeting House, The	Tuckernuck Island	1921
NAN.3037	Meeting House, The Pumphouse	Tuckernuck Island	c 1921
NAN.3038	Dunham, Isaac P. House	Tuckernuck Island	c 1820
NAN.3039	Dunham, Isaac P. Shed	Tuckernuck Island	
NAN.3040	Phinney, Joseph Warren Bathhouse	Tuckernuck Island	
NAN.3041	Coffin, George Black House	Tuckernuck Island	r 1830
NAN.3042	Coffin, George Black Shed	Tuckernuck Island	r 1850
NAN.3043	East End View House Hotel Outhouse	Tuckernuck Island	c 1882
NAN.3044	Coffin, George Edward House	Tuckernuck Island	c 1886
NAN.3045	Dunham, Harry - Dunham, Edward B. House	Tuckernuck Island	1877
NAN.3046	Dunham, Harry Shed	Tuckernuck Island	r 1880
NAN.3047	Dunham, Harry Outhouse	Tuckernuck Island	r 1880
NAN.3048	Coffin, George Edward Boathouse and Fish House	Tuckernuck Island	c 1905
NAN.3049	Brooks, Edward W. House	Tuckernuck Island	1880
NAN.3050	Brooks, Edward W. Shed	Tuckernuck Island	1880
NAN.3051	LaFarge, John Louis Bancel House	Tuckernuck Island	r 1805
NAN.3052	Bigelow, William Sturgis Darkroom	Tuckernuck Island	r 1875
NAN.3054	LaFarge, Bam Boathouse	Tuckernuck Island	1977
NAN.3055	Bigelow, William Sturgis Bath House	Tuckernuck Island	c 1890
NAN.3056	LaFarge Boathouse	Tuckernuck Island	1941
NAN.3057	Sand Flea, The	Tuckernuck Island	c 1930
NAN.702	Mitchell, Maria House	1 Vestal St	1790
NAN.703	Mitchell, Maria Observatory	1 Vestal St	1908
NAN.672	Mitchell, Maria Association Library	2 Vestal St	1830
NAN.706	Mitchell, Maria Association Library	2 Vestal St	c 1890
NAN.704		3 Vestal St	c 1840
NAN.707		4 Vestal St	1939
NAN.705		5 Vestal St	c 1840
NAN.708	Starbuck, Simon Cooper Shop	6 Vestal St	c 1825
NAN.712		7 Vestal St	c 1845
NAN.709		8 Vestal St	c 1930
NAN.710		8 Vestal St	c 1930
NAN.713		9 Vestal St	c 1845
NAN.711		10 Vestal St	c 1930
NAN.714		11 Vestal St	c 1790
NAN.722	Hussey, Gorham House	13A Vestal St	c 1820
NAN.723		13A Vestal St	c 1938

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.724		13B Vestal St	c 1938
NAN.715		14 Vestal St	c 1930
NAN.716		14 Vestal St	c 1938
NAN.725	Nantucket Old Jail	15R Vestal St	c 1805
NAN.726	Nantucket Old Gaol Museum Shed	15R Vestal St	c 1946
NAN.727	Nantucket Jail Keeper's House	15 Vestal St	c 1834
NAN.728		15 Vestal St	
NAN.766		15 Vestal St	c 1938
NAN.717		16 Vestal St	c 1904
NAN.718		16 Vestal St	c 1835
NAN.729		17 Vestal St	c 1834
NAN.730		17 Vestal St	c 1938
NAN.731		17 Vestal St	c 1938
NAN.719		18 Vestal St	c 1938
NAN.720		18 Vestal St	c 1938
NAN.733		21 Vestal St	c 1925
NAN.734		21 Vestal St	c 1975
NAN.735		21R Vestal St	c 1940
NAN.721	Tiger Lily	22 Vestal St	c 1940
NAN.736		23 Vestal St	c 1930
NAN.737		23 Vestal St	c 1940
NAN.369	Fair Wind	6 Walsh St	1915
NAN.370		6 Walsh St	1933
NAN.373		7 Walsh St	1940
NAN.374		7 Walsh St	1950
NAN.371		8 Walsh St	1920
NAN.372		8 Walsh St	
NAN.375		10 Walsh St	1964
NAN.376		13 Walsh St	1979
NAN.377		15 Walsh St	1979
NAN.319		16 Walsh St	1974
NAN.378		16 Walsh St	1960
NAN.311	Quarterboat	20 Walsh St	1950
NAN.310		22 Walsh St	1960
NAN.301		24 Walsh St	1840
NAN.40	White Elephant Guesthouse	25 Walsh St	1953
NAN.315	White Elephant Guesthouse	25 Walsh St	1953
NAN.316	White Elephant Guesthouse	25 Walsh St	1953
NAN.309		27 Walsh St	1961
NAN.302		29 Walsh St	1956
NAN.299	Pupsquatchet House	30 Walsh St	1950
NAN.300	Bedside Manor	31 Walsh St	1960
NAN.295		32 Walsh St	1962
NAN.296		32 Walsh St	c 1962
NAN.298	Close-Hauled	33 Walsh St	1960
NAN.312		34 Walsh St	1974
NAN.313		34 Walsh St	1981
NAN.314		34 Walsh St	c 1930
NAN.297		35 Walsh St	1960

