Town of Barnstable
Massachusetts

Multi-Hazard Mitigation Plan

Prepared for the Federal Emergency Management Agency in compliance with the Disaster Mitigation Act of 2000

2010

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ACKNOWLEDGEMENTS

2010 Multi-Hazard Mitigation Plan

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Maps included in this plan were developed by staff at the Cape Cod Commission.

INTRODUCTION

The Town of Barnstable, located in Barnstable County, Massachusetts, has developed a local Multi-Hazard Mitigation Plan (MHM) to identify and profile the town's risk and vulnerability to potential natural hazards. Specifically, this plan assesses the potential impacts of hurricanes, winter storms, shoreline change/coastal erosion, earthquakes, drought/wildfire, and dam failure and identifies properties, resources, and critical facilities which may be impacted by these hazard events. The plan identifies mitigation strategies and actions aimed at reducing the loss of or damage to life, property, infrastructure and natural, cultural, and economic resources. A corresponding implementation plan has been prepared to address the prioritization and administration of the identified strategies and actions. Lastly, the plan includes a schedule for monitoring, evaluating, and updating the plan.

This plan was prepared in compliance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act and the Disaster Mitigation Act of 2000. Furthermore, this plan was developed in collaboration with the Cape Cod Commission (CCC), the Cape's regional land use planning and regulatory agency.

Purpose of the Plan

Multi-hazard mitigation is defined as any sustained action to reduce and/or eliminate short or long-term risk to life and property from natural hazards. The purpose of this plan is to lessen the impact of a disaster before it occurs and provide the following benefits to the Town of Barnstable:

1. Protect lives and reduce social, emotional, and economic disruption following a disaster event;
2. Prevent the loss of property, infrastructure, and natural and cultural resources from natural disasters;
3. Increase public awareness of risk and vulnerability to natural disasters;
4. Increase access to funding sources for hazard mitigation projects; and
5. Improve the ability to implement post-disaster recovery projects.

These disaster mitigation goals are an effort to reduce or avoid both short and long-term vulnerabilities to the identified hazards. The objectives of the proposed mitigation strategies will include a section that identifies specific mitigation actions and analysis to reduce the effects of each hazard with particular attention on new and existing buildings and structures.

The Planning Process

The Planning Team

The multi-hazard mitigation planning team consisted of representatives from a comprehensive range of Town Departments and local agencies dealing with issues related to hazard mitigation and risk assessment. The team was comprised of the following members:

Airport: Roland Breault, Airport Manager

Building Department: Paul Roma, Building Inspector

Conservation Department: Rob Gatewood, Conservation Administrator

Department of Public Works: Bob Canevazzi, Engineer

Growth Management Department: Jo Anne Miller Buntich, Director

Harbor Master: Joe Gibbs, Assistant Harbormaster

West Barnstable Fire Department: Chief David Paananen and Assistant Chief Ron Goodale

COMM Fire District: Chief John Farrington

Barnstable Fire Department: Chief Robert Crosby

The Planning Process

The Town's Growth Management Department (GMD) was assigned the task of overseeing the development of the plan. The GMD convened the above Multi-Hazard Mitigation planning team (MHM team) to identify and evaluate hazards, risks, and vulnerabilities and recommend and prioritize mitigation actions.

The MHM team was originally assembled in 2004, in conjunction with the Cape Cod Commission's initiative to develop a multi-jurisdictional multi-hazard mitigation plan in compliance with the Disaster Management Act of 2000. The Town of Barnstable GMD completed a considerable amount of work on a local MHM plan during 2004, but the plan was never locally adopted or submitted to FEMA for certification. The GMD resumed the MHM planning process in 2010 by reviewing and updating the original draft of the plan and reconvening the MHM team. The following provides a summary of the planning process.

The MHM team first identified and reviewed the goals of the multi-hazard mitigation plan for the Town of Barnstable and reviewed the natural hazards that could potentially affect the Town. In the initial planning stages, the MHM team accomplished the following:

- A review of a history of past events, which are represented primarily by the Regional Hazard Risk Maps.
- An evaluation of the risk or frequency of each hazard occurring.
- An evaluation of the potential extent, or severity, of each identified hazard.
- A determination of the scope of potential damage that could be inflicted by each identified hazard.

The MHM team reviewed the Town's overall vulnerability to the hazards addressed in this plan and the Hazard Identification Matrix to ensure the scope and severity of potential disasters were accurately represented. The team reviewed the Risk and Vulnerability Assessment Map and Regional Hazard Risk Maps (Appendix A) to ensure they represented all specific geographic locations that are vulnerable for the identified hazards. An existing list of critical facilities was reviewed, updated, and analyzed for this plan. The Town's GIS department conducted an analysis of structures vulnerable to flooding. Finally, the Town's participation in the National Flood Insurance Program was reviewed.

Existing plans and policies were reviewed for goals and action items directly related to hazard mitigation. Additional mitigation actions were identified through interviews with department representatives and by members of the MHM team. Mitigation actions were analyzed by the MHM team through the STAPLEE process; actions were evaluated and prioritized based on the Town of Barnstable's existing fiscal, political, and social environment.

Regional Cooperation

The Cape Cod Commission (CCC) led a regional effort to develop a multi-jurisdictional hazard mitigation plan for Barnstable County. The Barnstable County Natural Hazards Pre-Disaster Mitigation Plan (the Regional PDM plan) addresses natural hazards affecting all of Cape Cod. The Town of Barnstable has maintained continuing representation on the regional Multiple Hazard Community Planning Team. The regional team consists of representatives from all 15 Cape Cod communities and representatives from regional environmental, social, and emergency management groups. The CCC began the process to update the 2004 regional plan in June of 2009 and has provided ongoing technical support for the development of this, and other local plans.

The CCC also provided GIS support for this plan. The Hazard Risk Maps and the Risk and Vulnerability Assessment Map (Appendix A) were obtained from the CCC and developed as part of the FEMA-funded *Project Impact Cape Cod* initiative. The CCC continually maintains the data; the maps presented here reflect the most current and best available data.

Public Participation

This plan was formulated and reviewed by the Town's MHM Team, but also benefited from review by the general public. The public review process was essential to the development of an inclusive and effective plan. A draft of the plan was made available for review on the Town website on August 6, 2010 and a public comment period was open through September 13, 2010. Availability of the plan for review was advertised through various channels, including Town newsletters and cable TV stations.

This plan was also made available to a wide range of local officials for review and comment, including the School Superintendent, Police Chief, Water Departments, and Director of Health. These officials, along with other members of the MHM Team, aided in the final review and distribution of the draft plan to interested parties.

Finally, the plan was presented to the Town of Barnstable Planning Board at its September 13, 2010 meeting. The contents of the plan were reviewed with the Board at a televised hearing.

The plan underwent a final revision process based on comments from the public, the Cape Cod Commission, the Planning Board, and other interested parties. Several revisions were made to ensure the plan was consistent with regional initiatives and critical facilities data were complete and accurate.

Local Adoption

On October 20, 2011, the Barnstable Town Council voted to pass a resolution adopting the 2010 Barnstable Multi-Hazard Mitigation Plan as presented (Appendix E).

HAZARD IDENTIFICATION

The MHM planning team determined that the Town of Barnstable is susceptible to hurricanes and coastal storms, winter storms and nor'easters, shoreline change/coastal erosion, sea level rise, earthquakes, drought/wildfire, and dam failure. Each disaster event may present a variety of hazards to life and property. For example, a hurricane event poses a threat of flooding, storm surge, episodic erosion, wind, and tornadoes. The following section identifies hazards that may affect the Town of Barnstable, a profile of the associated risks, and a record of previous occurrences.

Hurricanes

ASSOCIATED RISKS INCLUDE: FLOODING, STORM SURGE, TORNADOES, WIND, EPISODIC EROSION

The Atlantic hurricane season runs from June 1st through November 30th. Based on the number and intensity of storms, mid-August through mid-October is defined as the peak period. Historically, the Town of Barnstable has been directly impacted by at least 5 hurricanes or tropical storms; the most recent storm to make landfall in Barnstable was Hurricane Edna, a Category 1 event (74-95mph sustained winds) that occurred in 1954. The most severe event recorded in the town, as well as on the Cape, was a Category 2 event (96-110mph sustained winds) in 1869. The Town of Barnstable, as a coastal community, is subject to flooding, storm surge, episodic erosion, tornadoes, and wind damage from hurricanes.

