

## Section 1: Introduction

### Hazard Mitigation

In the context of natural disasters, *hazard mitigation*<sup>1</sup> is commonly defined as any sustained action that permanently reduces or eliminates long-term risk to people, property, and resources from natural hazards and their effects.

In the context of this Local Multi-Hazard Mitigation (MHM) Plan *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. *Risk* can be defined as “hazard; danger; peril; exposure to loss, injury, or destruction” or “the possibility of suffering harm or loss.” The Town’s hazard risk assessment determines which areas of Eastham may be affected by a natural hazard, how likely it is that a given hazard may occur, and how intense that hazard might be.

*Vulnerability* can be defined as “susceptibility to injury or attack.” Vulnerability indicates what is likely to be damaged by the identified hazards and how severe the damage might be. For example, if an area is determined to be at risk of flooding, vulnerability estimates could include potential residential property losses, impacts to the tax base and damages to public infrastructure in that area.

*Hazard mitigation planning* is the process that the Local Multiple Hazard Community Planning Team underwent to analyze our Town’s risk from natural hazards, to coordinate available resources, and to develop a strategy to implement actions to eliminate risk.

### Plan Benefits

The purpose of Eastham’s *Multi-Hazard Mitigation (MHM) Plan* is to fulfill the local hazard mitigation planning requirements of the federal *Disaster Mitigation Act of 2000 (DMA 2000)*, Section 322 (a-d). The MHM Plan identifies hazards; establishes local goals and objectives and selects mitigation activities that are appropriate for the Town of Eastham. The DMA 2000 requires that local governments, as a condition of receiving federal disaster mitigation funds, adopt a MHM Plan describing the municipalities process for identifying hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, encouraging the development of local mitigation and providing technical support for those efforts.

### Planning Process

On, June 2, 2003, the Eastham Board of Selectmen established the Local Multiple Hazard Community Planning Team (the “Planning Team”) consisting of two members of the Board of Selectmen, the Police Chief, Department of Public Works Superintendent, Building Inspector, Health Agent and Town Planner. The local team was updated by the Selectmen on May 18, 2009 in anticipation of the five-year recertification.

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<sup>1</sup> Definitions and text adapted from “Strategy for Reducing Risks from Natural Hazards in Narragansett, Rhode Island: A Multi-Hazard Mitigation Strategy, June 1999” and the Barnstable County MHM Plan.

Planning Team members are listed in Table 1. Activities and research were also coordinated with the Town’s Natural Resources Department, Harbormaster and Fire Department. In the future, as the Town moves forward in implementing the recommendations of this MHM Plan, the Planning Team may be expanded to include Conservation Commissioners and members of the general public.

**Table 1:** Eastham’s Local Multiple Hazard Community Planning Team

Martin McDonald, Chair Eastham Board of Selectmen 2500 State Highway Eastham, MA 02642 (508) 240-5900	Frank DeFelice, Building Inspector Eastham Building Department 2500 State Highway Eastham, MA 02642 (508) 240-5900 x 228
Aimee Eckman, Member Eastham Board of Selectmen 2500 State Highway Eastham, MA 02642 (508) 240-5900	Jane Crowley, Health Agent Eastham Board of Health 2500 State Highway Eastham, MA 02642 (508) 240-5900 x 229
Kenneth Roderick, Deputy Chief Eastham Police Department 2550 State Highway Eastham, MA 02642 (508) 255-0551	Sarah Raposa, Town Planner Eastham Planning Department 2500 State Highway Eastham, MA 02642 (508) 240-5900 x 202
Neil Andres, Superintendent Department of Public Works 555 Old Orchard Road Eastham, MA 02642 (508) 240-5973	Amy Usowski, Deputy Natural Resources Officer Department of Natural Resources 555 Old Orchard Road Eastham, MA 02642 (508) 240-5971

The MHM Plan was developed locally within a regional context with guidance from the Regional Planning Agency (RPA) or Cape Cod Commission (CCC). A Planning Team representative attended monthly Multi-Hazard Mitigation (MHM) workshops sponsored by the CCC to provide local municipalities with a framework and resources to develop a local plan. Planning Team members would typically meet bi-monthly (after the regional meetings) to work on task assignments to move forward on developing a Draft MHM Plan. Additionally, members of the local team participated in Comprehensive Emergency Management Plan meetings to identify additional areas of contribution and overlap. The Town Planner met with individually with various staff members to focus on past actions that may have occurred outside of the MHM framework for consistencies which would qualify as implementation.

Numerous reports, plans and documents were reviewed in this update. In addition to the framework of the 2004 Pre-Disaster Mitigation Plan, the Local Team reviewed the Local Comprehensive Plan (2002), Open Space and Recreation Plan (2009), the draft Housing Production Plan (2010, pending), the current Comprehensive Emergency Management Plan, and Eastham’s Region V Emergency Operations Plan (2005). The MHM is also a reference for incorporation into future updates of the aforementioned planning efforts.

Detail is provided in each section on the process or actions taken by the Local Team as appropriate i.e. Critical Facilities and Vulnerabilities, Sheltering, Risk Assessment, Protections and Strategies.

**Regional Multi-Hazard Mitigation Planning Team Meeting Schedule**

July 7, 2009	1:00-2:00 pm	Timothy Smith Room, Town Hall	MHM Plan
September 1, 2009	1:00-2:00 pm	Timothy Smith Room, Town Hall	MHM Plan
November 3, 2009	1:00-2:00 pm	Timothy Smith Room, Town Hall	MHM Plan
November 12, 2009	9:00-11:00 am	Timothy Smith Room, Town Hall	CEMP
January 11, 2010	9:00-11:00 am	Timothy Smith Room, Town Hall	CEMP

The plan has been available on the Town's website<sup>2</sup> for review since December 11, 2009 and presented to the public at a Board of Selectmen meeting on April 5, 2010.

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<sup>2</sup> [http://www.eastham-ma.gov/Public\\_Documents/EasthamMA\\_Planning/MHM\\_Plan/](http://www.eastham-ma.gov/Public_Documents/EasthamMA_Planning/MHM_Plan/)

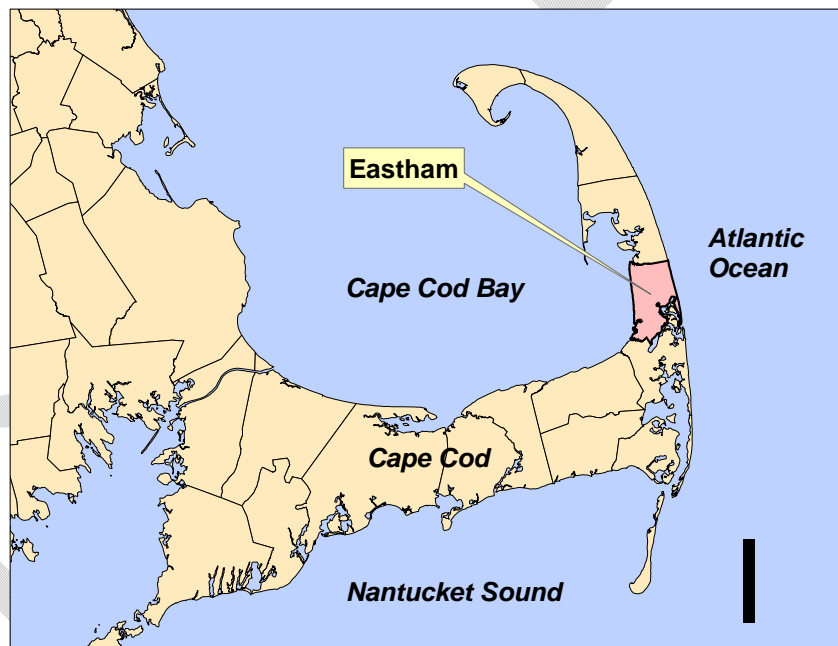
## Eastham Conditions

The Town of Eastham is located on a strip of land lying across the base of the “outer arm” of Cape Cod in Massachusetts. Eastham is approximately three (3) miles wide from east to west and approximately seven (7) miles long from north to south. The Town is bounded to the north by the Town of Wellfleet, on the south by the Town of Orleans, on the west by Cape Cod Bay and on the east by the Atlantic Ocean (Figure 1).

Eastham encompasses a total area of approximately 27 square miles, an upland area of approximately 14 square miles and has over 37 miles of tidal shoreline. The Town is located approximately 99 miles southeast of Boston, 96 miles east of Providence, Rhode Island and 25 miles east of Hyannis.

The Cape Cod National Seashore, authorized by Congress in 1961, comprises one-third of Eastham’s area (3,000 acres), including most of its six and one-half (6½) mile Atlantic Ocean shoreline, stretching from Orleans to Wellfleet.

**Figure 1:** Eastham Location Map



## ***Climate***

Eastham experiences the New England humid continental climate, characterized by a moderate to wide annual temperature range with well developed winter and summer seasons with average winter temperatures ranging between 27°F and 41°F rising to a summer average range of 56°F to 78°F. However, the July average daily maximum is from two to three degrees lower on the Cape than inland areas due to the cooling effect of summer afternoon breezes. The ocean also serves as a reservoir of warmth in the winter as January and February average daily temperatures are several degrees warmer than that of mainland Massachusetts.

Annual precipitation averages 48 inches, occurring on an average of 120 days and fairly evenly distributed throughout the year. Receiving an average of 37 inches of snow in 17 days, the Cape can also experience severe winter coastal storms (northeasters), with strong northeast winds, low clouds and a steady driving rain or snow. Of the 48 inches of average precipitation, approximately 16 inches filters through to replenish the water table.

With an average humidity of 75 percent, fog is relatively frequent and dense due to the cooler ocean water surface temperatures in the summer, which tends to reduce formation of strong vertical air movements. Thunderstorms are less common over the Cape than over the mainland.

## ***Geology***

Cape Cod and Eastham owes its existence to glacial deposits derived from the last ice sheet which moved over southeastern New England. Glauconite, fossil material, and the sparsity of feldspar in the glacial sand suggest that the ice sheet overrode coastal plain and shelf sediments of Pleistocene and pre-Pleistocene age before reaching Cape Cod. During deglaciation of southern New England, the topography of the continental shelf played a major role in determining the pattern of ice retreat. Major lobes formed in the relatively shallow basins on the shelf.

## ***Soils***

The climatically associated soils on Cape Cod are podzols. Their existence in this less than normal hostile climate is due to the porosity of the glacial material and the rapid leaching associated with it. The remaining sediments that are characteristic of the Eastham area are interior and coastal sands deposited by wind actions either along the present coast and associated with wave action or those sands associated with direct glacial deposition. Wet sediments found in and near salt marshes and freshwater swamps are also quite prevalent, particularly in southern and coastal Eastham areas.

## ***Topography***

Like most of Cape Cod, Eastham's terrain is level to gently rolling with land mass elevations generally from sea level to sixty feet above sea level. Perhaps the most significant feature of the topography is the nearly one half of the Town covered by water. Eastham might be considered the "low country" of the Cape, with many points of saltwater infiltration occurring at elevations below sea level. The most dramatic topographical features occur along the Atlantic Ocean coast where steep cliffs or bluffs are formed by the erosion of sand dunes.