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MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.291	Tandem House	36 Walsh St	1925
NAN.289	Tern A Bout	38 Walsh St	1928
NAN.290	Tern A Bout Garage	38 Walsh St	
NAN.288	Greenhill	40 Walsh St	1926
NAN.293		41 Walsh St	1920
NAN.294		41 Walsh St	
NAN.285	Sunny Breeze	42 Walsh St	1925
NAN.292	Cracker Box	45 Walsh St	c 1915
NAN.282		46 Walsh St	1984
NAN.280		48 Walsh St	1984
NAN.278		50 Walsh St	1984
NAN.279		50 Walsh St	1984
NAN.286	Sandpiper	51 Walsh St	1930
NAN.287	Sandpiper Garage	51 Walsh St	
NAN.283	Elephant House	53 Walsh St	1950
NAN.284	Elephant House Guesthouse	53 Walsh St	1963
NAN.274	Scuttle Butt	56 Walsh St	1930
NAN.273		62 Walsh St	1979
NAN.917	Coffin, Tristam Homestead Marker	Washing Pond Rd	
NAN.1932		12 Washing Pond Rd	1952
NAN.1937	Swordfish	16 Washing Pond Rd	1950
NAN.1938	Swordfish Garage	16 Washing Pond Rd	
NAN.1935		18 Washing Pond Rd	
NAN.1936		18 Washing Pond Rd	1925
NAN.1933		22 Washing Pond Rd	1983
NAN.1934		22 Washing Pond Rd	1983
NAN.1939		24 Washing Pond Rd	1965
NAN.1940		24 Washing Pond Rd	
NAN.1941		26 Washing Pond Rd	1975
NAN.1942		28 Washing Pond Rd	1967
NAN.1943		34 Washing Pond Rd	
NAN.1944		34 Washing Pond Rd	1950
NAN.1945		35 Washing Pond Rd	
NAN.1946		35 Washing Pond Rd	
NAN.1178		1 Washington Ave	
NAN.1078	Humane House	3 Washington Ave	c 1845
NAN.1063	Come Hither	4 Washington Ave	c 1940
NAN.1064		6 Washington Ave	c 1928
NAN.1065		6 Washington Ave	1928
NAN.1080		7 Washington Ave	
NAN.1081		7 Washington Ave	
NAN.1109		9 Washington Ave	
NAN.1076		10 Washington Ave	
NAN.1077		10 Washington Ave	
NAN.1110		11 Washington Ave	
NAN.1111		11 Washington Ave	
NAN.1079		12 Washington Ave	
NAN.1086		12 Washington Ave	
NAN.1114	Brooks	15 Washington Ave	