Flooding

The Town of Barnstable is highly susceptible to coastal flooding, but inland flooding is also a risk. Flooding results from heavy rains and storm surges and can be exacerbated by tidal restrictions and coastal erosion.

The most dangerous type of flooding occurs from storm surges, which can accompany hurricane and nor'easter events. Storm surge is a dome of water that comes ashore during or after a hurricane event. Flooding from storm surges poses the greatest risk to life during hurricanes and necessitates evacuation of vulnerable areas. Storm surges can wash out roads, damage infrastructure, overwhelm storm sewers, and contaminate drinking water.

Areas in the community vulnerable to flooding are identifiable through National Flood Insurance Rate maps (FIRMs) and Hurricane Surge Inundation areas. Hurricane Inundation data represents potential coastal flooding that may occur from critical combinations of hurricane track direction, forward speed, landfall location, and high astronomical tide. Areas at risk to flooding are shown on the Risk and Vulnerability Assessment Map (Appendix A).

Tornados and Waterspouts

Tornadoes, although rare on Cape Cod, are dangerous phenomena which can generate wind funnels of up to 200 MPH. Waterspouts are tornadoes that form over bays and oceans and primarily represent a threat to watercraft; waterspouts can, however, drift onshore and further threaten life and property. In Massachusetts, tornadoes and waterspouts usually occur during June, July, and August, frequently in conjunction with coastal storms or during a hurricane event. There were two moderate tornado events recorded on the Cape between 1951 and 2002; both of these events occurred within the Town of Barnstable. Additional tornado activity was recorded during Hurricane Bob in 1991.

Wind

Strong winds often accompany hurricanes, coastal storms, and Nor'easters. Effects from strong winds can include downed trees and power lines and damage to roofs and structures. Strong winds often result in scattered power outages. Flying debris from wind damaged structures and landscapes create additional danger. Coastal areas and water-dependent development are the most vulnerable to wind hazards.

Winter Storms/Nor'easters

ASSOCIATED RISKS INCLUDE: FLOODING, STORM SURGE, WIND, SNOW & ICE ACCUMULATION, EPISODIC EROSION

Winter storms are the most common of Bay State hazards, but the frequency and intensity of storms varies from season to season. Moderate storms frequently inconvenience Cape residents, but occasionally a severe event can seriously endanger life and property. There were winter storm or blizzard disaster declarations in Barnstable County in 2003, 2004, and 2005.

Severe winter storms can produce snow accumulation of up to six inches during a 24-hour period. Blizzards are winter storms that can produce sustained winds of up to 40 miles per hour, with heavy snow and extreme cold. Nor'easters are increasingly severe storms that may produce hurricane-force winds and can last from 12 hours to three days. In addition to snow and ice accumulation and wind hazards, winter storms can produce storm surges and coastal erosion, particularly affecting Barnstable's north coast.

Shoreline Change/Coastal Erosion

ASSOCIATED RISKS INCLUDE: FLOODING

The Town of Barnstable's coastline is constantly changing, but long-term trends indicate that 73% of Barnstable's shores are experiencing erosion and 25% are experiencing accretion. Shoreline change, specifically erosion, can result in a direct threat to waterfront property and indirectly impacts the developed environment by increasing vulnerability to storm damage and flooding. Erosion and accretion are important natural processes that mitigation actions must respect to protect the long-term health of Barnstable's beaches and dunes.

Shoreline change can result from both natural and human activity. Gradual sea-level rise and coastal storms are the primary natural causes of erosion. The extent of the erosion or accretion in a particular location is affected by a number of variables, including the site's exposure to storms and waves and sediment size and transport rates. Human-induced shoreline change results from the interruption of sediment sources by armoring coastal bluffs and the interruption of longshore sediment transport by the construction of jetties and groins.

Erosion and accretion rates along Barnstable's coast are represented on Regional Hazard Risk Map 1 (Appendix A). Areas most adversely impacted by erosion are found on Sandy Neck Beach and the north shore west of Barnstable Harbor; rates of erosion exceed two feet per year. On the south shore, areas with the most extreme erosion impacts are found in small areas west of Hyannis Point and along the west side of Long Beach in Centerville Harbor.

Sea Level Rise

ASSOCIATED RISKS INCLUDE: FLOODING, SHORELINE CHANGE/COASTAL EROSION

Recent climate change assessments predict that sea levels will rise three feet over the next 200 years, but caution that this change could occur as soon as the year 2100. A sea level rise of two feet will eliminate an estimated 10,000 square miles of land, including up to 43% of the country's current wetlands. Further rise will severely threaten development and infrastructure in low-lying areas and may significantly alter opportunities for public access to the water. Cape Cod and the Mid-Atlantic will likely be disproportionately affected, as threats of sea level rise are accompanied by observed subsidence of coastal land.

The adverse affects of rising waters are already evidenced by the submersion of low-lying lands, erosion of beaches, conversion of wetlands to open water, and exacerbated coastal flooding. Rising seas can inundate coastal areas, increase storm-surge flooding, erode shorelines, and increase the salinity of estuaries and aquifers. A recent report by the EPA entitled "*Coastal Sensitivity to Sea Level Rise*" highlights the increased flooding risks associated with sea-level rise:

> "Rising sea level increases the vulnerability of coastal areas to flooding because higher sea level increases the frequency of floods by providing a higher base for flooding to build upon. Erosion of the shoreline could also make flooding more likely because erosion removes dunes and other natural protections against storm waves. Higher sea level also raises groundwater levels, which can increase basement flooding and increase standing water. Both the higher groundwater tables and higher surface water levels can slow the rate at which areas drain, and thereby increase the flooding from rainstorms."

A major challenge for the Town in the future will be evaluating the ecological and social impacts of sea level rise and developing planning and adaption strategies that will address both environmental and human interests.

Earthquakes

Although New England has not experienced a damaging earthquake since 1755, numerous, less powerful earthquakes have been centered in Massachusetts and neighboring states. Seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernable pattern of previous earthquakes along these fault lines. Filled, sandy or clay soils are more vulnerable to earthquake pressures than other soils. Most buildings and infrastructure in Massachusetts were constructed without specific earthquake resistant design features, increasing the degree of vulnerability should a serious event occur.

According to the Cape Cod Commission's assessment, earthquake risk was the lowest of all identified hazards to the Cape. There has never been an earthquake recorded in the Town of Barnstable. Historic earthquake activity on the Cape is referenced on the Regional Hazard Risk Map 1 (Appendix A).

Dam Failure

ASSOCIATED RISKS INCLUDE: FLOODING

Dam failure is a highly infrequent occurrence, but a severe incident could prove deadly. Since 1984, three dams have failed in or very near Massachusetts, and two more have come very close to failing. One of these dam failures resulted in death. Many of the dams in the state were built in the 19th Century during the early industrial revolution and some are even older. These structures are definite hazards that must be considered when planning for the safety of local residents. Even dams which, theoretically, would pose little threat under normal circumstances can overspill or fail under the stress of a catastrophic event.

There are over 2,500 dams in Massachusetts. The Army Corps of Engineers, in conjunction with the Department of Conservation and Recreation Office of Dam Management assigns each dam a hazard potential classification. The State uses the following classification system:

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

The Town of Barnstable has three registered dams: Wequaquet Lake Dam, Mill Pond Dam, and Lumbert Pond Dam. All three dams have been assigned a hazard potential classification of "significant". The State determined that the Town is responsible for the ownership, maintenance, and operation of the Wequaquet Lake and Mill Pond Dams; the Lumbert Pond Dam is under private ownership. The Santuit Pond Dam in Mashpee has also been identified as a potential hazard for the town of Barnstable should the dam fail.

Wequaquet Lake Dam

Wequaquet Lake is the largest lake in the Town of Barnstable and the third largest on Cape Cod. The 654 acre lake is located south of Route 6 and Route 132 in Centerville. The lake has 7.5 acres of shoreline that is heavily developed with cottages and year-round homes. The lake discharges through a man-made channel into Long Pond and ultimately to the Centerville River.

The Wequaquet Lake dam consists of a concrete box culvert extending 37 feet under Phinney's Lane with a concrete retaining wall on either side of the road. Although the dam carries a hazard ranking of "significant", the condition of the dam is in satisfactory condition with no major deficiencies noted in a December 2009 inspection.