## ***Population Trends***

The population of the Town of Eastham has grown steadily and substantially for many years. More recently, from 1970 to 2000, it has increased from 2,043 to 5,453. Even during the most recent decade it has grown another twenty-two percent (22%). The special characteristics of Eastham's population have a special impact on the community. The resident population has gotten older. The median age remained fairly steady from 1970 to 1990 and increased substantially during the nineties from 41.7 years to 47.6 years in 2000. Furthermore, there is a larger and growing seasonal component ("shoulder" season) in the summer population. In 1990 the daily summer population was estimated to be 21,800 and by 2000 it was conservatively estimated to be 27,500. This is a twenty-six percent increase as compared with the twenty-two percent increase in the resident population over the same time period. The Eastham Police Department, which annually projects daily summer population, estimates the 2009 value to be approximately 30,000.

These dramatic changes in Eastham's population are supported by increasing income, increased mobility of people, the draw of the National Seashore and other natural attractions as well as by the general appeal of the character of the community. Such growth and changes in population impacts the use of the land and relationships with natural systems. The management of the responses to these developments will determine the extent to which the mission and goals of this plan are achieved.

The likely impacts felt in the Town by this projected growth in population will include increased local and through traffic, demand for additional services and pressure for additional residential development, including the conversion of seasonal homes to year-round homes. Eastham's population has increased by an additional twenty-two percent or 991 people, between the years 1990 and 2000. The town's population is projected to continue to increase to 7,280 by 2010.

It should also be noted that the population projection does not account for potential conversion of over 3,000 existing seasonal homes to year-round dwelling units. Although the rates of conversion have not been predicted there is evidence to show that such conversions have been occurring. The United States Bureau of the Census reports that in 2000 more than 43% of all housing units were occupied year-round while in 1990 the comparable ratio was only 39%. There is a movement toward year-round use of housing. "Conversion" is a matter of use or occupancy. Other factors which could influence conversions include improved transportation and communications and the continued growth of the surrounding areas. The full conversion of seasonal to year-round housing units would have twice the potential impact on Eastham's municipal infrastructure, services and finances than would result with the complete development of the remaining vacant residential land in town.

## ***Existing and Future Development Patterns***

There are approximately 1,200 acres of vacant developable land with the potential for additional residential development. The potential residential buildout for Eastham under the current zoning is approximately 734 additional housing units resulting in a total of 6,000 units at buildout. Over the last 25 years Eastham has averaged 103 new housing units per year. Using that average rate, Eastham it was projected that residential buildout could be reached by 2006. More recently, new housing units have averaged at 38 per year (2005-2008), with 2008 creating just 11 new units (mostly due to the volatile economic climate) making a buildout year less predictable. Buildout



figures do not account for approximately 400 grandfathered lots that are below the current zoning requirements but are protected under MGL.Ch.40A. While these grandfathered lots could be built without regard to current zoning, they are subject to other Town by-laws and regulations. That, combined with the lack of sewer or water service, will reduce the number of potential units.

There are approximately 37 acres of commercial land and 25 acres of industrial land available for development. If all the land is used, there could be eleven and one-half (11.5) acres or about five hundred thousand (500,000) square feet of gross floor area of commercial development and seven and one-half (7.5) acres or about three hundred and twenty-seven thousand (327,000) square feet of gross floor area of industrial development. It should be noted that most of the vacant industrial land has inadequate access at this time due to lack of frontage on a private way.

Major challenges face the Town including whether future development will change the character of Eastham, and how to pay for the increased demands placed on municipal services by the development of the remaining vacant land and conversion of seasonal to year-round housing units. The configuration of the Town, its existing land use pattern, traffic volume along Route 6, fiscal constraints and lack of a public water supply or wastewater disposal limits the options. Presently land use development is guided by local ordinances, in accordance with the MGL Chapter 40A (The Zoning Act) and MGL Chapter 81 (The Subdivision Control Law).

In the context of hazard mitigation planning, the current population and seasonal visitation trends coupled with a diminishing amount of easily developable land with minimal constraints will place increasing pressure on lands considered marginally developable. Additionally, the dense development patterns established prior to enactment of zoning controls on the western side of Town near Cape Cod Bay will also face considerable redevelopment pressures, often in environmentally sensitive areas. Continued oversight of development and redevelopment in areas adjacent to coastal water bodies/marshes, as well as those adjacent to inland Wetland Resource Areas, will be critical to eliminate and mitigate the potential for losses as a result of natural hazards.

### **Town Goals Supporting Hazard Mitigation**

While hazard mitigation is not explicitly mentioned as a guiding principle in the Comprehensive Emergency Management Plan (CEMP), Local Comprehensive Plan (LCP) or Open Space and Recreation Plan (OSRP), components of such an approach are indicated in various goals, performance standards and recommendations found in both of these documents. Additionally, the Board of Selectmen have consistently supported Town Meeting Articles to purchase or acquire (land swaps) parcels containing both sensitive wetlands and floodplain on portions of the property for conservation purposes, removing them from future potential development and creating potential hazards.

The practice of acquiring environmentally sensitive lands has resulted in many acres being removed from potential development and the corresponding placement of structures in locations susceptible to damage from natural hazards.

## **Eastham's Goals for Hazard Mitigation**

The 2004 Plan identified six (6) goals established by the Town of Eastham for purposes of developing a strategy to implement actions to eliminate risk. The 2009 Local Planning Team review and concurred with the existing goals as they were meant to be general and broad in nature and can only be achieved through the long-term implementation of more specific objectives. Each Goal listed below will be more specifically addressed and realized through the implementation of an Action Plan, defining short-term mitigation objectives and actions established and maintained in *Section 5: Mitigation Strategy*. The goals of Eastham's MHM Plan are as follows:

**Goal #1** - Reduce the potential for loss of life, property, infrastructure, and environmental and cultural resources in Eastham from natural disasters.

**Goal #2** - Coordinate local hazard mitigation planning activities with those of Barnstable County and neighboring towns.

**Goal #3** - Seek for and take advantage of funding opportunities to implement the Plan.

**Goal #4** - Mitigate potential financial losses incurred by municipal, residential and commercial establishments due to disasters.

**Goal #5** - Ensure that mitigation measures are context sensitive to natural features, historic resources, and community character.

**Goal #6** - Increase the public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.



## Section 2: Hazard Analysis and Risk Assessment

### Geographical Position

The Town of Eastham is vulnerable to a host of hazards including hurricanes, earthquakes, coastal and inland flooding, culvert/bridge failure, wildfires, drought, and winter storms; although the Eastham is most vulnerable to hurricanes, severe winter storms, and floods. Other hazards pose potential risks to the Town's population and property. To spatially evaluate the range of potential hazards to conduct a risk analysis, a series of maps were developed by the CCC and reviewed by the Planning Team. The content of those maps is described in the following section.

### Hazard Mapping (Maps – Appendix)

**Risk and Vulnerability Assessment** – This map depicts the locations of critical facilities and infrastructure, Med Flight locations, extent of “A” and “V” flood zones, Repetitive Loss properties, evacuation routes and indication of facilities located Sea, Lake and Overland Surges from Hurricanes or SLOSH zones. Critical facilities were also grouped into functional areas (i.e., shelters, public safety facilities, etc.).

**Hazard Risk Map 1** – Historical occurrences of tornadoes, earthquakes, landslides and shoreline change are noted on this map.

**Hazard Risk Map 2** – This map indicates average annual snowfall amounts and tracks of hurricanes in the Eastham vicinity.

**Hazard Risk Map 3** – Local areas of wildfire risk and the wildland/urban interface are mapped and relationships with residentially and commercially developed areas are also indicated.

### Historical Damage/Events

#### *Winter Storms*

Review of historical accounts point to the winters of 1716, 1874-1875 and 1978 having significant distinguishing characteristics. Sidney Perley's 1891 classic book chronicled every major New England weather event. Perley noted, '*Snow fell in considerable quantities several times during the month of January, and on February 6 it lay in drifts in some places twenty-five feet deep, and in the woods a yard or more on the level.*'

In more recent memory, the Blizzard of 1978, referred to some as the 'Storm of the Century' wreaked havoc along the Cape and Eastham in particular. At Coast Guard Beach in Eastham, storm surges from the storm breached the dune line, flattening 90 percent of the dunes themselves, carrying out most of the beach cottages, including Henry Beston's Outermost House. This storm totally destroyed a bathhouse and parking lot. The Blizzard of 1978 still holds the record for the highest storm total and 24 hour total snowfall ever in February. In this storm 23.6 inches of snow fell in 24 hours (Laurel Guadazno, Provincetown Banner).

## *Hurricanes*

Eastham's maritime position adjacent to the Atlantic Ocean, makes it most vulnerable to hurricanes between June and October. Recent hurricanes which have made landfall near the Cape are Gloria (1986) and Bob (1991). The probability of a hurricane occurring on the outer Cape is approximately 7 percent for any given year (Simpson and Lawrence, 1971). Despite the fact that the eye of Hurricane Bob in 1991 missed Eastham by almost 100 miles, tree damage was severe and electric service was lost for up to ten (10) days in some locations.

## *Erosion*

The average rate of erosion along the Atlantic shore is about 3.1 feet per year (Ziegler et al, 1964); along the Cape Cod Bay shore it is somewhat less. Major changes in the shoreline resulting from erosion and deposition occur primarily during storm events coupled with "spring" tides. When erosion threatens structures which are not easily relocated, such as the numerous cottages along the Cape Cod Bay cliffs, property owners have sought to stabilize the bank with engineered structures such as bulkheads or revetments. The net effect of these structures is to reduce the amount of sand available to the beach and consequently the barrier beaches at Sunken Meadow and First Encounter. Various alternatives have been utilized, such as nourishment using sand from inland sources, "soft" solutions using sand bags; vegetative cover and sand drift fencing.

Recent changes in the offshore sand bars near Nauset Light Beach have resulted in accelerated erosion. As a result, the lighthouse structure was in danger of collapsing into the sea. A coordinated effort of private citizens, the Cape Cod National Seashore and the United States Coast Guard provided for the safe removal of the structure to a more landward location in the fall of 1996. Erosion along the dune at Coast Guard Beach in 1992 revealed artifacts of an encampment. A team of National Park Service (NPS) archaeologists completed a detailed examination of the site over a period of ten (10) months and documented valuable information about the inhabitants some 8,000 years ago.

## *Floods*

Eastham, because of its coastal New England location, is highly susceptible to northeasters. A northeaster travels in a southwest to northeast direction along the Atlantic coast collecting moisture over the ocean and sending it inland via northeast winds. Northeasters differ from hurricanes in that they cover a large area. While a hurricane may last for several hours, a northeaster may last for several days; therefore northeasters usually are accompanied by at least one (1) high tide, increasing the severity of coastal flooding.