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MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.1115	Brooks Garage	15 Washington Ave	
NAN.1123		17 Washington Ave	
NAN.1112	Brooks Landing	18 Washington Ave	
NAN.1113	Brooks Landing Garage	18 Washington Ave	
NAN.1124	Whispering Pines	19 Washington Ave	
NAN.1121	Queequeg	20 Washington Ave	c 1938
NAN.1122	Queequeg Garage	20 Washington Ave	c 1938
NAN.1126		24 Washington Ave	c 1938
NAN.1127		24 Washington Ave	c 1938
NAN.1137		27 Washington Ave	
NAN.1181	Bennett's	50 Washington Ave	c 1960
NAN.1182		53 Washington Ave	
NAN.1183		53 Washington Ave	
NAN.1186		55 Washington Ave	
NAN.1187		57 Washington Ave	
NAN.1188	Et Cetera	57 Washington Ave	
NAN.1189		57 Washington Ave	c 1938
NAN.1200		62 Washington Ave	
NAN.1203		68 Washington Ave	
NAN.1206	Dunleavy - Doherty House	68 Washington Ave	
NAN.2927		Wauwinet Rd	c 1957
NAN.2954	Anchorage	Wauwinet Rd	c 1909
NAN.2955	Wauwinet Hotel	Wauwinet Rd	c 1874
NAN.2972	Wauwinet Wildlife Refuge Reception Station	Wauwinet Rd	
NAN.2980		Wauwinet Rd	
NAN.2978		102 Wauwinet Rd	
NAN.2979		102 Wauwinet Rd	
NAN.2976		104 Wauwinet Rd	
NAN.2977		104 Wauwinet Rd	
NAN.2974		106 Wauwinet Rd	c 1938
NAN.2975		106 Wauwinet Rd	
NAN.2973		108 Wauwinet Rd	c 1920
NAN.2969		110 Wauwinet Rd	1893
NAN.2970		110 Wauwinet Rd	
NAN.2971		110 Wauwinet Rd	
NAN.2966		112 Wauwinet Rd	1970
NAN.2965	House On Pines	113 Wauwinet Rd	c 1911
NAN.2967	Mushroom	113 Wauwinet Rd	1984
NAN.2968	Mushroom Garage	113 Wauwinet Rd	1984
NAN.2963	Good Luck	114 Wauwinet Rd	
NAN.2964	Good Luck Garage	114 Wauwinet Rd	
NAN.2957	Wauwinet Hotel Guesthouse	115 Wauwinet Rd	c 1896
NAN.2958	Wauwinet Hotel Guesthouse	115 Wauwinet Rd	
NAN.2959	Wauwinet Hotel Guesthouse - Willet	115 Wauwinet Rd	
NAN.2960	Wauwinet Hotel Guesthouse - Idlewild	115 Wauwinet Rd	
NAN.2961	Belfry	116 Wauwinet Rd	c 1880
NAN.2962	Belfry Shed	116 Wauwinet Rd	c 1938
NAN.2951	Morgan	117R Wauwinet Rd	c 1988
NAN.2952	Wreck, The	117 Wauwinet Rd	c 1889

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MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2953	Wreck, The Boathouse	117 Wauwinet Rd	
NAN.2956	Winklehut	122 Wauwinet Rd	c 1879
NAN.2944	Mistral	123 Wauwinet Rd	
NAN.2945	Wonoma Lodge	125 Wauwinet Rd	
NAN.2946	Boathouse	127 Wauwinet Rd	
NAN.2947	Ondine	129 Wauwinet Rd	
NAN.2948	Lockup Shed	133 Wauwinet Rd	
NAN.2949	Lockup	133 Wauwinet Rd	
NAN.2939	Boynton, F. P. House	139 Wauwinet Rd	1953
NAN.2937	Martin, Everet Dean House	141 Wauwinet Rd	1923
NAN.2938	Boynton, F. P. Guesthouse	141 Wauwinet Rd	1949
NAN.2935		143 Wauwinet Rd	1928
NAN.2936		143 Wauwinet Rd	
NAN.2933	Yates Boathouse	145 Wauwinet Rd	c 1929
NAN.2934		145 Wauwinet Rd	c 1929
NAN.2932	Yates House	147 Wauwinet Rd	c 1929
NAN.2931	Sea Nip	151 Wauwinet Rd	c 1971
NAN.2930	Windhover	153 Wauwinet Rd	c 1964
NAN.2928		155 Wauwinet Rd	c 1952
NAN.2929		155 Wauwinet Rd	c 1952
NAN.2950		121 Wauwinet Way	c 1960
NAN.2943		124 Wauwinet Way	
NAN.2942		131 Wauwinet Way	
NAN.2941		135 Wauwinet Way	
NAN.2940		137 Wauwinet Way	
NAN.1909		1 Wesco Pl	1929
NAN.1910		2 Wesco Pl	c 1930
NAN.1911		6 Wesco Pl	1973
NAN.1758		West Chester St	
NAN.1551		1 West Chester St	c 1830
NAN.1552		3 West Chester St	c 1810
NAN.1553		7 West Chester St	c 1915
NAN.1557	Brayton, Robert House	8 West Chester St	c 1798
NAN.1554	Hussey, Thomas House	9 West Chester St	c 1795
NAN.1556	Hussey, Thomas Barn	9 West Chester St	
NAN.1555	Hussey, John House	11 West Chester St	1800
NAN.1559		13 West Chester St	1970
NAN.1560		15 West Chester St	c 1930
NAN.1561		15 West Chester St	
NAN.1562		17 West Chester St	c 1850
NAN.1563	Nantucket Cottage Hospital Nurses' Residence	19 West Chester St	1820
NAN.1564		19A West Chester St	c 1893
NAN.1565		19A West Chester St	
NAN.1566		20 West Chester St	1977
NAN.1896	Middle Shingle	21 West Chester St	c 1800
NAN.1894		22 West Chester St	1976
NAN.1895		22 West Chester St	
NAN.1535	Nantucket Cottage Hospital Building	23R West Chester St	1940
NAN.1897		23 West Chester St	c 1800