Mill Pond Dam

Mill Pond is located northwest of the intersection of Route 28 and Route 149 in Marstons Mills. The warm-water pond is fed by the Marstons Mills River and discharges into wetlands adjacent to Prince Cove and ultimately to the Three Bays. The Mill Pond dam is 52 feet in length and located at the

southeast end of the pond, just east west of Route 149. The dam structure consists of an uncontrolled spillway, a tier pool, and a fish ladder pool outlet. Flows then pass through a trash rack and a 4' pipe culvert extending 280 feet under Route 149. Although the dam carries a hazard ranking of "significant", the dam is in fair condition, as determined by a December 2009 inspection.

Santuit Pond Dam

Santuit Pond is located just west of Barnstable in the Town of Mashpee; however, the Santuit Pond dam is a potential hazard for the Town of Barnstable should this dam fail. Santuit Pond is a 172 acre warm-water pond approximately a mile north of Route 28 and east of Route 130. The MCDR has assigned the Santuit Pond dam a hazard ranking of significant. According to the Mashpee MEC, the Santuit River outlet structure was recently repaired to mitigate erosion during high water events; however, according to State Officials, the dam needs added repairs. Additionally, the Mashpee Department of Health has found the pond to be contaminated with blue-green algae and E. coli bacteria, and traces of the potentially toxic algae anabaena.

Drought/Wildfires

Massachusetts and the Cape generally receive a generous amount of rainfall relative to other regions of the country. According to the Massachusetts Department of Conservation and Recreation, the Cape receives, on average, 44 inches of precipitation annually. Occurrences of drought, however, occur periodically and can last for a season or can be multi-year events. The last drought watch issued for the Cape was in the winter of 2002-2003 as a result of long-term below-normal groundwater levels.

Drought conditions can exacerbate the risk for wildfires in large tracts of pitch pine forests and salt marshes where invasive phragmiteses are prolific. In 2008, 2,740 fires were reported in the state affecting almost 1,900 acres of land. The number of occurrences and areas impacted were greater in 2008 than in recent reported years according to data from the DCR Bureau of Forest Fire Control and Forestry. The Cape is one of the highest risk areas for wildfire in the state; a U.S. Forest Service study found that Barnstable and Plymouth counties, with their sandy soils, drying winds and fuel types are as wildfire prone as the often fire ravaged regions of southern California.

Over the course of the town's development, urban areas, both residential and commercial, have encroached into natural wildlife areas. People, structures, and facilities in urban/wildland interface areas are at the greatest risk from wildfires. Wildfire risk areas and wildland/urban interface areas are identified on Regional Hazard Risk Map 3 (Appendix A).

The vast majority of wildfires are started by humans; some fires are attributable to accidents and negligence, but historically almost half have been attributed to arson. Although most wildfires begin unnaturally, it is important to keep in mind that wildfires can play an important role in the natural cycle of plant succession and can have positive impacts on wildlife areas. These benefits should be considered when developing mitigation actions and response strategies.

RISK ASSESSMENT

The MHM team conducted a risk assessment to help identify the most serious risks to the Town and to aid in the prioritization of mitigation actions. The assessment is based on the potential frequency, severity, and scope of the natural hazards that can affect the Town of Barnstable. The risk assessment provides a basis for activities proposed in the strategy to reduce losses from identified hazards.

Historical Risks

The attached hazard risk maps (Appendix A) provide a historical record of disaster activity in the Town of Barnstable. The maps identify the historic frequency of disaster events as well as provide a spatial representation of the range of the hazards.

- Hazard Risk Map I: Identifies long-term shoreline change susceptibility, historic tornado activity and historic earthquake activity for Cape Cod.
- Hazard Risk Map II: Identifies flood hazard areas, historic hurricane activity and risk, and historic average annual snowfall for Cape Cod.
- Hazard Risk Map III: Identifies wildfire hazard areas and wildland/urban interface areas for the Town of Barnstable.

For additional information on historical occurrences of hazard events in Barnstable County, refer to the regional Multi-Hazard Mitigation Plan, coordinated and written by the Cape Cod Commission.

Hazard Identification Matrix

The following Hazard Identification Matrix represents a summary of the MHM team's risk assessment. The matrix rates the hazards for mostly likely and most damaging to least likely and least damaging; the matrix accounts for the locations potentially affected by the hazard, the frequency of occurrence, and the extent, or magnitude, of the hazard. Hazard rankings were developed using the methodology provided by the MEMA/DCR publication *Natural Hazards Mitigation Planning: A Community Guide*.

Hazard Identification Matrix				
Natural Hazard	Frequency (0-3)	Location (1-3)	Extent (1-4)	**Hazard Ranking**
Flood	3	3	4	**10**
Hurricane	2	3	4	**9**
Wind	3	3	3	**9**
Snow & Ice Accumulation (winter storm or nor'easter)	3	3	2	**8**
Shoreline Change/Coastal Erosion (long-term or episodic)	3	2	3	**8**
Drought/Wildfire	1	3	3	**7**
Tornado	1	2	3	**6**
Sea Level Rise	1	2	2	**5**
Earthquake	1	2	2	**5**
Dam Failure	1	1	2	**4**

Rating System

Frequency of Occurrence

0= Unlikely less than 1% probability in the next 100 years
1= Possible between 1-10% probability in the next year; or at least 1 chance in next 100 years
2= Likely between 1-100% probability in the next year; or at least 1 chance in next 10 years
3= Highly Likely near 100% probability in the next year

Location

1= Small isolated to a specific parcel, building, intersection, or neighborhood
2= Medium occurring in multiple locations across town during one event
3= Large affecting a significant portion of town during one event

Extent

1= Limited injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities for 24 hours or less; properly severely damaged is <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%

Note that one hazard can be the result of numerous events. For example, flooding is a natural hazard that can be caused by a hurricane, winter storm, or nor'easter.

VULNERABILITY ASSESSMENT

Vulnerability refers to the susceptibility of the Town's residents, infrastructure and natural, cultural, and historic resources to hazard events. Vulnerability indicates what is likely to be damaged by a hazard and how severe the damage might be. The vulnerability assessment conducted for the Town of Barnstable includes a profile of the Town's existing development patterns and natural environment. Critical facilities such as hospitals, public safety facilities, and schools are identified, mapped, and surveyed for potential vulnerability. GIS analysis was used to assess vulnerability of existing structures to flooding and estimates potential dollar losses. Finally, a review of the Town's participation in the National Flood Insurance Program is included.

Community Profile

The Town of Barnstable is located in Barnstable County in Cape Cod, Massachusetts. The total land area of the Town is approximately 40,000 acres. Barnstable is one of the most urbanized towns on the Cape and is a regional center of administrative and commercial activity. Hyannis Village functions as a regional commercial center and Barnstable Village is the Barnstable County seat. Originally founded in 1639, the Town contains numerous historic resources; there are more than 40 known Native American archaeological sites, 14 national historic districts, two local historic districts, and an additional 74 individually designated sites. The town's coastal location, wetland habitats, and forested open spaces collectively create a high susceptibility to natural hazards.

Year-Round Population……	47,380
Seasonal Population…….	78,333
Peak Daytime Population……	126,000
Acres of Developed Land……	17,764
Acres of Conservation Land……..	7,198
Miles of Coastline…….	170
Centerline Miles of Roads……..	447 (381 public, 66 private)
Acres of Open Water……	1,868
Number of Great Ponds……..	11
Acres of Forested Woodland…….	12,348
Acres of Salt Marsh…….	3,817
Acres of Fresh Marsh…….	264
Acres of Cranberry Bogs……	242
Acres of Shrub Swamp……	468
Acres of Barrier Beach/Dunes…..	932
Tidally Restricted Wetland Sites..	17
Acres in Hurricane Surge Zones..	7,475
Acres in Flood Zones……..	8,000
Hazardous Waste Sites……	30, plus 40 monitored sites
Critical Facilities……..	105
Regional Critical Facilities…….	11
Repetitive Loss Properties……..	18

Critical Facilities Inventory

A critical facilities inventory was complied for the Town of Barnstable. Critical facilities identified within the Town of Barnstable include:

- Emergency Facilities/Shelters
- Public Safety Services
- Hospitals
- Town Government Facilities
- Wastewater Infrastructure
- Hazardous Material Facilities
- Schools
- Nursing Homes/Elderly Housing
- Group Day Care Facilities
- Senior/Youth/Recreation Facilities
- Designated Emergency Animal Shelters
- Marinas/Boat Yards

The critical facilities inventory is represented on the Risk and Vulnerability Assessment Map. Ten of the critical facilities identified in the Town of Barnstable are also identified as regional critical facilities by the Cape Cod Commission. The regional facilities are the American Red Cross, the Barnstable County Complex, Cape Cod Hospital, Barnstable Municipal Airport, Cape Cod Community College, the Barnstable County Fire and Rescue Training Academy, the Humane Society, and the MSPCA Animal Shelter. Appendix B includes the critical facilities inventory.