In addition to flooding, damaging waves may accompany the tidal surge in coastal areas. Both the eastern and western shorelines of Eastham are subject to wave action. The storm of 1978 has been designated approximately a 100 year event, causing inundation along much of Eastham's shoreline below elevations of ten (10) to twelve (12) feet. The strength of this storm was demonstrated by the loss of public beach area and the parking lot at Coast Guard Beach on the Atlantic Ocean.

The dunes and the bath house at Coast Guard Beach were also lost to the attacking waves, while the storm surge inundated the bike trail bridge. Storm waters washed many locations at Nauset

spit carrying away houses and eroding dunes. At Nauset Light Beach, waves eroded the base of the cliffs, causing some damage to the parking lot. Many areas were inundated by the storm surge including the parking area at Rock Harbor, houses along Town Cove on Ellis Road and portions of Bridge Road.

During the Storm of January 9, 1978, the bayside beaches suffered erosion due to gale force winds from the southwest occurring at the peak of the tide. These areas suffered further damage during the February storm from the tidal surge which elevated waters at least three feet above the normal high tide. Winds, however, were from the northeast at the time of the peak tides; therefore, waves were not generated that would damage south and west facing shorelines.

In October of 1991, the so called "Perfect Storm" formed in the Atlantic Ocean as a result of three storm systems combining into one massive storm. As this storm traveled off the coast of Cape Cod, strong storm surf, driving rain and associated high winds, with gusts above hurricane force recorded at Chatham, damage rivaling the "Blizzard of 78" was experienced. Along the western shore of Town Cove, flooding at Collins Cottages far exceeded that associated with the "Blizzard of 78" by over 20 inches, with close to 4 ½ feet of water flooding the "shucking house" and the lower level of the main house above the existing seawall on the site. Additionally State Highway (Route 6) flooded in the vicinity of Mary Chase Marsh and was closed for approximately two (2) hours.

### ***Shoreline Change***

The alignment of the seaward shore of Nauset Beach and the cliffs cut in the glacial deposits to the north suggest that the shoreline is retreating westward at a constant rate. Material eroded from the glacial deposits is transported by waves and currents and deposited at the distal end of the spits as shoals or beach deposits. During storms the seaward shore of the spits is eroded and beach deposits are deposited several feet above normal high tide. Locally, storm waves cut channels (storm sluices) through the spits and dunes, carrying material into the lagoon where it is deposited as over wash fans which re-vegetate in succeeding seasons.

Recent, generalized long-term shoreline change mapping indicates Eastham's Atlantic shoreline is eroding at a rate of greater than two (2) feet per year. Shoreline change along the Cape Cod Bay shoreline ranges between zero (0) – one (1) and one (1) – two (2) feet per year.

### ***Shoaling***

Sea cliff erosion of glacial deposits and long shore transport of beach sand provide sediment for the growth of spits in the Ocean and sediment deposition in the Bay. The location of Nauset Inlet is a dynamic entity, subject to seasonal tidal cycles, weather patterns and episodic storm events. The entrance to Rock Harbor Creek, is subject to sediment deposition over time, reducing the depth of its navigation channel.

### ***Wildfire***

The three principal factors affecting wildfires are topography, fuel and weather. A fire's rate of spread varies directly with wind velocity. Other hazards may trigger wildfires, and wildfires may contribute to other hazards. For example, high winds can result in downed power lines, which can start fires.

Due to the large amount of contiguous undeveloped land, mostly with the boundary of the National Seashore, significant potential for wildfire exists in Eastham. Lack of a municipal water supply adds concerns and highlights the needs to coordinate closely with the National Seashore on responses and mitigative actions to wildfire threats. Special attention should be given to areas of the urban/wildland interface where vegetation and the built environment provide fuel. National Seashore data indicates an average of 10.7 wildfires per year, mostly attributable to campfires and unknown causes.

### ***Drought***

A drought can best be described as a deficiency of rainfall causing a shortage of available water. Droughts can result in inadequate levels of water available for residential, commercial, recreational uses and fire fighting. The Cape is perceived as “water-rich”, however, it can experience extended periods of dry weather, from single season events to multi-year events. As recently as 2002 and early 2003, The Massachusetts Drought Management Task Force - a multi-agency coordinating body, issued a Drought Advisory for the Cape and Islands Region as a result of long-term below normal groundwater levels. However, no known water supply shortages have been linked to any prolonged dry periods to date; although, in the summer months with the increased number of residents and vacationers, the aquifer experiences a drawdown.

### ***Earthquakes***

No earthquakes have been recorded in Eastham, but the Regional MHM plan provides information about and a history of earthquakes in the Northeast and locates the epicenter of three earthquakes that have been recorded on Cape Cod, including Harwich in 1847, Falmouth in 1961, and Chatham in 1976.

### **Climate Change**

#### ***Climate Change in Barnstable County, Massachusetts***

It is by now clear that climate change is real; observations show that there is no question that the climate has warmed over the past century about 1.5°F globally and the same for the US. It is also projected by the Intergovernmental Panel on Climate Change (IPCC, 2007), through the use of many global climate models, that global and US temperatures could rise between 2 and 10 °F by the end of the century (depending on what choices are made around energy use and emissions). Many of the changes that have already been observed, for instance increased air and water temperatures, reduced snow cover and glaciers, increased frequency and intensity of heavy downpours, and rising sea levels are expected to continue while new ones will likely emerge, such as increased intensity of hurricanes. Trends will continue for generations—even if mitigation is extremely successful. These expected changes will result in some impacts that are valued as positive, such as longer growing seasons, and some as negative. For our region, these negative impacts will include increases in storm surge, wind, and rainfall.

According to the “*Global Climate Change Impacts on the United States*” (CCSP, 2009) document the northeast of the US has already experienced an increase in annual average temperature of 2°F and the winters are warming at twice that rate. This level of warming has already contributed to: more frequent days above 90°F, increases in heavy precipitation events which contribute to localized flooding, increases in sea surface temperatures that contribute to

strengthening hurricanes, and rising sea levels that contribute to increasing damage from storm surge. Temperature increase projections above historical levels for this region in the future range from the lower emissions level of 4 to 6 °F in winter and 3 to 7°F in summer to twice that much change projected for a high emissions scenario.

The second climate change related issue that is very likely to become an even larger problem for the Cape Cod region over time is sea-level rise. Sea-level rise is already occurring at various rates around the US coastal region. The projections for the rates of sea-level rise are uncertain at this time; however, projections for this region include an increase that is more than the global average (CCSP, 2009, pg. 107).

Sea-level rise combined with the possibility for stronger storms including greater winds, increasing storm surge, and greater amounts of precipitation could lead to increases in inundation, flooding, and erosion in the coastal areas. The projections include the now once-in-a-century flood in Boston to change its frequency to become every two to three years by mid-century. This could result in shoreline change in some areas and become more and more problematic especially for populated areas, recreational areas, and infrastructure. All of these potential changes could result in impacts that would include increases in potential regional hazards with resulting economic ramifications for the region and specific local areas.

## **Hazard Analysis**

### ***Hazard Identification***

Historically, the Town of Eastham has sustained damage from flooding, storm tides/surges, and high winds associated with hurricanes, nor'easters, and heavy rains. However, this MHM Plan and its mitigation strategy addresses multiple natural hazards, even those assessed with low probability. As part of the development of this Plan, the Planning Team developed a matrix intended to be a planning tool for hazard assessment purposes to help Eastham determine its most likely and most potentially damaging natural hazards. The Planning Team applied their best professional judgment and solicited information and knowledge from various sources (historical data and Town employees) to consider as comprehensively as possible, potential natural hazards in Eastham.

The range of risks identified by the Planning Team posing potential damage to life and property include:

- Wind (from hurricanes, nor'easters, tornadoes)
- Flood (from coastal storm surge, storm tides & wave action, erosion, and sea level rise)
- Shoreline erosion (from shoreline change)
- Wildfire
- Snow and ice (severe winter storms)
- Earthquakes
- Drought



## *Hazard Rating*

In order to establish the potential degree of impact of the identified hazards within Eastham, the Planning Team applied a rating system to evaluate the location (geographic extent), frequency of occurrence and magnitude/severity of each identified hazard. A Hazard Rating System (Table 2) was applied to the hazards identified above. Each hazard's ranking was determined by adding the rating scores for location, frequency and magnitude/severity (Table 3).

**Table 2:** Hazard Ranking

<b>Location</b>	
<b>1=small</b>	(isolated to a specific parcel, building, intersection, or neighborhood)
<b>2=medium</b>	(occurring in multiple locations across town during one event)
<b>3= large</b>	(affecting a significant portion of town during one event)
<b>Frequency of Occurrence</b>	
<b>0=unlikely</b>	(less than 1% probability in the next 100 years)
<b>1=possible</b>	(between 1 – 10% probability in the next year; or at least one chance in next 100 years)
<b>2=likely</b>	(between 10-100% probability in the next year; or at least one chance in next 10 years)
<b>3=highly likely</b>	(Near 100% probability in the next year)
<b>Magnitude/Severity</b>	
<b>1=limited</b>	(injures 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%)
<b>2=significant</b>	(injuries and/or illness do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%)
<b>3=critical</b>	(injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50%, >25%)
<b>4=catastrophic</b>	(multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%)

Source: Cape Cod Commission



**Table 3:** Hazard Identification Matrix – Ranked by Hazard Score

<i>Natural Hazard:</i>	<i>Location</i>  <i>RATE:</i> <i>1=small</i> <i>2=medium</i> <i>3= large</i>	<i>Frequency of Occurrence</i>  <i>RATE:</i> <i>0=unlikely</i> <i>1=possible 2=likely</i> <i>3=highly likely</i>	<i>Magnitude / Severity</i>  <i>RATE:</i> <i>1=limited</i> <i>2=significant</i> <i>3=critical</i> <i>4=catastrophic</i>	<i>Hazard Score</i>
<b>Flood</b>	2	3	4	<b>9</b>
<b>Wind</b>	3	2	2	<b>7</b>
<b>Chronic Erosion</b>	2	3	2	<b>7</b>
<b>Fire</b>	2	2	2	<b>6</b>
<b>Snow &amp; Ice Accumulation</b>	3	1	2	<b>6</b>
<b>Geologic</b>	3	0	1	<b>4</b>
<b>Drought</b>	2	1	1	<b>4</b>
<b>Climate Change</b>	2	1	1	<b>4</b>

Flooding remains Eastham’s most prolific hazards affecting property in this update. The Local Team reviewed the information and agreed that wind and erosion continue to have high hazard metrics as well. Fire and snow and ice accumulation continue to have mid-range hazard scores. Geologic factors (earthquakes, landslide, sink holes and tsunamis) are grouped together and remain a lower hazard score, as do drought and climate change. These lower-scored naturally occurring hazards occur rarely and have lower levels of severity than flooding, wind and erosion, but remain on the matrix due the past regional occurrences. The Plan identifies areas in Eastham affected by such hazards in Section 3.