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MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.1898		24 West Chester St	
NAN.1899		25 West Chester St	c 1820
NAN.1900		25 West Chester St	
NAN.1901		25 West Chester St	
NAN.1903		26 West Chester St	c 1800
NAN.1904		26 West Chester St	
NAN.1569		27 West Chester St	c 1915
NAN.1570		27 West Chester St	c 1930
NAN.1571		27 West Chester St	
NAN.1567		28 West Chester St	c 1930
NAN.1568		28 West Chester St	1925
NAN.1902		28 West Chester St	1989
NAN.1572	Ramsdell, Catherine House	29 West Chester St	1925
NAN.1573		29 West Chester St	
NAN.1908		30 West Chester St	c 1930
NAN.1574		31 West Chester St	c 1930
NAN.1577	Gardner, Richard Jr. House	32R West Chester St	1722
NAN.1578	Byrne, Francis H. B. Shed	32R West Chester St	c 1930
NAN.1575		33 West Chester St	1925
NAN.1576		33 West Chester St	
NAN.1579	Ups 'N Downs	34 West Chester St	1945
NAN.1580		35 West Chester St	1928
NAN.1581		36 West Chester St	1924
NAN.1585		37 West Chester St	1953
NAN.1582		38 West Chester St	1911
NAN.1712		40 West Chester St	1950
NAN.1713		40 West Chester St	c 1920
NAN.1715		41 West Chester St	1846
NAN.1714		42 West Chester St	c 1920
NAN.1717		43 West Chester St	1972
NAN.422		44R West Chester St	c 1940
NAN.423		44R West Chester St	c 1940
NAN.424		44R West Chester St	c 1940
NAN.1716	Running Tide	44 West Chester St	1922
NAN.1718		45 West Chester St	c 1900
NAN.1719		46 West Chester St	1960
NAN.1720		48 West Chester St	c 1916
NAN.1728		49 West Chester St	1940
NAN.1729		49 West Chester St	
NAN.1730		49 West Chester St	1954
NAN.1726		50 West Chester St	1951
NAN.1727		50 West Chester St	
NAN.1731		51 West Chester St	1940
NAN.1732		51 West Chester St	1984
NAN.1733		52 West Chester St	c 1850
NAN.1734		54 West Chester St	1960
NAN.1735		55 West Chester St	1932
NAN.1736		55 West Chester St	
NAN.1737		56 West Chester St	c 1952