Hurricane Surge Inundation Areas (SLOSH Zones) – Vulnerability Analysis

Hurricane Surge Inundation Areas, also known as Sea, Lake, and Overland Surges from Hurricanes (SLOSH) zones, are based on a computer model designed by the National Weather Service to forecast storm surges and potential flooding from hurricanes that may make landfall in New England. Surge limits shown on the community maps represent potential flooding that may occur from critical combinations of hurricane track direction, forward speed, landfall location, and high astronomical tide.

The Town of Barnstable has a total of 11.68 square miles (7,474.78 acres) of property in Hurricane Inundation zones. In addition, critical facilities located in Hurricane Inundation zones are represented on the Risk Assessment and Vulnerability Map and as follows:

# of Critical Facilities in Hurricane Zone	# of Critical Facilities in FIRM	Total # of Critical Facilities	Regional Critical Facilities in Hurricane Zone	Total # of Regional Critical Facilities
24	24	105	2	11

Data: Cape Cod Commission Regional MHM Plan

23 Cape Cod Hospital, Hyannis (Regional)
31 Barnstable Housing Authority, Hyannis
47 Pope John Paul II High School, Hyannis
71 Hyannis Head Start, Hyannis
83 Humane Society of the US, Barnstable
86 Anchor and Marine Ltd, Hyannis
87 Barnstable Harbor Marina, Barnstable
88 Barnstable Marine Service, Barnstable*
89 Bismore Park Marina, Hyannis
90 Crosby Yacht Yard, Osterville*
91 Gateway Marina, Hyannis
92 Hyannis Marine, Hyannis*
95 Millway Marina, Barnstable
96 Nauticus Marina, Osterville
97 Oyster Harbors Marine, Osterville*
98 Sandy Neck Gatehouse, West Barnstable
99 West Bay (Oyster Harbors) Bridge, Osterville
100 Harbormaster's Building and Visitors Center, Hyannis
101 South Street Pump Station
102 Mill Way Pump Station
103 Steamship Authority, Hyannis
104 Lewis Bay Boat Ramp, Hyannis
105 Blish Point Boat Ramp, Barnstable
106 Bay Shore Road/Old Harbor Road Boat Ramp

* Also a Tier 2 Reporter

Wildfire Hazards Areas – Vulnerability Analysis

A significant percentage of the Town's total acreage is identified as a wildfire hazard area. Wildfire hazard areas are defined as unfragmented forest habitat greater than 40 acres in size or salt marsh areas greater than three acres in size.

There are 13 Critical Facilities located in wildfire hazard areas or in wildfire/urban interface zones in the Town of Barnstable.

12 Osterville Elementary
26 Barnstable Water Department at 1841 Phinney's Lane
29 Cotuit Water Department
33 Hyannis Water Department

38 Town Offices – Marine and Environmental Affairs at 1189 Phinney's Lane
45 Cape Cod Academy
52 Cape Cod Community College
62 Bright Promises Preschool
64 Cape Cod Conservatory Preschool
78 West Parish Family School
82 Bayview Kennels
83 Humane Society of the U.S.
85 Special K Kennels

Flood Zones – Vulnerability Analysis

To assess the vulnerability of the Town's built environment to flood hazards, an analysis of the structures and land uses in FEMA flood zones was conducted by the Town's GIS Department[1]. The following table summarizes that analysis; the table represents the number of parcels located in FEMA A and V flood zones, building square footage, and assessed building values. The vulnerability analysis was conducted using the recently released 2009 FEMA Flood Insurance Rate Maps. Although these maps were not officially adopted by the Town at the time of the analysis, they provided the opportunity for the most accurate analysis.

Loss Estimates/Area Vulnerability Assessment Town of Barnstable Development in Flood Zones by Land Use				
Land Use	# of Parcels (including condo units)	# of Parcels (not including condo units)	Building Area (Sq.Ft.)	Assessed Building Value
Residential	1,114	924	5,018,550	$425,944,300
Commercial	178	42	533,146	$38,354,100
Industrial	0	0	0	$0
Recreational	0	0	0	$0
Agricultural	0	0	0	$0
Tax Exempt	19	19	88,625	$7,905,400
Mixed Use	13	13	116,619	$14353,900
TOTAL	1,354	998	5,756,940	$486,557,700

Loss Estimates/Area Vulnerability Assessment Town of Barnstable Development in Flood Zones by Village				
Land Use	# of Parcels (including condo units)	# of Parcels (not including condo units)	Building Area (Sq.Ft.)	Assessed Building Value
Barnstable	123	119	366,397	$22,412,500
Centerville	309	272	1,101,363	$84,563,200
Cotuit	73	73	501,117	$38,342,100
Hyannis	596	281	1,508,021	$148,064,500
Marstons Mills	15	15	124,134	$11,526,500
Osterville	225	225	2,128,547	$179,963,100
West Barnstable	13	13	27,391	$1,685,800
TOTAL	1,354	998	5,756,940	$486,557,700

As expected, residential properties are the most vulnerable to flood damage in terms of numbers, square footage, and assessed value; 1,114 housing units totaling over $425.9 million in value are located in flood hazard areas. Potential commercial losses from flooding total over $38 million, not including commercial enterprises that might be included in the mixed use category. Many of these uses are likely marine-related businesses that rely on having good access to the water. A closer

[1] The methodology used by the Town of Barnstable GIS Department to calculate these figures can be found in Appendix C.

evaluation of the locations and functions of these commercial properties would be valuable and facilitate efforts to minimize economic losses after major flood events.

The Village of Hyannis has the greatest number of structures vulnerable to flood damage; many of these structures are located around the Inner Harbor, Lewis Bay, Hyannis Harbor, and Stewart's Creek. The Village of Osterville faces the greatest potential dollar losses from flooding. The average assessed value of a structure in the flood zone in Osterville is almost $800,000. This data reflects the vulnerability of high dollar homes located on Vineyard Sound and the Three Bays. The Village of Centerville also has a high number of structures vulnerable to flooding; these properties are located primarily around the Centerville Harbor and Centerville River.

In addition to concerns regarding vulnerability of structures, the MHM Planning Team identified several roads that are prone to flooding. Flooding of these roadways could potentially interfere with travel of emergency vehicles and evacuation of residents. The following areas are of concern:

- Route 6 in Barnstable (evacuation route)
- Mill Way in Barnstable
- Commerce Road in Barnstable
- West Bay (Oyster Harbors) Bridge (also vulnerable to wind hazards)

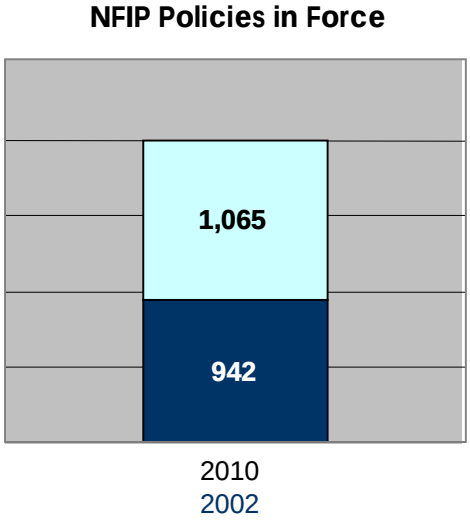
National Flood Insurance Program and Repetitive Loss Properties

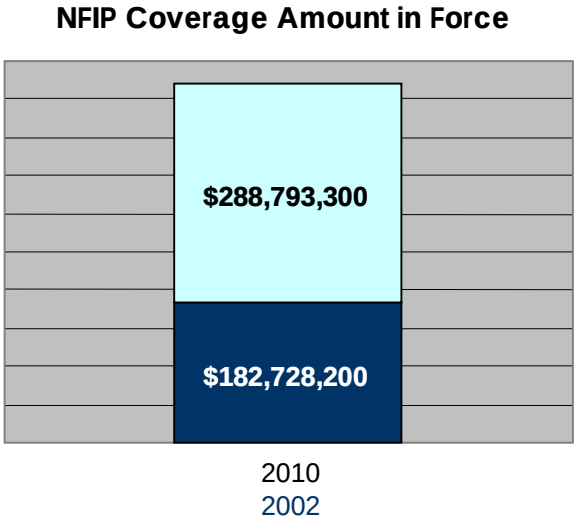
The Town of Barnstable participates in the National Flood Insurance Program (NFIP). As of March 31, 2010, the town had 1,065 NFIP policies in force, totaling $288,793,300 of coverage. Between 2002 and 2010, the number of policies held in Barnstable increased by 123, increasing the total coverage amount in force by $106,065,100. From the inception of NFIP in 1972 to March 31, 2010, 277 loss claims were filed in the Town; 115 of those claims were paid totaling $2,901,868.