## Section 3: Vulnerability Assessment

### Critical Facilities and Infrastructure

To establish a planning baseline, the Planning Team used the “Risk and Vulnerability Assessment Map / Local Critical Facilities Map” (Appendix Map 1) generated by the CCC to review locations of critical facilities and infrastructure in the context of Hazard Mitigation Planning. The 2009 Planning Team reviewed and commented on a draft map created by the CCC. Thirteen (13) critical facilities are located within Eastham falling into eight (8) of the twelve (12) functional categories identified for the region (Table 4).

**Table 4:** Eastham’s Critical Facilities

CRITICAL FACILITY OR INFRASTRUCTURE	ADDRESS	SLOSH (Y/N)	FIRM (Y/N)	WILDFIRES (Y/N)
Emergency Operations Center (Police Station)	2550 Rte.6	NO	NO	NO
Eastham Town Hall	2500 Rte. 6	NO	NO	NO
Nauset Regional High School	100 Cable Rd.	NO	NO	<b>YES</b>
Eastham Fire Department	2520 Rte. 6	NO	NO	NO
Council On Aging	1405 Nauset Rd.	NO	NO	<b>YES</b>
Department of Public Works / Transfer Station / Natural Resources	555 Old Orchard Rd.	NO	NO	NO
Public Library	190 Samoset Rd.	<b>YES</b>	<b>YES</b>	NO
Eastham Elementary/ After School Program	200 Schoolhouse Rd.	NO	NO	<b>YES</b>
The Children's Place	Foster Ave.	NO	NO	<b>YES</b>
Nauset Kennels	2685 Nauset Road	NO	NO	NO
Eastham Veterinary Hospital	725 State Highway	NO	NO	NO
Salt Pond Visitors Center	Nauset Road	NO	NO	NO
NEEDS Building / Old Coast Guard Station	Ocean View Dr.	NO	NO	NO

Of the thirteen (13) critical facilities identified, only one of the parcels was identified in a Special Flood Hazard Area (SHFA) and SLOSH zone. However, it should be noted that actual facility, the Library, is located above the floodplain indicated on the FIRM, only lower portions of the lot directly adjacent to Depot Pond area subject to storm flooding. In a 100 year storm event access to the facility would not be compromised. Additionally, the Library is not designated as a shelter location. In a widespread flooding event all of Eastham’s critical facilities would not be expected to be inundated with water.

Access to the NEEDS Building could be impacted by a Category 4 storm surge, but the facility itself is not in a SLOSH zone.

The CCC conducted an analysis to assess wildfire hazards for the Region. Undeveloped areas, unfragmented forest land greater than forty (40) and marshes greater than three (3) acres, were evaluated in relation with their proximity to developed land uses. This mapping exercise identified areas of Wildfire Risk and the Wildland/Urban Interface (see Appendix Map 4). A total of four (4) of Eastham’s thirteen (13) critical facilities are located in areas susceptible to wildfires. Nauset Regional High School, Eastham Elementary School and the Children’s Place

are all located in an area identified as Wildfire Risk. Eastham’s Council on Aging is located at a Wildland/Urban Interface.

As an update to the 2004 Plan, the CCC analyzed locations of “Tier II Reporters” in the Risk and Vulnerability Assessment. Facilities covered by Emergency Planning and Community Right-to-Know Act (EPCRA) requirements must submit an Emergency and Hazardous Chemical Inventory Form to the Local Emergency Planning Committee (LEPC), the State Emergency Response Commission (SERC), and the local fire department annually. Facilities provide either a Tier I or Tier II form. Most States require the Tier II form. Some states have specific requirements in addition to the federal Tier II requirements.

Eastham has two (2) current (2010) Tier II reporters: Cape Cod Ready Mix is located at 175 Holmes Road and the DPW facility at 555 Old Orchard Road. Another reporter (Laidlow Transit Inc.), also located on Holmes Road, closed its facility in 2009 and no longer reports.

### **Vulnerability Analysis**

The Planning Team used the map identifying critical facilities and infrastructure to review potential vulnerabilities during the natural hazard events identified and described in *Section 2: Analysis and Risk Assessment*. To clearly and efficiently evaluate all of the potential natural hazards identified by the Planning Team, the location and extent of possible specific areas were identified. A descriptive locations chart was developed that grouped potential natural hazards, identified cause and effects of each hazard and displays areas susceptible to damage.

After identifying types and areas of risk, a vulnerability analysis was conducted to help determine the unprotected points in Eastham. The Planning Team’s analysis examined potential vulnerabilities in the built environment, such as structures, utilities, roads, culverts and bridges. Additionally, environmental vulnerability, such as beaches that can suffer from erosion was evaluated.

### **Existing Shelters**

Eastham has a total of five (5) emergency shelter facilities located within Town boundaries, with a total capacity for 1,200 persons. None of the shelters are located in areas prone to flooding. However, two (2) of the five (5) shelters are located in potential wildfire hazard areas.

**Table 5:** Eastham Public Shelter Facility Capacities

<b>Facility Name</b>	<b>Flood Potential</b>	<b>Wildfire Hazard</b>	<b>Capacity</b>
Council on Aging	No	Yes	25
Eastham Town Hall	No	No	100
Eastham Police Station	No	No	25
Eastham Fire Station	No	No	50
Nauset Regional High School	No	Yes	1,000
<b>Total Shelter Capacity =</b>			<b>1,200</b>

## Shelter Adequacy Analysis

Using the methodology developed in the *Southern Massachusetts Hurricane Evacuation Study (USACE and FEMA, 1997)* which 1990 US Census value for permanent population as a baseline, the Planning Team adjusted the figures in the analysis to reflect 2000 US Census population value and Eastham Police Department's seasonal population estimate of 30,000 for 2009. New shelter capacity has come on-line since 1997, specifically, the Council on Aging and the Fire Station. The Eastham Elementary School, although renovated in 2007, provides no additional sheltering capacity.

Revised vulnerable population values were determined by applying more recent permanent and seasonal values to the proportions from the original analysis. Vulnerable populations were calculated for two hurricane scenarios (weak and severe). Additionally, revised evacuating population values were also generated for both hurricane scenarios. The new values are highlighted by bolding in Tables 6 and 7.

The Town Planner will consult with other town departments for ensure consistency with the MHM plan.

**Table 6:** Vulnerable Populations – Under Weak and Severe Hurricane Scenarios

<i>Weak Hurricane Scenario</i>						
Population				Vulnerable Population		
Census	Permanent	Seasonal	Total	Permanent	Seasonal	Total
1990	4,460	15,930	20,390	850	2,590	3,440
<b>2000</b>	<b>5,450</b>	<b>24,550</b>	<b>30,000</b>	<b>1,039</b>	<b>3,991</b>	<b>5,030</b>
<i>Severe Hurricane Scenario</i>						
Population				Vulnerable Population		
Census	Permanent	Seasonal	Total	Permanent	Seasonal	Total
1990	4,460	15,930	20,390	1,380	4,060	5,440
<b>2000</b>	<b>5,450</b>	<b>24,550</b>	<b>30,000</b>	<b>1,686</b>	<b>6,257</b>	<b>7,943</b>

**Table 7:** Evacuating Populations – Under Weak and Severe Hurricane Scenarios

<i>Weak Hurricane Scenario</i>						
Population				Vulnerable Population		
Census	Permanent	Seasonal	Total	Permanent	Seasonal	Total
1990	4,460	15,930	20,390	850	2,590	3,440
<b>2000</b>	<b>5,450</b>	<b>24,550</b>	<b>30,000</b>	<b>1,039</b>	<b>3,991</b>	<b>5,030</b>
<i>Severe Hurricane Scenario</i>						
Population				Vulnerable Population		
Census	Permanent	Seasonal	Total	Permanent	Seasonal	Total
1990	4,460	15,930	20,390	4,900	750	5,650
<b>2000</b>	<b>5,450</b>	<b>24,550</b>	<b>30,000</b>	<b>5,988</b>	<b>1,156</b>	<b>7,144</b>

To evaluate the adequacy of shelter capacity in Eastham, the Planning Team determined that a hurricane would be the best indicator as that type of event would most likely result in large scale evacuation. To contrast the Town's existing shelter capacity for 1,200 persons with the likely utilization of such facilities under weak and severe hurricane scenarios, again a methodology developed in the *Southern Massachusetts Hurricane Evacuation Study (USACE and FEMA, 1997)* was updated to reflect values from the 2000 US Census and Eastham Police Department to account for the increased population since the analysis was originally conducted in 1997.

Under the weak hurricane scenario, an excess capacity of 570 persons was projected. An excess capacity of 150 persons was projected under a severe hurricane scenario. While, excess shelter capacity appears to exist, it should be noted that Nauset Regional High School (NRHS) is a regional facility that could draw persons from outside of Eastham. During a major flooding or storm surge event, access to NRHS would not be expected to be restrained to the north, southern portions of Wellfleet in particular.

**Table 8:** Shelter Utilization Analysis – Under Weak and Severe Hurricane Scenarios

<i>Weak Hurricane Scenario</i>					
Census	Surge Vulnerable Residents	Non-surge Vulnerable Residents	Total Utilization	Capacity	Capability
1990	440	60	500	125	(375)
<b>2000</b>	<b>538</b>	<b>92</b>	<b>630</b>	<b>1,200</b>	<b>570</b>
<i>Severe Hurricane Scenario</i>					
Census	Surge Vulnerable Residents	Non-surge Vulnerable Residents	Total Utilization	Capacity	Adequacy
1990	670	150	820	125	(695)
<b>2000</b>	<b>819</b>	<b>231</b>	<b>1,050</b>	<b>1,200</b>	<b>150</b>

### ***Repetitive Loss Properties***

A repetitive loss property is any property, which the National Flood Insurance Program (NFIP) has paid two or more flood claims of \$1,000 or more in any, given 10-year period since 1978. Specific property information is confidential, but within the Town of Eastham there have been sixty-four (64) total loss<sup>3</sup> claims, fifty-one (51) closed losses<sup>4</sup>, and thirteen (13) CWOP<sup>5</sup> losses totaling \$388,704.45 through April 30, 2009. There are seven (7) repetitive loss properties in Eastham, all residential. Three (3) are located on the bay side, two (2) are on Town Cove near the rotary, and two (2) are on the Atlantic side near Coast Guard Beach. Only two (2) repetitive flood loss claims were filed between 2004 and 2009 in Eastham.

As of April 30, 2009 there were 155 flood insurance policies in-force<sup>6</sup> in Eastham, with a total in-force value<sup>7</sup> of \$45,563,100 and the written premium in-force<sup>8</sup> amount was \$122,582. Barnstable County had a total value of 2,400,155,400 in insurance policies with written premium in force valued at \$11,345,994.