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MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.1738		58 West Chester St	1979
NAN.1739		60 West Chester St	1982
NAN.1740		62 West Chester St	1987
NAN.1741		63 West Chester St	c 1940
NAN.1742		63 West Chester St	c 1940
NAN.1743		63 West Chester St	1950
NAN.1744		67 West Chester St	1945
NAN.1745		67 West Chester St	
NAN.1746		67 West Chester St	
NAN.1747		71 West Chester St	1987
NAN.1748	Never-Never Land	74 West Chester St	1980
NAN.1749		76 West Chester St	1960
NAN.1750	Never Done	78 West Chester St	1960
NAN.1751	Never Done Garage	78 West Chester St	1985
NAN.1752		82 West Chester St	1985
NAN.1753		84 West Chester St	1950
NAN.1754		86 West Chester St	1987
NAN.1755		90 West Chester St	1987
NAN.1756		94 West Chester St	1984
NAN.1759		95 West Chester St	1985
NAN.1760		95 West Chester St	
NAN.1757		98 West Chester St	1979
NAN.1761	Heddens	103 West Chester St	1968
NAN.1762	Heddens Outbuilding	103 West Chester St	
NAN.1763	Heddens Garage	103 West Chester St	
NAN.1764	Heddens Shed	103 West Chester St	
NAN.1765		106 West Chester St	1984
NAN.2436	Brant Point Lighthouse Building	4 West Sankaty Rd	r 1850
NAN.2437	Low Bridge Guesthouse	4 West Sankaty Rd	c 1938
NAN.2433	Leeway	5 West Sankaty Rd	c 1930
NAN.2434	Leeway Shed	5 West Sankaty Rd	c 1938
NAN.2435	Leeway Garage	5 West Sankaty Rd	c 1938
NAN.2438		8 West Sankaty Rd	c 1916
NAN.2439		8 West Sankaty Rd	
NAN.2431	Siasconset Public School	10 West Sankaty Rd	1917
NAN.2432	Siasconset Public School Garage	10 West Sankaty Rd	c 1917
NAN.2473		12 West Sankaty Rd	c 1923
NAN.2497		13 West Sankaty Rd	c 1923
NAN.2474		14 West Sankaty Rd	c 1923
NAN.2475		14 West Sankaty Rd	c 1923
NAN.2476		16 West Sankaty Rd	c 1925
NAN.2477		16 West Sankaty Rd	c 1938
NAN.2498	Ensconst	17 West Sankaty Rd	c 1975
NAN.2499	Ensconst Garage	17 West Sankaty Rd	c 1975
NAN.2478	Nannies Folly	18 West Sankaty Rd	c 1925
NAN.2492		18 West Sankaty Rd	c 1938
NAN.2493		18 West Sankaty Rd	
NAN.2500		19 West Sankaty Rd	c 1920
NAN.2479	Why Worry	20 West Sankaty Rd	c 1925

MACRIS Search Results

Inv. No.	Property Name	Street	Year
NAN.2501	Spice Box	21 West Sankaty Rd	c 1938
NAN.2505		23 West Sankaty Rd	c 1950
NAN.2480		24 West Sankaty Rd	c 1938
NAN.2481		24 West Sankaty Rd	
NAN.2489		24 West Sankaty Rd	c 1938
NAN.2502		27 West Sankaty Rd	c 1938
NAN.2482		28 West Sankaty Rd	c 1938
NAN.2483	Patience	28 West Sankaty Rd	c 1938
NAN.2503	Evenbetter	29 West Sankaty Rd	c 1920
NAN.2504		33 West Sankaty Rd	c 1920
NAN.2878	Surfside Bath House	Western Ave	
NAN.2879	Surfside Bath House Concession Stand	Western Ave	
NAN.2880		2 Western Ave	
NAN.2876	Hull, Margery House	12 Western Ave	c 1925
NAN.2877	Hull, Margery Garage	12 Western Ave	c 1925
NAN.2874	Barrett, Ray House	13 Western Ave	1985
NAN.2875	Surf Song	14 Western Ave	
NAN.2871	Whalebone	15 Western Ave	1909
NAN.2872		16 Western Ave	c 1938
NAN.2873		16 Western Ave	
NAN.2870	Waterfront	18 Western Ave	c 1938
NAN.2869	Escape Hatch	20 Western Ave	c 1938
NAN.2867		21 Western Ave	c 1938
NAN.2868	Queen's Full	22 Western Ave	c 1930
NAN.2862	Weweeder Cottage	25 Western Ave	c 1900
NAN.2863	Weweeder Cottage Garage	25 Western Ave	c 1938
NAN.2866		28 Western Ave	
NAN.2864		30 Western Ave	1955
NAN.2865		30 Western Ave	
NAN.2848	Surfside Lifesaving Station	31 Western Ave	1874
NAN.2849	Surfside Lifesaving Station Stable	31 Western Ave	c 1921
NAN.2850	Surfside Lifesaving Station Storage Shed - Privy	31 Western Ave	c 1884
NAN.2851	Surfside Lifesaving Station Garage	31 Western Ave	c 1938
NAN.2852	Surfside Lifesaving Station Outbuilding	31 Western Ave	c 1938
NAN.2853	Columbia	32 Western Ave	c 1965
NAN.2846	Dune Moor Cottage	36 Western Ave	c 1946
NAN.2847	Dune Moor Cottage Garage	36 Western Ave	
NAN.2845	Point O'Breakers	40 Western Ave	c 1900
NAN.2854		40 Western Ave	1978
NAN.2855	Point O'Breakers Shed	40 Western Ave	
NAN.1405		3 Westmoor Ln	1940
NAN.1412	Westmoor Cottage	4 Westmoor Ln	1964
NAN.1413	Westmoor Cottage Shed	4 Westmoor Ln	
NAN.1406	Mousse Hole	5 Westmoor Ln	1940
NAN.1409	Westmoor Inn	10 Westmoor Ln	1919
NAN.1410	Westmoor Inn Garage	10 Westmoor Ln	
NAN.1411	Westmoor Inn Trailer	10 Westmoor Ln	
NAN.1407	Tennis Club	12 Westmoor Ln	1920
NAN.1408	Tennis Club Pro Shop	12 Westmoor Ln	