Repetitive loss properties are those with one or more NFIP claims in force. The Town of Barnstable has 17 repetitive loss properties, the second most on the Cape behind the Town of Falmouth. Three of the properties are located on the north shore near Barnstable Harbor. Twelve of the properties are on the south shore, including a concentration of eight properties on Centerville Harbor. The final two properties are in the Village of Hyannis, near the intersection of Route 28 and Bearse's Way. Ten of the repetitive loss properties are located in "A" zones and one in a "V" zone. One property has 5 paid loss claims (a non-residential property), one has 4, and two have three paid loss claims. The areas where repetitive loss properties are located are shown on the Risk and Vulnerability Assessment Map.

The town is presently coordinating the review of the 2009 Flood Insurance Rate Maps (FIRMs); these maps are currently available to the public for appeal or protest. The target date for adoption of the updated FIRMs is June 2011.

Barnstable's floodplains are managed through zoning, wetlands, and health regulations. The Town is committed to the ongoing enforcement of these regulations and will continue to review and enhance requirements to best protect the environment and vulnerable properties. Additionally, the Town is engaged in public outreach programs to promote private floodplain management best practices and participation in the NFIP. The Town is encouraging early participation in the NFIP program for property owners that will likely be affected by the 2009 FIRM adoptions.





EXISTING HAZARD MITIGATION EFFORTS

State Protection Measures

A full evaluation of the state's hazard mitigation capability can be found in the Commonwealth of Massachusetts State Hazard Mitigation Plan 2010, Section 5.2 *State Capability Assessment*.

Local Protection Measures

Existing Protection	Description	Area Covered	Enforcement Responsibility	Hazards
Town Zoning Ordinance: Section 240-34	Flood Area Provisions	Areas at or below A or V zones determined by FIS[1]	Building Commissioner	Coastal Storms Winter Storms Floods
General Ordinance Chapter 47	Building Construction	Town-wide	Building Commissioner	Flooding, high winds
General Ordinance Section 206, Article II	Snow and Ice Removal	Town-wide	DPW – Highway Division	Snow & Ice Accumulation
Snow and Ice Control Operations Plan	Snow and Ice Removal	Town-wide	DPW – Highway Division	Snow & Ice Accumulation
General Ordinance Chapter 237	Wetlands Protection	Town-wide wetlands and water related resources	Conservation Commission	Flooding Costal Storms
Town of Barnstable Emergency Response Plan, 2008	Emergency Response	Town-Wide	Barnstable Police Department	All

1 (FIS) Flood Insurance Study

Barnstable Comprehensive Plan

The Town of Barnstable's Comprehensive Plan (BCP) contains numerous goals and objectives that directly relate to hazard mitigation. The plan outlines a strategy for accommodating future development in areas with adequate infrastructure through compact development patterns and infill and redevelopment. This approach is aimed at preserving the Town's sensitive environmental areas and natural resources. The BCP generally designates areas as "designated for growth", "designated for infill and redevelopment", or "not designated for growth". The plan expressly states that lands subject to flooding, including FEMA flood zones and Hurricane Surge Inundation areas, are "not designated for growth."

The BCP includes an extensive discussion of improving and protecting water quality and overall environmental health through stormwater management, development regulation, and hazardous materials and waste management. Goals and strategies addressing the protection of coastal resources, freshwater resources, wetland resources, and habitat resources are all included. The ongoing implementation of the plan will reduce the vulnerability of people, structures, and infrastructure to a number of natural hazards identified in this plan including flooding, storm surge, and shoreline change.

Barnstable 2010 Open Space and Recreation Plan

The Town's 2010 Open Space and Recreation Plan (OSRP) is a subset of the Barnstable Comprehensive Plan that examines the Town's open space needs and presents a strategy for land preservation. The OSRP outlines a policy for open space protection that supports the mitigation goals of this plan and recognizes the opportunity to acquire, improve, and restore open spaces for the purposes of flood mitigation. The plan also calls for a continuation of the Town's policy of property "undevelopment" for the mitigation purposes, a strategy consistent with the goal of repetitive loss property acquisition discussed herein.

Wildland Fire and Preparedness Plans

In 2005, the Cape Cod Cooperative Extension and Town staff produced a report entitled *Wildland Fire and Preparedness Plan for the West Barnstable Conservation Area and Adjacent Open Space Land*. The plan was prepared for the 1,114 acre West Barnstable Conservation Area and 700 acres of adjacent open space owned by the town and the COMM Fire District. The plan presents recommendations to reduce the threat of wildfire while maintaining the ecological integrity of this large open space tract. To date, the Town has received over $43,000 in grants from the County to implement the recommendations of that plan. The funding has been used for mechanical clearing around roads and abutting residential areas, road improvements, and trail mapping and signage.

A second plan for the Old Jail Lane Conservation Area in the Village of Barnstable was adopted in 2010. The plan, also funded by the Cape Cod Cooperative Extension, includes recommendations for improving access for emergency vehicles and road and trail clearing. The Old Jail Lane Conservation area consists of 180 acres of town-owned open space, dominated by pitch pine and scrub oak; the area is bordered by residential development to the north and west.

Three Bays Coastal Resource Management Plan

In 2009, the Coastal Resources Management Committee, with staff assistance from the Growth Management Department, prepared an updated coastal resources management plan for the Three Bays area. The study area encompasses Cotuit Bay, North Bay, West Bay, East Bay and the Centerville River. The development of the plan involved multiple stakeholders including commercial and recreational shellfishers, private property owners, marina operators, the Conservation Commission, the Waterways Committee and the Shellfish Committee. The overall goals of the plan are to protect and enhance natural resources, enhance public access to the water, protect traditional on-the-water activities and uses, and enhance the aesthetic quality of the coastal area.

The coastal resources management plan includes sections addressing coastal erosion, impacts of sea level rise, and coastal development. The Three Bays area contains barrier beach, coastal beach, and coastal dune formations; the plan recommends protecting these formations from development disturbance and controlling erosion to the greatest possible extent. Sea level rise would have myriad negative effects on the Three Bays area; the plan identifies and recommends management practices to prepare and potentially mitigate its damaging effects. Finally, the plan offers recommendations regarding coastal structures, coastal land use and coastal access that aim to strengthen waterfront character, protect natural habitats and resources, and promote sustainable and responsible use of the Three Bays area.

Dam Inspections and Evaluations

In 2009, the Town and Wright-Pierce Engineering completed Phase I inspections of the Wequaquet Lake Dam in Centerville and the Mill Pond Dam in Marstons Mills. The inspections and associated reports were conducted in accordance with the Department of Conservation and Recreation Office of Dam Safety's standards for compliance with 302 CMR 10.00 Dam Safety Regulations. The reports provide detailed evaluations of the current conditions of the dams and make recommendations for future studies and improvements that will facilitate the reclassification of the dams to the "Low" hazard ranking. To date, the State has not required emergency actions plans for either of these dams.

Salt Marsh Restoration Projects

Tidal wetlands are an important source of protection from flooding associated with storm surges and other severe weather events. The Cape Cod Commission's Atlas of Tidally Restricted Salt Marshes identifies 17 sites in Barnstable impacted by undersized culverts or pipes. These undersized structures cause hydrological changes that reduce the maximum elevations of tidal flooding, thus altering the ecosystem and reducing the wetland's capacity to store floodwaters. Tidal restrictions can also impound storm water within the wetland and increase the severity of flood events. Additionally, these restrictions may obstruct anadromous fish runs, increase the proliferation of invasive species, damage wildlife and shellfish habitat, and degrade water quality.

In 2005, the Bridge Creek Salt Marsh project restored 40 acres of degraded marsh in West Barnstable. The project enlisted a wide range of partners including the Town of Barnstable, USDA Natural Resources Conservation Service, NOAA/Gulf of Maine, Conservation Law Foundation, Commonwealth of Massachusetts, Corporate Wetlands Restoration Partnership, Ducks Unlimited, the Barnstable Land Trust and others. The Town received $1.5 to restore tidal flow into the critical wetland by enlarging the two culverts. Upon completion, the project was recognized by the President's Council on Environmental Quality.