<sup>3</sup> All losses submitted regardless of the status

<sup>4</sup> Losses that have been paid

<sup>5</sup> Losses that have been closed without payment

<sup>6</sup> Policies in force on the "as of" date of the report

<sup>7</sup> The coverage amount for policies in force

<sup>8</sup> The premium paid for policies in force

## Quantification of Potential Losses

The Planning Team desired to conduct a quantification of potential losses and estimation of potential losses for the MHM, however, due to data processing limitations, this analysis could not be conducted for this plan. As the Town’s Geographic Information System (GIS) capabilities expand, these estimates will be calculated. With the development of a building footprint GIS “layer”, the estimation of potential losses at varying degrees of storm surge, wind, and stormwater hazard severity, as well as specific impacts on critical facilities will be evaluated.

In the absence of such data, the Planning Team used GIS to quantify the amount of potential losses using FEMA FIRM zones and local Assessor’s 2008 land and building values. Approximately 312 parcels in Eastham intersect with AO (over wash) zones or V (Velocity) zones identified by MassGIS. The land value of these parcels totals \$309,387,200 with building values totaling \$44,132,600. It should be noted that this figure is high as not all value of land may be lost in a storm event and, more importantly, not all structures on a parcel are located within the actual flood zone.

## Descriptive Locations

As part of its comprehensive analysis, the Planning Team developed a Descriptive Location Chart (Table 9) to identify specific vulnerable locations. The analysis included evaluating the cause and effect associated with each natural hazard identified in the MHM plan and potential resulting problems and their expected specific locations.

**Table 9:** Descriptive Location Chart

NATURAL HAZARD	CAUSE ( ► ) & EFFECT ( ● )	DESCRIPTIVE LOCATION
<p><b>FLOOD</b></p>	<p>► <b>Natural Inundation</b> in the floodplain (caused by heavy downpours, coastal storms; winter storms; northeasters; hurricanes)</p> <ul style="list-style-type: none"> <li>● Coastal Flooding</li> <li>● Episodic Erosion</li> <li>● River Flooding</li> <li>● Pond Flooding</li> <li>● Infrastructure Failure</li> </ul> <p>► <b>Infrastructure Failure</b> (caused by coastal storms; winter storms; northeasters; hurricanes; ice/snow melt)</p> <ul style="list-style-type: none"> <li>● Bridge Failure</li> <li>● Culvert Failure</li> <li>● Dam Failure</li> <li>● Storm Drain Failure</li> <li>● Dike Failure</li> <li>● Sink Holes</li> </ul>	<p><b>Areas of Coastal Flooding</b></p> <ul style="list-style-type: none"> <li>➤ Dyer Prince Road</li> <li>➤ Bridge Road (Boat Meadow Area)</li> <li>➤ Route 6 (Governor Prence Area)</li> <li>➤ Samoset Road and Herring Brook Road (First Encounter Beach)</li> <li>➤ Steele Road (Cooks Brook Beach Vicinity)</li> <li>➤ Undeveloped parcels in Boat Meadow area</li> <li>➤ North &amp; South Sunken Meadow area</li> <li>➤ Low-lying areas around Nauset marsh</li> </ul> <p><b>Areas of Episodic Erosion</b></p> <ul style="list-style-type: none"> <li>➤ Nauset Light Road /Nauset Light Beach Vicinity</li> <li>➤ Coast Guard Beach Vicinity</li> <li>➤ Cape Cod Bay Shoreline</li> </ul> <p><b>Areas of Pond Flooding</b></p> <ul style="list-style-type: none"> <li>➤ Northeast and Southwest bank of Great Pond</li> <li>➤ North and south banks of Long Pond</li> <li>➤ Southwest bank of Muddy Pond</li> </ul> <p><b>Areas of River Flooding</b></p> <ul style="list-style-type: none"> <li>➤ Rock Harbor Creek along Dyer Prince Road</li> <li>➤ Boat Meadow Creek at intersection with Bridge Road</li> <li>➤ Herring River at intersection with Bridge Road</li> </ul> <p><b>Deficient Infrastructure</b></p> <ul style="list-style-type: none"> <li>➤ Culvert/crossing at Hatches Creek/Massasoit Road</li> <li>➤ Culvert/crossing at Cole Brook/Herring Brook Road</li> <li>➤ Culvert/crossing at Herring River/Herring Brook Road</li> </ul>



NATURAL HAZARD	CAUSE ( ▶ ) & EFFECT ( ● )	DESCRIPTIVE LOCATION
<b>WIND</b>	<ul style="list-style-type: none"> <li>▶ <b>Hurricanes</b> <ul style="list-style-type: none"> <li>● Roofs Blowing Off</li> <li>● Trees Downed</li> </ul> </li> <li>▶ <b>Northeasters</b> <ul style="list-style-type: none"> <li>● Roofs Blowing Off</li> <li>● Trees Downed</li> </ul> </li> <li>▶ <b>Tornadoes</b> <ul style="list-style-type: none"> <li>● Roofs Blowing Off</li> <li>● Trees Downed</li> </ul> </li> </ul>	<p><b>Roof Damage</b> - Residences in close proximity to:</p> <ul style="list-style-type: none"> <li>➤ Atlantic Ocean</li> <li>➤ Nauset Estuary</li> <li>➤ Town Cove</li> <li>➤ Cape Cod Bay</li> </ul> <p><b>Trees Downed</b> - Locations proximal to wind activity:</p> <ul style="list-style-type: none"> <li>➤ Town Wide</li> <li>➤ Great Pond (northern shore)</li> <li>➤ Long Pond (southern shore)</li> </ul>
<b>FIRE</b>	<ul style="list-style-type: none"> <li>▶ <b>Drought</b> <ul style="list-style-type: none"> <li>● Wildfire</li> </ul> </li> <li>▶ <b>Lightning Strikes</b> <ul style="list-style-type: none"> <li>● Wildfire</li> </ul> </li> </ul>	<p><b>Wildfire</b> – Developed land / forested area interfaces:</p> <ul style="list-style-type: none"> <li>➤ Residences within and adjacent the National Seashore</li> <li>➤ Nauset Regional High School</li> <li>➤ Undeveloped areas within National Seashore</li> <li>➤ Residences adjacent to undeveloped open space</li> <li>➤ Undeveloped open space areas</li> </ul>
<b>GEOLOGIC</b>	<ul style="list-style-type: none"> <li>▶ <b>Earthquakes</b> <ul style="list-style-type: none"> <li>● Structural Damage</li> <li>● Loss of Land</li> </ul> </li> <li>▶ <b>Landslides</b> <ul style="list-style-type: none"> <li>● Loss of Land</li> </ul> </li> <li>▶ <b>Sink Holes</b> <ul style="list-style-type: none"> <li>● Loss of Land</li> </ul> </li> <li>▶ <b>Tsunamis</b> <ul style="list-style-type: none"> <li>● Loss of Land</li> <li>● Structural Damage</li> <li>● Wave Inundation</li> </ul> </li> </ul>	<p><b>Structural Damage</b> – Locations proximal to seismic activity:</p> <ul style="list-style-type: none"> <li>➤ Buildings and Structures</li> <li>➤ Infrastructure</li> </ul> <p><b>Loss of Land</b> – Atlantic Coastal Bluffs</p> <ul style="list-style-type: none"> <li>➤ Nauset Light Road (northern segment)</li> <li>➤ Nauset Light Beach Area</li> <li>➤ Ocean View Drive Area</li> <li>➤ Coast Guard Beach Area</li> </ul> <p><b>Wave Inundation</b> – Following wave prone areas:</p> <ul style="list-style-type: none"> <li>➤ Atlantic Shoreline</li> <li>➤ Cape Cod Bay Shoreline</li> <li>➤ Low lying coastal areas</li> </ul>

NATURAL HAZARD	CAUSE ( ▶ ) & EFFECT ( ● )	DESCRIPTIVE LOCATION
<b>OTHER</b>	<ul style="list-style-type: none"> <li>▶ <b>Snow &amp; Ice Accumulation</b> <ul style="list-style-type: none"> <li>● Street flooding from melt</li> <li>● Impassable roads from snow</li> <li>● Structural damage</li> </ul> </li> <li>▶ <b>Chronic Erosion</b> <ul style="list-style-type: none"> <li>● Eroding shoreline/ acreage losses</li> </ul> </li> <li>▶ <b>Climate Change</b> <ul style="list-style-type: none"> <li>● Eroding shoreline/ acreage losses</li> </ul> </li> <li>▶ <b>Sediment Deposition</b> <ul style="list-style-type: none"> <li>● Navigation restriction</li> </ul> </li> <li>▶ <b>Drought</b> <ul style="list-style-type: none"> <li>● Reduced water availability</li> </ul> </li> </ul>	<p><b>Street Flooding</b> – Compromised drainage:</p> <ul style="list-style-type: none"> <li>➤ Inadequate/obstructed catch basins and culverts</li> </ul> <p><b>Structural damage</b> – Town wide potential</p> <ul style="list-style-type: none"> <li>➤ Roof cave-in</li> </ul> <p><b>Impassable Roads</b> – Ability to plow</p> <ul style="list-style-type: none"> <li>➤ State maintained</li> <li>➤ Town maintained (particularly Bridge Road/Boat Meadow and Great Pond Road/Great Pond areas)</li> <li>➤ Privately owned</li> </ul> <p><b>Eroding Shoreline</b> – Following adjacent marine areas:</p> <ul style="list-style-type: none"> <li>➤ Un-armored private properties along Cape Cod Bay</li> <li>➤ Town-owned Cape Cod Bay Beaches</li> <li>➤ Atlantic Coastline</li> </ul> <p><b>Navigation Restriction</b> – Following navigational areas:</p> <ul style="list-style-type: none"> <li>➤ Nauset Inlet</li> <li>➤ Rock Harbor</li> </ul> <p><b>Reduced Water</b> – Town wide potential</p> <ul style="list-style-type: none"> <li>➤ Private/Community wells</li> <li>➤ Reduced surface water levels (freshwater)</li> </ul>

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## Section 4: Existing Local Hazard Mitigation Programs, Projects and Activities

### Existing Protection

As part of the development of the MHM, the Planning Team created a matrix assessing existing plans, programs and policies that Eastham already has in place that incorporate hazard mitigation or other protective measures (Table 10). Primary protection measures can be generally grouped into three general groupings including: land development regulations, land management programs and complementary programs. Although many of the protections overlap, the chart is separated by regulatory jurisdiction and specific ordinance reference.