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Inv. No.	Property Name	Street	Year
NAN.27		3 Willard St	1914
NAN.28		3 Willard St	
NAN.29		3 Willard St	
NAN.30		7 Willard St	1980
NAN.31		9 Willard St	1983
NAN.35		12 Willard St	1980
NAN.36		12 Willard St	c 1980
NAN.38		12 Willard St	1980
NAN.32	White Elephant Guesthouse	13 Willard St	1915
NAN.33	White Elephant Guesthouse	13 Willard St	1923
NAN.34	White Elephant Guesthouse	13 Willard St	1960
NAN.37	Time Out	15 Willard St	1950
NAN.41		20 Willard St	1960
NAN.39		21 Willard St	1951
NAN.42		22 Willard St	1960
NAN.43	Salt Air	25 Willard St	c 1930
NAN.44	Salt Air Garage	25 Willard St	
NAN.45	Bella Rowe	26 Willard St	1976
NAN.46	Arcturus	26 Willard St	1976
NAN.47		30 Willard St	c 1904
NAN.48		30 Willard St	
NAN.3084	Coffin, Adm. Sir Isaac Lancastrian School	4 Winter St	1852
NAN.2906		Woodbine St	c 1950
NAN.2904	Innisfree	4 Woodbine St	
NAN.2905	Innisfree Guesthouse	4 Woodbine St	
NAN.638		6 Woodbury Ln	1988
NAN.639		6 Woodbury Ln	1988
NAN.636		9 Woodbury Ln	1988
NAN.637		9 Woodbury Ln	1988
NAN.640		10 Woodbury Ln	1989
NAN.641		18 Woodbury Ln	c 1975
NAN.642		18 Woodbury Ln	c 1940
NAN.643		18 Woodbury Ln	c 1940
NAN.652		30-34 Woodbury Ln	c 1940
NAN.1540		2 Wyers Ln	c 1893
NAN.1542		3 Wyers Ln	
NAN.1543		3 Wyers Ln	
NAN.1541		4 Wyers Ln	c 1930
NAN.1724		3 Wyers Way	c 1960
NAN.1725		3 Wyers Way	
NAN.3081	Higginbotham, Florence House	27 York St	c 1774
NAN.3082	Higginbotham, Florence Cottage	27 York St	c 1923
NAN.3083	Higginbotham, Florence Garage	27 York St	c 1923
NAN.1	African Meeting House	29 York St	c 1824

APPENDIX G: RECORD OF ADOPTION BY TOWN OF NANTUCKET

See page 2 of this document for the Certificate of Adoption.