Barnstable is eligible for federal funding to restore tidally restricted salt marshes under the Cape Cod Water Resource Protection Project. The Conservation Division is currently working to address two restrictions at Rushy Marsh Pond and Stewart's Creek. These projects are in the final stages of permitting and work on the restorations is expected to commence next year.

Development Trends

The Town of Barnstable experienced high rates of development during the 1970's and 1980's, including new residential construction and auto-oriented commercial development. The Town has employed a number of strategies to prevent development from further encroaching on natural resources areas and to ensure growth does not exceed resource, service, and infrastructure capacities. In 2001, the Town of Barnstable was designated as a District of Critical Planning Concern (DCPC), limiting new residential development to 96 market rate units and 33 affordable units annually. Subsequently, downtown Hyannis was designated as a Growth Incentive Zone; the designation is intended to encourage compact development through flexible zoning and expedited permitting. Three other DCPCs have either been adopted or are under review for Pond Village in Barnstable, Centerville Village, and Craigville Beach.

In conjunction with the effort to concentrate growth into downtown Hyannis and other strategic planning areas, the Town adopted a Resource Protection Overlay District which increased the minimum lot size for new subdivisions to two acres. The overlay district was adopted for the recharge areas to the Centerville River, Popponessett and Shoestring Bays and the Three Bays area,

together with areas dependent upon private well water supplies. This area covers the majority of the villages of Centerville, West Barnstable, Marstons Mills, Osterville, and Cotuit. The Town also has Aquifer Protection, Groundwater Protection, and Well Protection Overlay District in effect; these districts encourage non-hazardous uses that are compatible with groundwater recharge areas.

MITIGATION STRATEGY

Plan Goals

The overall goals of this plan, as outlined in earlier sections, are as follows:

1. Protect lives and reduce social, emotional, and economic disruption following a disaster event;
2. Prevent the loss of property, infrastructure, and natural and cultural resources from natural disasters;
3. Increase public awareness of risk and vulnerability to natural disasters;
4. Increase access to funding sources for hazard mitigation projects; and
5. Improve the ability to implement post-disaster recovery projects.

Mitigation Strategy

To achieve the overall goals of this plan, the Town has developed the following disaster mitigation strategy. The strategy is designed to holistically address the threat of natural disasters through preventative regulation, property and natural resource protection, structural improvements, and increased public awareness.

1. Preserve the natural and beneficial functions of the town's floodplain, wetlands, beaches and dunes through continued support of natural resource protection policies.
2. Limit development in high hazard and environmentally-sensitive areas to minimize loss of life and structures, reduce erosion and prevent other environmental damage resulting from natural hazards.
3. Control erosion in barrier beaches and coastal banks to the greatest extent possible to protect important wildlife habitat from storm surge protection and to preserve recreational amenities.
4. Reduce wildfire hazard within vulnerable open space lands and urban interface zones through integrated and proactive land management programs.
5. Pursue reclassification of the two Town-owned dams from a hazard potential rating "significant" to a hazard potential rating of "low".
6. Adopt and/or amend (re)development regulations applicable to land, structures and wastewater systems in hazard-prone areas to ensure structures are designed to withstand potential events and to prevent the disturbance of natural areas.
7. Incorporate hazard mitigation goals into the Town's land acquisition strategy, considering both direct acquisition and acquisition of development rights. Focus on acquiring parcels with high development pressure in hazard-prone areas and reducing the number of repetitive loss properties.
8. Continue to foster educational outreach programs that promote awareness of hazard risks and vulnerabilities and increase community responsibility for actions and their impacts.
9. Educate property owners on the affordable, individual mitigation and preparedness measures that can be taken before a hazard event.

10. Protect critical facilities and infrastructure from hazard events.
11. Coordinate local hazard mitigation planning and activities with the Cape Cod Commission and neighboring towns.
12. Enhance the Town's capability to conduct hazard risk assessments, demonstrate funding needs and track mitigation activities. Improve institutional knowledge of cost-effective mitigation and preparedness measures.
13. Identify and implement infrastructure projects that will increase the level of protection of vulnerable areas from natural hazards and will provide long-term mitigation benefits.

Mitigation Actions

The MHM team identified a series of specific hazard mitigation actions that correlate with the Town's overall strategy for hazard mitigation.

To aid in prioritization and identification of alternatives, the mitigation actions were arranged into six broad categories:

1. **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built.
2. **Property Protection:** Actions that involve modification of existing buildings or structures to protect them from a hazard or removal from the hazard area.
3. **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.
4. **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the function of natural systems.
5. **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event.
6. **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard.

To facilitate implementation, each action includes a discussion of the following:

- What hazard the action is intended to mitigate.
- The department(s) or boards primarily responsible for implementation.
- The mitigation strategies that the action is intended to accomplish.
- A general indication of priority, based on STAPLEE analysis and other extenuating factors, as discussed below.

Mitigation Action Prioritization - STAPLEE

The MHM team reviewed the suggested action items and discussed the potential resulting social, political, fiscal, and environmental impacts. The actions were analyzed using STAPLEE criteria (Appendix D) as suggested in the Local Multi-Hazard Mitigation Planning Guidance. The STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) methodology provides a general set of criteria used to make decisions regarding community initiatives. STAPLEE generally correlates feasibility with priority. Utilization of this method to prioritize actions allows the

Town to review both the costs and the benefits of the activity and prioritize them based on cost effectiveness and political and social capital.

In certain cases, the MHM team identified criteria for specific items that should be weighted, influencing the overall prioritization of the action. For example, in some cases the environmental benefits of an action make it worth pursuing, despite the need to overcome social and political opposition.

Actions are divided into three levels of prioritization, defined as follows:

- High: Of priority importance, such that inaction would leave property and critical facilities vulnerable to natural hazards with a high likelihood of occurrence. Implementation is critical to support the goals of this plan.
- Moderate: Of emerging importance, such that ongoing inattention may result in damage or loss from natural hazards if the issue is not addressed.
- Low: Long-term opportunities or challenges that may only have limited immediate or wide-spread positive benefits, or where constrains are present that prevent implementation in the short-term.

List of Prioritized Mitigation Actions

PREVENTION

Mitigation Action #1

Develop necessary implementing regulations to adopt a "No Adverse Impact" policy that ensures the actions of one property owner do not adversely impact flooding risk for other properties or imperil public safety.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, DPW
IMPLEMENTATION STRATEGIES: 2, 6, 9
PRIORITY LEVEL: Low

Mitigation Action #2

Develop additional Coastal Resources Management Plans for vulnerable coastal areas within the Town Barnstable. Management plans should include:

- An inventory of existing coastal resources, existing public and private access, and all available water quality data;
- An overview of existing federal, state and local regulations;
- An assessment of potential impacts from coastal storms;
- Projections for future conditions including a buildout analysis for FEMA A and V zones, barrier beaches and coastal banks; and
- Recommendations for protecting critical habitats and important resources while providing for recreational and commercial uses.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, MEA, DNR, DPW
IMPLEMENTATION STRATEGIES: 3, 12
PRIORITY LEVEL: Moderate

Mitigation Action #3

Develop a Resource Management Plan for the Sandy Neck ACEC that meets Department of Environmental Protection and Massachusetts Coastal Zone Management requirements to aid in the management of this important resource.

HAZARD TO MITIGATE: Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Mass Estuaries Program, DNR, DPW
IMPLEMENTATION STRATEGY: 3, 12
PRIORITY LEVEL: Low

Mitigation Action #4

Explore the adoption of regulations and incentives to restrict new development and redevelopment in A and V zones, on barrier beaches, or on coastal dunes where there is known to be danger of significant flood damage.

- Inventory and map vacant land in velocity zones.
- Existing structures may be reconstructed or renovated in conformance with all regulatory requirements provided there is no increase in area or intensity of use.
- Where applicable, non-water dependent development shall be concentrated on that part of the lot outside the A and V Zones.

HAZARD TO MITIGATE: Flooding, Shoreline Change
IMPLEMENTATION RESPONSIBILITY: GMD, Town Council, Conservation, Board of Health
IMPLEMENTATION STRATEGY: 1, 2, 3, 6
PRIORITY LEVEL: Low

Mitigation Action #5

Adopt a sewer neutral regulation through a General Ordinance.