**Table 10:** Eastham – Hazard Protection Matrix

Existing Protection	Description	Area Covered	Enforcement and/or Effectiveness
Zoning Bylaw Section IV - Flood Plain Zoning	Defines 100 Year Floodplain/Compliance Requirements	100 Year Floodplain (Zones A,AO,AH,A1--30, A-99, V and V1-30) FIRM 250006-005	Building Inspector (includes required comprehensive staff routing) and Zoning Board of Appeals - Rated excellent
Environmentally Sensitive Area - Regulation F(1) and (2)	Does not allow granting of variances from septic disposal regulations.	Land area within 100' of water resources and areas of high water table	Board of Health - Rated excellent
Local Wetlands Protection By-Law	Regulates development within and adjacent to Wetland Resource Areas	Wetland Resource Areas and establishes 50' protection buffer	Conservation Commission - Rated excellent
Building Permits	Enforcement of Building Code to ensure compliance	Buildings and structures Town wide	Building Inspector - Rated excellent
Beach Renourishment Program	Beneficial Reuse of dredged material to bolster shoreline protection	Town operated Cape Cod Bay beaches	Department of Public Works - Rated good
Comprehensive Emergency Management Plan	Establishes public safety response framework	Town wide	Police Chief - Components tested well
Subdivision Regulations	Requires underground utilities/drainage accommodating 25 year storm	Residential/Commercial Districts	Planning Board - Rated excellent
Section XIV - Residential Site Plan Approval	References avoiding impacts on flood plains	Residential Districts	Planning Board - rated excellent
Section XIII - Commercial Site Plan Review	Requires underground utilities/drainage accommodating 25 year storm	Commercial Districts	Planning Board - Rated excellent
Wildfire Assessment & Preparedness Program	County grant program to reduce potential fuel for wildfires	Town-owned Open Space Parcels	Barnstable County's Cooperative Extension Service – Rated excellent
National Flood Insurance Program (NFIP)	Federally backed flood insurance available to homeowners, renters, and business owners	100 Year Floodplain (Zones A,AO,AH,A1--30, A-99, V and V1-30) FIRM 250006-005	FEMA/Building Inspector – Rated excellent

## Section 5: Mitigation Strategy

This section of the MHM outlines Eastham's overall strategy to reduce vulnerability to the effects of natural hazards. The Mitigation Strategy has been separated into the following three sections:

**Mitigation Objectives** – Designed to support and correspond directly with Eastham's Community Goals (see *Section 1*).

**Mitigation Actions** – Specific measures to be undertaken by the Town in order to achieve identified objectives. Each action identifies the objective it is intended to achieve, includes some general background information justifying the proposed action, and provides measures to assure successful and timely implementation.

**Implementation of Mitigation Measures** – An **Action Plan** describing how the actions identified will be prioritized, implemented, and administered by Eastham.

### Mitigation Objectives

The Mitigation Objectives have been formulated to support and correspond directly with the Community Goals articulated in *Section 2*. These objectives have been developed to provide Eastham with measurable, short term milestones (within a five year planning horizon). Each objective is numbered (i.e., "1.1") with the first digit representing the corresponding Community Goal.

**Objective 1.1** - Preserve the natural and beneficial functions of Eastham's floodplain, wetlands, beaches and dunes through continued support of natural resource protection policies and by discouraging growth in environmentally-sensitive areas.

**Objective 1.2** - Enhance the Town's capability to conduct hazard risk assessments, demonstrate funding needs, and track mitigation activities throughout town (whether directly as part of this plan, or indirectly through the normal course of business).

**Objective 1.3** - Ensure that all new construction is completed using wind-resistant design techniques that will limit damage caused by high winds and reduce the amount of wind-borne debris.

**Objective 2.1** - Ensure that current emergency services are adequate to protect public health and safety. Ensure coordination with neighboring towns and County emergency services.

**Objective 3.1** - Maximize the use of available hazard mitigation grant programs to protect the Town's most vulnerable populations and structures.

**Objective 3.2** - Decrease the number of FEMA-identified "repetitive loss properties" from six (6) currently to three (3), or 50%, by the year 2009.

**Objective 4.1** - Ensure that all critical facilities are protected from the effects of natural hazards to the maximum extent possible.

**Objective 4.2** - Increase the level of knowledge and awareness for Town residents on the hazards that are potential threats to the area.

**Objective 5.1** – Ensure that all municipal structural mitigation measures be coordinated with Town Boards and Commissions to review a project’s sensitivity to natural features, historic resources and community character.

**Objective 6.1** - Educate property owners on affordable, individual mitigation and preparedness measures that can be taken before the next hazard event.

**Objective 6.2** - Educate Town staff on cost-effective, mitigation and preparedness measures that can be taken before the next hazard event.

## **Mitigation Actions**

In formulating the Town’s Mitigation Strategy, a wide range of activities were considered in order to help achieve the goals of the community and to lessen the vulnerability of Eastham to the effects of natural hazards. In general, all of these activities fall into one of the following broad categories of mitigation techniques:

- Prevention
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Public Information and Awareness

## ***Summary Available Mitigation Techniques***

**Prevention** - Proactive actions are intended to keep problems resulting from hazards getting worse. They are effective in reducing a community’s future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and Zoning
- Open space preservation
- Floodplain regulations
- Stormwater management
- Drainage system maintenance
- Capital improvements programming
- Shoreline setbacks

**Property Protection** - Property protection measures protect existing structures by modifying the building to withstand hazardous events, or removing structures from hazardous locations. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Retrofitting (i.e., windproofing, floodproofing, etc.)
- Insurance

**Natural Resource Protection** - Natural resource protection activities reduce the potential for impact from natural hazards by preserving or restoring natural areas and their defensive functions. Such areas include floodplains, wetlands and dunes. Examples include:

- Floodplain protection
- Beach and dune preservation
- Wetland Resource Area buffers
- Fire resistant landscaping
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization

**Structural Projects** - Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Levees / dikes / floodwalls / seawalls
- Diversions / Detention / Retention
- Channel modification
- Beach nourishment
- Storm drainage

**Emergency Services** - Although not typically considered a “mitigation technique,” emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

- Warning systems
- Evacuation planning and management
- Sandbagging for flood protection
- Installing shutters for wind protection

**Public Information and Awareness** - Public Information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public include:



- Outreach projects
- Speaker series / demonstration events
- Hazard map information
- Real estate disclosure
- Library materials
- School children education
- Hazard expositions

### **Mitigation Action Plan (MAP)**

The primary purpose of the MHM Plan is to produce a schedule of activities that will best address Eastham's hazard and flood problems, identified vulnerabilities and meet other local needs in a manner consistent with FEMA hazard mitigation planning process guidelines. Actions that will be undertaken to implement effective hazard mitigation in high risk areas in the Town of Eastham are consistent with the State and County approach of using both non-structural and structural projects, and to use a *non-structural* hazard mitigation approach before undertaking a *structural* approach.

- A *non-structural* hazard mitigation approach is a strategy that does not change the natural hazard, but involves preventative actions that improve infrastructure to reduce the damages, or improve coordination of resources.
- A *structural* hazard mitigation approach involves strategies that inhibit a natural hazard, such as a sea wall or dam.

It is important to note that these mitigation actions are short-term, specific measures to be undertaken by Eastham. It is expected that this component of the MHM Plan will be the most dynamic; it will be used as the primary indicator to measure the Plan's progress over time and will be routinely updated and/or revised through future planning efforts. As part of the developing the MHM, numerous actions items were identified through the planning process forming the basis of the MAP. Several action items remain in the MAP as the Town continues incorporating this planning effort into other comprehensive & capital improvements. Staffing and funding remain to be limiting factors in implementation. The Planning Team has grouped the identified action items of the MAP into the three following groups: General (G), Infrastructure/Management (IM) and Educational (E), but chose to not rank them by order as each action item is ranked by score in STAPLEE further in the plan. The Action Items proposed for Eastham to undertake are listed on the pages that follow. Each has been designed to achieve the goals and objectives identified in the MHM Plan. Each proposed action includes:

- Appropriate category for the mitigation technique
- Hazard it is designed to mitigate
- Objective(s) it is intended to help achieve
- General background information
- Implementation status of action item
- Potential funding sources, if applicable
- Agency/person assigned responsibility for carrying out the strategy
- Feasibility/Implementation

**General (G) Action Items**

<b>Action Item G1</b>	Increase protection of the floodplain by enhancing floodplain management activities within the Town of Eastham. Adopt Floodplain regulations that are consistent with updated FIRM maps.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	1.1
General background of item:	Review existing floodplain regulations and controls in a multi-hazard context and strengthen/clarify requirement for substantial reconstruction definition
Implementation Status:	The Planning Board is working with FEMA and the State (DCR) on language which is consistent with the pending FIRM maps. The FIRM maps and amendments to the existing Section IV (Floodplain Zoning) are expected to be adopted at the 2011 Annual Town Meeting.
Responsibility:	Building Inspector, Planning Board
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	High / 2011

<b>Action Item G2</b>	Become a participant in the National Flood Insurance Program (NFIP) Community Rating System (CRS) program through enhanced floodplain management activities. Explore opportunities to join with Barnstable County as a whole.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	1.1
General background of item:	The NFIP CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, 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
Implementation Status:	Town staff continues to attend workshops on the CRS program. No formal analysis of the program benefits/costs has been done for Eastham. The Town will continue to work with the County on regional efforts.
Responsibility:	Selectmen, Town Planner, Building Inspector
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2011

<b>Action Item G3</b>	Advertise and promote the availability of flood insurance to Town property owners by direct mail yearly.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	1.1, 4.2, 6.1
General background of item:	NFIP flood insurance policies protect property owners by offering affordable rates for protecting both structures and contents.
Implementation Status:	Homeowners are required to have flood insurance if they are located within a flood zone as identified by the current FIRM. The Town will advertise the benefits of NFIP for all properties, including those not required to purchase flood insurance through the local newspaper and direct mailings when feasible in the budget.
Responsibility:	Building Inspector/Town Planner
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	Medium / 2012

<b>Action Item G4</b>	Use the Town's emerging Geographic Information System (GIS) to maintain current building and parcel data for the purposes of conducting more detailed hazard risk assessments and for tracking permitting / land use analysis.
Hazard designed to mitigate:	All
Objective intended to help achieve:	1.2, 2.1, 4.1, 4.2, 5.1, 6.2
General background of item:	A fully developed GIS system will greatly enhance the Town's technical capability to collect, manage, analyze and display spatially-referenced data to further hazard mitigation goals.
Implementation Status:	The Town has made improvements to its base map and parcel data layers GIS system since the 2004 plan however planimetrics (building, paved areas) would be an advantageous investment, not only in analyzing flood plain construction damage estimates, but also in collaboration future with water &/or wastewater infrastructure.
Responsibility:	Town Planner, MIS Director, Assessing Department
Potential funding source:	Operating Budget, Grants
Feasibility/Implementation:	High / Ongoing

<b>Action Item G5</b>	Continue to acquire and preserve parcels of land subject to repetitive flooding from willing and voluntary property owners.
Hazard designed to mitigate:	Flood, Erosion, Sea Level Rise
Objective intended to help achieve:	1.1, 3.2
General background of item:	Land acquisition is an effective mitigation technique to permanently eliminate the potential

	for damages from future flood events. Eastham has successfully used Land Bank and Community Preservation Act funds to acquire flood prone parcels of land in the past from voluntary and willing property owners.
Implementation Status:	The Town continues to use the Open Space and Recreation Plan as a source for identifying priority parcels. The Town acquired a conservation restriction on a property subject to flooding in 2009. <sup>9</sup>
Responsibility for implementation assigned to:	Town Meeting, Selectmen, Town Planner, Natural Resources Director
Potential funding source(s):	Land Bank, Grants and Donations
Feasibility/Implementation:	High / Ongoing

<b>Action Item G6</b>	Conduct a thorough evaluation of the Town's most at-risk locations identified in the Vulnerability Analysis, and evaluate the potential mitigation techniques for protecting each location to the maximum extent possible.
Hazard designed to mitigate:	All
Objective intended to help achieve:	1.2, 4.1, 5.1, 6.2
General background of item:	A thorough evaluation of potential mitigation opportunities for Eastham's identified critical locations must still be completed. An inventory/database on critical facilities should be created and maintained by the Town. This inventory should include information on the risk to each location, and should also document any cost-effective mitigation techniques to consider when funding becomes available
Implementation Status:	The Town continues to compile information on mitigation opportunities on an ad hoc basis. Limitations on staffing and funding prohibit extensive fulfillment of this action item.
Responsibility:	DPW, NRO, BOH, BI and TP
Potential funding source(s):	Town Meeting, Grants
Feasibility/Implementation:	Medium / 2012

<b>Action Item G7</b>	Monitor the Town's emergency response services to identify needs or shortfalls in terms of personnel, equipment or required resources.
Hazard designed to mitigate:	All
Objective intended to help achieve:	2.1
General background of item:	Any identified needs or shortfalls should become documented and result in specific recommendations to the Selectmen for emergency service enhancements.

<sup>9</sup> 170 Old Farm Road

Implementation Status:	Ongoing effort in partnership with the Comprehensive Emergency Management Plan.
Responsibility:	Police Chief, Fire Chief, Health Agent
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	High / Ongoing

<b>Action Item G8</b>	Revise the Town’s Flood Plain Zoning (Section IV) to incorporate cumulative substantial damage or improvement requirements.
Hazard designed to mitigate:	Flood, Erosion, Sea Level Rise
Objective intended to help achieve:	1.1
General background of item:	Eastham’s Zoning Bylaws currently limits the definition of “substantial improvement” to one-time damage repairs or improvements. Communities can reduce flood damage by counting improvement and repair projects cumulatively, so that buildings will be brought into compliance with flood protection standards earlier in their life cycle. This will require the Town to maintain permit history so when cumulative repairs or improvements equal 50% of the building value, the building must be brought up to current codes for floodplain development.
Implementation Status:	The FIRM update and associated zoning bylaw language amendment at Annual Town Meeting 2011 provides an ideal opportunity for the Planning Board to fully discuss this action item.
Responsibility for implementation:	Town Planner, Building Inspector, Planning Board, Town Meeting
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2011

<b>Action Item G9</b>	Incorporate the inspection and management of hazardous trees/limbs into the Town’s routine monitoring process.
Hazard designed to mitigate:	Wind, Snow & Ice
Objective intended to help achieve:	2.1, 4.1, 5.1, 6.2
General background of item:	A significant amount of property damage during high wind events results from tree failure. Trees that fall into utility lines have additional serious consequences such as causing power outages, surges, fires and other damage. The Town’s ability to recognize and prevent hazardous tree conditions (through inspection, pruning or removal) is the best defense against problems and costly damages resulting from tree failure. Specifically, trees located on Town properties which pose immediate threats to property, utility lines and other critical facilities should be addressed.
Implementation Status:	The Town achieves this action item in conjunction



	with NStar's Vegetation Management Plan.
Responsibility:	DPW, Fire Department
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	Medium / Ongoing

<b>Action Item G10</b>	Augment the enforcement the State Building Code and related Town Bylaws by encouraging wind-resistant design techniques for new residential construction and reconstruction during the Town's permit process. Follow 2007 State Building Code to improve safety of structures.
Hazard designed to mitigate:	Wind
Objective intended to help achieve:	1.3, 4.1, 4.2, 6.1, 6.2
General background of item:	Although the State Building Code requires certain building practices for wind loss reduction, experts agree that structures built to exceed high wind provisions have a much greater chance of surviving violent wind storms. Additional techniques include adding protection for windows (i.e., shutters), anchoring door frames with multiple hinges, stiffening garage doors with additional bracing, reinforcing masonry chimneys with vertical steel, and strengthening connections between walls and the roof with hurricane straps and ties. These techniques should be promoted to building contractors and homebuyers by the Town for all new residential construction, to the maximum extent possible during the building permit process.
Implementation Status:	The State Building Code was updated in 2007 to require many hurricane strength reinforcements i.e. 110 mph windproof windows, tie-down straps from the foundation to the roof and arc-faulted or GFI electrical outlets. The State Code requirements are limited to structures $\leq 1$ mile from the coastline. The Town should continue to encourage contractors and homeowners to construct or renovate to these standards town-wide.
Responsibility:	Building Inspector
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	Low / 2013

<b>Action Item G11</b>	Conduct a quantification of potential losses by estimating potential losses at varying degrees of storm surge, wind, and stormwater hazard severity, as well as specific impacts on critical facilities for the MHM five (5) year update.
Hazard designed to mitigate:	All
Objective intended to help achieve:	1.2, 2.1, 3.1



General background of item:	Due to data processing limitations, this analysis could not be conducted for this plan. As the Town's Geographic Information System (GIS) capabilities expand, these estimates will be calculated. With the development of a building footprint GIS "layer", the estimation of potential losses at varying degrees of storm surge, wind, and stormwater hazard severity, as well as specific impacts on critical facilities will be evaluated. However, analysis has been performed to quantify potential losses to parcels within AO and V zones.
Implementation Status:	Along with action item G4, the Town will continue to upgrade its GIS capacity to include planimetrics.
Responsibility:	Town Planner
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	High / 2010

<b>Action Item G12</b>	Develop a map indicating hazard sensitive parcels acquired by Eastham
Hazard designed to mitigate:	All
Objective intended to help achieve:	1.1, 1.2, 4.2, 5.1, 6.1, 6.2
General background of item:	A graphical depiction of past land acquisitions that further hazard mitigation principles does not exist.
Implementation Status:	The 2009 Open Space and Recreation Plan contains a map of Town-Owned parcels. Town Staff will overlay the map with flood zones. Town staff will do a shoreline survey to identify parcels with severe erosion.
Responsibility:	Town Planner, Natural Resources Officer
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2011

***Infrastructure/Management (IM) Action Items***

<b>Action Item IM1</b>	Regular maintenance dredging of Rock Harbor Creek
Hazard designed to mitigate:	Erosion, Sea Level Rise
Objective intended to help achieve:	2.1, 4.1, 5.1
General background of item:	In order to protect economic and recreational interests by keeping this vital waterway connection with Cape Cod Bay viable for navigation purposes.
Implementation Status:	The Town has an open Order of Conditions to maintain access to Rock Harbor as needed basis.
Responsibility for implementation:	Natural Resources Officer
Potential funding source(s):	Grants
Feasibility/Implementation:	Medium / 2012

<b>Action Item IM2</b>	Reconstruction of infrastructure identified by NPDES Phase II Annual Permitting.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	1.1, 3.1, 4.1, 5.1
General background of item:	The goal of the proposed project is to correct drainage deficiencies of areas identified on the Town's annual reporting of stormwater infrastructure which impacts water bodies. Locations identified include: Great Pond Road, Herring Brook Road at the herring run, Ellis Road, Cole Road, Gov. Prence Ext, Gov. Prence Road, Depot Pond, Campground Beach, Herring Brook Road at Herring pond, Locust Road, and McKoy Road.
Implementation Status:	New action item. The Town re-prioritized its stormwater infrastructure list in 2009 as required by the NPDES Phase II MS4 permit. Efforts are underway to not only reconstruct but improve the infrastructure to minimize flooding and preserve property. The DPW has applied for and will continue to seek grant funding to assist in funding. The reconstruction of Steele Road (2004 PDM action item) was completed in 2007.
Responsibility for implementation:	DPW
Potential funding source(s):	Chapter 90 Funds, Grants
Feasibility/Implementation:	High / 2011

<b>Action Item IM3</b>	Continue to participate in marsh restoration project that improve tidal flushing
Hazard designed to mitigate:	Flood, Fire, Erosion, Sea Level Rise
Objective intended to help achieve:	1.1, 4.1, 5.1
General background of item:	Several tidally influence water bodies in Eastham are physically restricted in their ability to exchange water freely during tidal cycles. Reducing or removing these restrictions provide hazard mitigation benefits including increased flood storage capacity and reduced wildfire fuel potential from invasive species growth (i.e., phragmites) resulting from limited flushing.
Implementation Status:	The DPW has initiated a prioritized culvert replacement list (Dyer Prence Road, Herring run at Cole Road project in progress (grant funded), Hatches Creek Dike).
Responsibility:	Natural Resources Officer, Town Planner, DPW
Potential funding source(s):	Grants
Feasibility/Implementation:	Medium / Ongoing

<b>Action Item IM4</b>	Participate in Barnstable County's Cooperative Extension Service's grant program for wildfire fuel reduction programs.
Hazard designed to mitigate:	Fire
Objective intended to help achieve:	3.1, 4.1
General background of item:	The Town owned parcels of conservation and recreation lands are potential sources of wildfires in areas with proximity to residentially developed areas. The Town received grant awards for Wiley Park, and the Nickerson Property.
Implementation Status:	The Natural Resource Department continues to maintain participation in this grant program.
Responsibility:	Natural Resources Officer
Potential funding source(s):	Grants
Feasibility/Implementation:	Medium / 2012

<b>Action Item IM5</b>	Coordination with National Seashore on fuel reduction programs and response
Hazard designed to mitigate:	Fire
Objective intended to help achieve:	2.1, 3.1, 4.1
General background of item:	The Cape Cod National Seashore encompasses over 3,000 acres within Eastham or approximately 1/3 of its land area.
Implementation Status:	The National Seashore maintains its own burning/trimming program. The Town does not assist the Seashore, but is kept informed of activities involving burns.
Responsibility:	Fire Department
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	Medium / Ongoing

### ***Educational Action Items***

<b>Action Item E1</b>	Continue to collect educational materials on preparedness/mitigation measures for individual property owners, for display and distribution at Town Hall, Natural Resources Office, Library and Council on Aging offices.
Hazard designed to mitigate:	All
Objective intended to help achieve:	4.2, 6.1
General background of item:	FEMA, the Massachusetts Emergency Management Agency (MEMA), the National Weather Service and other agencies can provide information brochures and pamphlets on property protection measures at no cost to local governments.