- Where new sewers are proposed, residential development and redevelopment shall be permitted to have only the number of bedrooms allowed under Title V and local regulations for that property whether or not town sewer is available.
- In barrier beach areas and FEMA A and V Zones where there is existing development, the Town may install wastewater infrastructure to better protect or improve coastal waters or sensitive habitat areas subject to the sewer neutral regulation.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Erosion Control
IMPLEMENTATION RESPONSIBILITY: GMD, Planning Board, Town Council, Board of Health, DPW
IMPLEMENTATION STRATEGY: 2, 6
PRIORITY LEVEL: Low

Mitigation Action #6

To prevent earth placement or removal that interferes with the natural flood protective function of barrier beaches and other coastal formations, develop a regulation that limits earth removal and placement and develop an appropriate building height definition.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Planning Board, Town Council
IMPLEMENTATION STRATEGY: 3, 6
PRIORITY LEVEL: Moderate/High

Mitigation Action #7

Explore adoption of a regulation that prevents armoring structures and mounded septic systems from interfering with the natural flood protective function of barrier beaches and other coastal formations.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Planning Board, Town Council, Conservation, Board of Health
IMPLEMENTATION STRATEGY: 1, 2, 6
PRIORITY LEVEL: Low

Mitigation Action #8

Explore updating the floodplain bylaw to incorporate the additional provisions in the Cape Cod Commission's Model Floodplain Bylaw to better protect land subject to coastal storm flowage.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Planning Board, Town Council
IMPLEMENTATION STRATEGY: 1, 2, 3, 6, 11
PRIORITY LEVEL: Low

Mitigation Action #9

Reduce impacts in FEMA A and V zones by amending the Zoning Ordinance to require floor area ratio requirements that allow development and redevelopment that does not create large impervious surface.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Planning Board, Town Council
IMPLEMENTATION STRATEGY: 1, 2, 6
PRIORITY LEVEL: Moderate

Mitigation Action #10

Review and, if necessary, revise regulations to ensure development or redevelopment on a coastal bank or dune or within 100 feet landward of these resources shall be designed to have no adverse effect on the height, stability or use of the bank or dune as a natural sediment source.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: Conservation, Board of Health
IMPLEMENTATION STRATEGY: 3, 6
PRIORITY LEVEL: Low

Mitigation Action #11

Buildings and infrastructure in areas of projected sea level rise should be designed for protection from flooding as well as to minimize risk to human health and safety.

- Determine the extent of protection needed from the real threat of sea level rise.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, Regulatory Sevices
IMPLEMENTATION STRATEGY: 2, 6, 10
PRIORITY LEVEL: Low

Mitigation Action #12

Design stormwater management systems and new and replacement septic systems within FEMA A and V zones to accommodate a sea level rise.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: DPW, Board of Health, Regulatory Services
IMPLEMENTATION STRATEGY: 1, 6
PRIORITY LEVEL: Low

Mitigation Action #13

Continue to identify, certify and map vernal pools and other isolated lands subject to flooding. Determine their flood control and flood mitigation value and assess the need for additional regulation to protect this vital function.

HAZARD TO MITIGATE: Flooding
IMPLEMENTATION RESPONSIBILITY: GMD, Conservation Division
IMPLEMENTATION STRATEGY: 1, 12
PRIORITY LEVEL: Low

Mitigation Action #14

To increase preparedness for flood hazard events, explore certifying a member of the Town staff as a Floodplain Manager with the Association of Floodplain Managers. Certified managers are kept up-to-date on flood mitigation requirements and strategies and work to reduce flood losses and protect and enhance the natural resources and functions of floodplains.

HAZARD TO MITIGATE: Flooding
IMPLEMENTATION RESPONSIBILITY: Conservation Division
IMPLEMENTATION STRATEGY: 1, 13
PRIORITY LEVEL: Low

Mitigation Action #15

Identify, pursue, and fund actions, regulations or outreach efforts necessary to qualify for the National Flood Insurance Program's Community Rating System (CRS). CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: 1) reduce flood losses; 2) facilitate accurate insurance rating; and 3) promote the awareness of flood insurance.

HAZARD TO MITIGATE: Flooding
IMPLEMENTATION RESPONSIBILITY: Conservation, GMD, Board of Health, Town Council, DPW, Regulatory Services
IMPLEMENTATION STRATEGY: 1, 8, 9
PRIORITY LEVEL: Moderate

Mitigation Action #16

Continue wildfire assessment and preparedness planning for conservation parcels with the highest risk, specifically the areas largest in size and in closest proximity to residential development.

- Consider developing a plan for the 95-acre Crocker Neck Conservation Area in Cotuit; this area consists of pine/oak forest and salt marshes and is in close proximity to residential development to the west.

HAZARD TO MITIGATE: Drought/Wildfire
IMPLEMENTATION RESPONSIBILITY: Conservation Division, DPW, Fire Departments
IMPLEMENTATION PRIORITY: 4, 10, 12
PRIORITY LEVEL: Moderate

Mitigation Action #17

Coordinate with the Town Mashpee on the upkeep, monitoring and maintenance of the Santuit Pond Dam. Explore the need for a Memorandum of Understanding to ensure the ongoing structural integrity of the dam.

HAZARD TO MITIGATE: Dam Failure
IMPLEMENTATION RESPONSIBILITY: DPW, Town Manager, Natural Resources
IMPLEMENTATION STRATEGIES: 5, 11, 12, 13
PRIORITY LEVEL: Low

PROPERTY PROTECTION

Mitigation Action #18

Incorporate multi-hazard mitigation actions into the Town's land acquisition program by:

1. Selecting parcels to protect natural resources in flood prone areas of the Town;
2. Preserving ecological systems in coastal, riverine and all areas subject to flooding;
3. Acquiring properties and relocating flood prone structures; and
4. Removing repetitive loss structures and preserving the land as open space;

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion, Drought/Wildfire
IMPLEMENTATION RESPONSIBILITY: GMD, DNR
IMPLEMENTATION STRATEGIES: 1, 2, 4, 7
PRIORITY LEVEL: Moderate

Mitigation Action #19

To reduce or prevent future property damage and the loss of life or injury as a result of flooding, apply for HMGP funding for the acquisition and demolition of damaged property.

- Federal assistance is available for the acquisition and demolition of flood-damaged property or for the relocation of structures outside of the 100-year floodplain.
- All projects are subject to the conditions of Section 404 of the Stafford Act.

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: GMD, DNR
IMPLEMENTATION STRATEGIES: 1, 2, 7
PRIORITY LEVEL: Moderate

Mitigation Action #20

Identify, evaluate, and fund measures to reduce the vulnerability of critical facilities, including fire stations, hospitals and airports, to natural hazards.

HAZARD TO MITIGATE: Flooding, Drought/Wildfire
IMPLEMENTATION RESPONSIBILITY: Fire Departments, DPW, Conservation Division, Natural Resources
IMPLEMENTATION STRATEGIES: 10, 13
PRIORITY LEVEL: Moderate

PUBLIC EDUCATION AND AWARENESS

Mitigation Action #21

Increase public awareness of hazard risk and vulnerability through a public education program.

1. Provide natural hazard seminars for contractors as well as the general public;
2. Provide natural hazard pre-mitigation materials to all residents of the Town via the website, cable shows, etc;
3. Maintain, review and publicize the current action plan on an annual basis;
4. Coordinate with the County to maintain, review and publicize evacuation routes on an annual basis.

HAZARD TO MITIGATE: All
IMPLEMENTATION RESPONSIBILITY: GMD, Conservation, CSD, Town Manager, Town Council
IMPLEMENTATION STRATEGIES: 8, 9
PRIORITY LEVEL: High

Mitigation Action #22

Increase public awareness of the hazards posed by wind-born debris. Provide public information about:

1. Protection of people and personal property.
2. Window glazing and other prevention techniques.
3. Benefits of tree trimming and removal around homes at risk.

HAZARD TO MITIGATE: Wind
IMPLEMENTATION RESPONSIBILITY: Regulatory Services, CSD, Fire Departments
IMPLEMENTATION STRATEGIES: 8, 9
PRIORITY LEVEL: High

Mitigation Action #23

Prioritize public education about flood action and flood proofing. Make materials available describing simple and inexpensive means of flood proofing, which may be obtained from agencies such as FEMA.

HAZARD TO MITIGATE: Flooding
IMPLEMENTATION RESPONSIBILITY: Conservation, CSD
IMPLEMENTATION STRATEGIES: 1, 8, 9
PRIORITY LEVEL: Moderate

Mitigation Action #24

Provide landowners abutting wildfire hazard areas with information regarding fire hazards and recommendations to protect life and property from wildfire.

- The Town should advocate applicable “firewise standards” for dwellings, other structures, propane storage, and vegetation around dwellings in the wildland/residential interface.
- Provide information to appropriate landowners on fire hazards and the recommendations to protect life and property from wildfire through a series of information workshops at local fire stations.

HAZARD TO MITIGATE: Drought/Wildfire
IMPLEMENTATION RESPONSIBILITY: Conservation Division, Fire Departments
IMPLEMENTATION STRATEGIES: 4, 8, 9
PRIORITY LEVEL: High

NATURAL RESOURCE PROTECTION

Mitigation Action #25

Continue to implement the recommendations of the Wildland Fire Preparedness Plan for the West Barnstable Conservation Area, the Old Jail Lane Conservation Area, and the Hyannis Ponds WMA.

- Explore possible sources of sustained funding for the ongoing maintenance of improvements made as a result of plan recommendations.

HAZARD TO MITIGATE: Drought/Wildfire
IMPLEMENTATION RESPONSIBILITY: Conservation, Fire Departments, DCR
IMPLEMENTATION STRATEGY: 4, 10, 11, 12
PRIORITY LEVEL: Moderate

Mitigation Action #26

Restore tidally restricted salt marshes by upsizing or improving culverts, pipes or other structures to provide increased protection from flooding and storm surges.

HAZARD TO MITIGATE: Flooding
IMPLEMENTATION RESPONSIBILITY: DPW, Conservation Division, in coordination with US Army Corps of Engineers
IMPLEMENTATION STRATEGIES: 5, 11, 12, 13
PRIORITY LEVEL: Moderate

EMERGENCY SERVICES

Mitigation Action #27

Ensure continuing ability of the Barnstable Municipal Airport to aid in disaster response and recovery. Explore the need for training and awareness programs to improve the Airport's ability to respond and the potential vulnerability of the airport to disasters.

HAZARD TO MITIGATE: Flooding, Snow & Ice Accumulation, Wildfire
IMPLEMENTATION RESPONSIBILITY: Airport
IMPLEMENTATION STRATEGIES: 8, 10
PRIORITY LEVEL: Low

STRUCTURAL PROJECTS

Mitigation Action #28

Implement the recommendations of the Wequaquet Lake Dam Inspection and Evaluation Report. Recommendations of the report include:

- Conduct a detailed hydrological and hydraulic analysis for the impoundment drainage area and spillway outlet capacity;
- Complete a stability analysis of the spillway structure; and
- Develop an Operations and Maintenance Plan.

HAZARD TO MITIGATE: Dam Failure
IMPLEMENTATION RESPONSIBILITY: DPW, Natural Resources
IMPLEMENTATION STRATEGIES: 5, 12, 13
Priority Level: Low

Mitigation Action #29

Implement the recommendations of the Mill Pond Dam Inspection and Evaluation Report. Recommendations of the report include:

- Repair deteriorated concrete and stone/masonry at fish ladder entrance;
- Repair left side of man-made channel, downstream of fish ladder entrance;
- Repair spalled concrete and Notched Weirs No. 1 and 2;
- Remove vegetation and debris from Notched Weirs No. 1 and 2 and trash rack.

HAZARD TO MITIGATE: Dam Failure
IMPLEMENTATION RESPONSIBILITY: DPW, Natural Resources
IMPLEMENTATION STRATEGIES: 5, 12, 13
PRIORITY LEVEL: Low

Mitigation Action #30

Evaluate the condition of breakwaters and make repairs as necessary to ensure their long-term effectiveness for mitigating storm damage

- Repair the inner (Town) portion of the Hyannisport breakwater
- Repair the two breakwaters that protect the entrance into West Bay

HAZARD TO MITIGATE: Flooding, Shoreline Change/Coastal Erosion
IMPLEMENTATION RESPONSIBILITY: DPW, Natural Resources, Conservation, in coordination w/ USACOE
IMPLEMENTATION STRATEGIES: 5, 11, 12, 13
PRIORITY LEVEL: Low

PLAN IMPLEMENTATION

Implementation Strategies

Fiscal resources for the implementation of the actions recommended in this plan are limited. Actions that can be accomplished within the Town's existing operating budget will be identified and pursued in accordance with current department priorities. Where applicable, land acquisition and capital projects not already identified in existing plans will be incorporated and prioritized in accordance with available funds and competing town objectives.

Town plans, including the Capital Improvements Plan, Comprehensive Plan, Open Space and Recreation Plan, and Harbor Plans should be evaluated to ensure they incorporate all relevant hazard mitigation actions. Additionally, review of departmental work plans should be reviewed to see where actions can be integrated or added as special projects.

When considering implementation of the actions listed in the plan, the total cost of achieving the objective will be considered, along with the action's contribution to achieving the overall goals of this plan. A benefit-cost analysis should be conducted when prioritizing infrastructure projects. Prioritized projects should be those producing maximum benefits in relation to project costs. The benefits of a project may primarily consist of avoided damages or losses, such as:

- Damage to buildings, equipment, and infrastructure;
- Economic impacts of loss of building, public services, net business income and costs for temporary quarters;
- Avoided emergency response;
- Economic impacts of loss of function of roads, bridges, utilities, and travel costs; and
- Death and injury.

Implementation Resources

Possible funding sources for the actions identified in this plan include the following:

- General Funds – For planning and infrastructure projects
- Community Preservation Act Funds – For acquisition of open space
- FEMA Pre-Disaster Mitigation Program – For mitigation of flood-related hazards
- FEMA Flood Mitigation Assistance Grants – For mitigation of flood-related hazards
- FEMA Severe Repetitive Loss Grant Program – For acquisition, elevation, or flood-proofing of Severe Repetitive Loss Properties (residential properties with 4+ losses)
- FEMA Hazard Mitigation Grant Program – For mitigation of flood-related hazards
- Massachusetts Office of Coastal Zone Management SmartCoasts program – To address coastal storm damage and sea level rise issues
- Massachusetts Office of Coastal Zone Management Coastal Estuarine Land Conservation Program - To purchase significant coastal and estuarine lands (or conservation easements on

such lands) that are considered important for their ecological, conservation, recreational, historical, or aesthetic values

- Federal Land and Water Conservation Fund - For the acquisition, development and renovation of park, recreation or conservation areas
- Energy and Environmental Affairs Division of Conservation Services LAND Program – For acquiring land for natural resource and passive outdoor recreation purposes
- Department of Fish and Game Landowner Incentive Programs – To restore or create wildlife habitat for the benefit of species-at-risk on private lands
- Cape Cod Cooperative Extension – For development and implementation of wildland fire hazard mitigation plans
- Department of Conservation and Recreation Forest Stewardship Program – For development of management plans for woodlands
- US Army Corps of Engineers Hurricane and Storm Damage Reduction Programs - To study, design, and construct small coastal storm damage reduction projects
- US Army Corps of Engineers Flood Damage Reduction Programs - To study, design, and construct small flood control projects
- US Army Corps of Engineers Emergency Streambank and Shoreline Protection Program - to construct emergency shoreline and streambank protection works to protect public facilities and non-profit public facilities, such as churches, hospitals, and schools
- US Army Corps or Engineers Aquatic Ecosystem and Environmental Restoration Programs – To plan, design and build projects to restore aquatic ecosystems for fish and wildlife

PLAN MAINTENANCE

Plan Monitoring and Evaluation

Periodic monitoring and reporting on this plan is necessary to ensure appropriate and timely plan implementation. The MHM team (or other group, should the Town Manager or Town Council dictate) will be responsible for conducting an annual review of the plan. The annual review should include an evaluation of the identified mitigation actions to monitor their appropriateness, progress, and prioritization.

The MHM team should also evaluate the Plan after disaster events to examine the effectiveness of mitigation strategies and the impact of disasters on critical facilities and other infrastructure. If necessary, recommendations for revisions or amendments should be made in response to the evaluation.

Any revisions or amendments made to the Plan should be done with the approval of the Town Council. Proposed amendments should be distributed to all relevant Town Departments and other interested parties for review. The public should be made aware of pending changes through traditional channels and an open review and comment period should be established. Proposed and adopted amendments should be sent to the Cape Cod Commission and to MEMA.

The Plan will be updated every five years in accordance with FEMA requirements. The MHM team will reconvene to reevaluate the Town's risks and vulnerabilities. The team will evaluate new development patterns, increased exposure to risk, advances in mitigation capabilities or techniques, or changes in Federal, State, or County legislation. An analysis of the plan mitigation strategy and action items will be conducted to ensure all measures are appropriate.

SOURCES

Town of Barnstable Comprehensive Plan. Growth Management Department, 2010.

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