Implementation Status:	Ongoing Activity. The Town's website links to various organizations to provide access to the aforementioned information.
Responsibility:	Building Inspector / Town Planner
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	High / 2010

<b>Action Item E2</b>	Develop an educational flyer targeting NFIP policyholders on the Increased Costs of Compliance (ICC) coverage, to be disseminated following a flood event that results in substantial damage determinations by the Town.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	3.1, 4.2, 6.1, 6.2
General background of item:	Increased Cost of Compliance (ICC) under the NFIP provides for the payment of a claim to help pay for the cost to comply with State or community floodplain management laws or ordinances from a flood event in which a building has been declared substantially damaged. When an insured building is damaged by a flood and the State or community declares the building to be substantially damaged, ICC will help pay for the cost to elevate, flood proof, demolish or relocate the building up to \$20,000. This coverage is in addition to the building coverage for the repair of actual physical damages from the flood.
Implementation Status:	The Town will use the local media to bring attention to this action item.
Responsibility:	Building Inspector
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2010

<b>Action Item E3</b>	On an annual basis, contact all owners of FEMA-identified repetitive loss properties and inform them of the assistance available through the federal Flood Mitigation Assistance (FMA) program, in addition to other flood protection measures.
Hazard designed to mitigate:	Flood
Objective intended to help achieve:	1.1, 3.1, 3.2, 4.2, 6.1, 6.2
General background of item:	Each of these properties are targeted by FEMA and the State of Massachusetts for Flood Mitigation Assistance (FMA) funding, which will fund up to 75% of a mitigation project to eliminate future flood risk (usually through elevation or acquisition or relocation). FMA funds are awarded on an annual basis by the Massachusetts Division of Emergency Management. Eligible property owners should be contacted every year to promote the availability of the FMA funding and to determine

	their level of interest in applying for the program.
Implementation Status:	The Town will use the local media and targeted mailings to bring attention to this action item.
Responsibility:	Building Inspector, Town Planner
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	High / 2011

<b>Action Item E4</b>	Annually host a public hazards display for the residents of Eastham, in combination with the “Windmill Weekend” festival or another appropriate community event.
Hazard designed to mitigate:	All
Objective intended to help achieve:	1.1, 4.2, 6.1
General background of item:	A hazard display for Town residents should be added to an established community event drawing large crowds. The display should be geared toward educating them on the hazards which threaten Eastham, and the mitigation and preparedness measures available to protect them. Educational displays/handouts should be provided such as Flood Insurance Rate Maps, storm surge inundation maps, FEMA publications, hurricane tracking charts, safety tips, etc.
Implementation Status:	Staffing limitations hindered execution of this action item. Unmanned displays have been exhibited in the past.
Responsibility for implementation assigned to:	Town Planner / Building Inspector
Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2011

<b>Action Item E5</b>	Conduct an educational workshop targeting Cape Cod Bay coastal area land owners and contractors on hazard mitigation.
Hazard designed to mitigate:	Flood, Wind, Erosion, Sea Level Rise
Objective intended to help achieve:	1.1, 1.3, 3.1, 3.2, 4.2, 6.1
General background of item:	Development pressure to redevelop existing dwellings in hazard prone areas is increasing an educational forum would be beneficial to homeowners and the contracting/design community. This workshop would also be an opportunity to provide a detailed presentation on shoreline change data
Implementation Status:	Staffing limitations hindered execution of this action item. The Conservation Commission routinely discusses the impacts of development in high hazard locations on public access television during their twice-monthly meetings.
Responsibility:	Town Planner, Building Inspector, Natural Resources Officer



Potential funding source(s):	Operating Budget, Grants
Feasibility/Implementation:	High / 2012

<b>Action Item E6</b>	Enhance promotion of concepts developed as part of National Fire Protection Association's FIREWISE program ( <a href="http://www.firewise.org">www.firewise.org</a> ) beyond National Seashore residents.
Hazard designed to mitigate:	Wildfire
Objective intended to help achieve:	4.1, 4.2, 6.1, 6.2
General background of item:	Currently, the Cape Cod National Seashore with the assistance of AmeriCorps has a program introducing Firewise concepts to residents within the Seashore Boundary. Additional education of residents beyond seashore boundary is warranted due to potential wildfire hazards Town wide
Implementation Status:	The Fire Department participates in FIREWISE educational programs.
Responsibility:	Fire Department
Potential funding source(s):	Operating Budget
Feasibility/Implementation:	Medium / Ongoing

### MAP Prioritization

The items listed in the MAP provide a framework for mitigating future damages and/or losses of life based upon the analysis conducted in this MHM Plan. To place the MAP in a context recognizing potential constraints to implementation, the Planning Team discussed each action item and determined its feasibility and priority. Discussions were based upon the STAPLEE criteria suggested in the Natural Hazards Mitigation Planning: A Community Guide. STAPLEE is an acronym for a general set of criteria used to make decisions regarding community initiatives, standing for social (S), technical (T), administrative (A), political (P), legal (L), economic (E), and environmental (E) decision-making criteria. Using these criteria the Planning Team determined the overall feasibility of the action items included in the MAP. No formal cost/benefit was performed as it was found to be technically onerous as the results of applying the STAPLEE criteria, generally correlates feasibility with priority.

STAPLEE ranks all action items against each other, without regard to impact on reducing Eastham's vulnerability to natural hazards. Consideration had to be given to actions intended to address the greatest hazard risk(s). Therefore, the Planning Team weighted the ranking of the STAPLEE criteria by adding in the hazard scores assigned to the hazards Eastham faces (refer to Table 3: Hazard Identification and Ranking Matrix).

If an action item would address multiple hazards it was given a value often (10), which is one number higher than the highest hazard score assigned. This hazard-weighted STAPLEE mitigation strategy resulted in three levels of priority based on equally distributing the results:

- High (31-29 points) = 14 Action Items
- Medium (28-26 points) = 8 Action Items
- Low (25-23 points) = 1 Action Item



**Table 11: STAPLEE Feasibility Analysis of MAP Action Items**

MAP Action Item	Hazard Index	Feasibility / Soundness					Soundness		Score
		Social	Technical	Admin.	Political	Legal	Econ.	Environ.	
<b>High Feasibility</b>									
E1	10	3	3	3	3	3	3	3	31
G5	10	3	3	3	3	3	3	3	31
G7	10	3	3	3	3	3	3	3	31
E3	9	3	3	3	3	3	3	3	30
E4	10	3	3	2	3	3	3	3	30
E5	10	3	3	2	3	3	3	3	30
G2	9	3	3	3	3	3	3	3	30
G4	10	3	3	2	3	3	3	3	30
G8	10	3	3	3	2	3	3	3	30
E2	9	3	3	2	3	3	3	3	29
IM2	9	2	3	3	3	3	3	3	29
G1	9	3	3	3	2	3	3	3	29
G11	10	3	2	2	3	3	3	3	29
G12	10	3	2	2	3	3	3	3	29
<b>Medium Feasibility</b>									
G3	9	3	3	2	2	3	3	3	28
G9	10	2	3	2	2	3	3	3	28
IM3	10	2	3	2	2	3	3	3	28
E6	6	3	3	3	3	3	3	3	27
G6	10	2	3	2	2	3	2	3	27
IM1	10	2	3	1	2	3	3	3	27
IM4	6	3	3	3	3	3	3	3	27
IM5	6	3	3	3	3	3	3	3	27
<b>Low Feasibility</b>									
G10	7	2	3	2	2	3	3	3	25

Key: 1 – Not Acceptable / No      2 – Somewhat Acceptable / Maybe      3 – Desirable / Yes

STAPLEE Feasibility Analysis of MAP Action Items (Table 11) presents the complete results. Although all of the action items identified will likely reduce costs by avoiding losses, many projects are costly to implement. Eastham will continue to seek outside funding assistance for projects in both the pre- and post-disaster environment.

## **Section 6: Implementation and Adoption of this Plan**

### **Process**

The Eastham MHM will be implemented through the delegation of assignments by the Board of Selectmen through the Town Administrator, and as specified within this Plan. In *Section 3: Mitigation Strategy*, mitigation actions are listed and assigned specific implementation measures which include the assignment of responsibilities to Town departments and/or specific Town staff, along with the establishment of a targeted completion date for each proposed mitigation action. When applicable, potential funding sources were also listed.

It will be the responsibility of the Town Administrator, as he/she sees fit, to ensure these actions are ultimately carried out no later than the target completion dates unless reasonable circumstances prevent their implementation (i.e., lack of funding availability). Otherwise, the completion of each proposed mitigation action has been determined feasible within the timeframe allowed.

### **Funding Sources**

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The Town of Eastham will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. A list of primary Federal, State and County grant programs for Eastham to consider is included in the Barnstable County Regional MHM Plan.

### **Monitoring and Reporting**

Periodic monitoring and reporting of the MHM is required to ensure that the goals and objectives for Eastham are kept current and that local mitigation efforts are being carried out. The Plan has therefore been designed to be user-friendly in terms of monitoring implementation and preparing regular progress reports.

### **Annual Reporting Procedures**

The MHM shall be reviewed annually, by the Planning Team, or as situations dictate such as following a disaster declaration. Each year, the Town Administrator will assign responsibility for conducting this annual review to a specific department or individual. This department or individual will ensure the following:

1. The Board of Selectmen and the Town Administrator will receive an annual report and/or presentation on the implementation status of the MHM. This report will include, at a minimum, a completed, printed version of the Mitigation Action Plan (MAP) indicating the implementation status of each identified action.
2. The report will also include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan. If the Board of Selectmen determines that the recommendations warrant modification to the MHM, the Board may initiate a Plan Amendment as described below.

## **Revisions and Updates**

Periodic revisions and updates to the MHM are required to ensure that the hazard mitigation goals and objectives for Eastham are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

**Five (5) Year Plan Review** - The MHM should be reviewed every five (5) years to determine if there have been any significant changes in Town that would affect the Action Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and changes to Federal, State or County legislation are examples of changes that may affect the condition of the MHM.

**Disaster Declaration** - Following a disaster declaration, the MHM will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

**Selectmen Determination** - If the Board of Selectmen determines that the recommendations warrant modification to the MHM, the Board may either initiate a Plan Amendment as described below or, if conditions justify, may direct the Town Administrator to undertake a complete update of the Plan.

## **Plan Amendments**

An amendment to the Plan should be initiated only by the Board of Selectmen, either at its own initiative or upon the recommendation of the Town Administrator, Town Planner, Town Emergency Manager, or some other person or agency. Upon initiation of an amendment to the Plan, Eastham will forward information on the proposed amendment to all interested parties including, but not limited to, all affected Town departments, residents and businesses. Information will also be forwarded to Barnstable County (Cape Cod Commission) and the Massachusetts Emergency Management Agency. This information will be sent out in order to seek input on the proposed Plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Town Administrator (or his/her designee) for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Town Administrator (or his/her designee) will review the proposed amendment along with the comments received from other parties, and submit a recommendation to the Board of Selectmen within sixty (60) days.

## References

- Addison County, Vermont. *Region Wide – All Hazards Mitigation Plan*.
- Barnstable County, Massachusetts. *Natural Hazards Pre-Disaster Mitigation Plan – Final Draft*. September 16, 2004.
- Cape Fear Council of Governments. *Town of Holden Beach, North Carolina Community-Based Hazard Mitigation Plan*. Adopted July 28, 2003
- Eastham, Massachusetts. *Local Comprehensive Plan – Second Edition*. Adopted October 2002
- Eastham, Massachusetts. *Open Space and Recreation Plan*. March 5, 1998.
- Eastham, Massachusetts. *Comprehensive Emergency Management Plan*. Revised 2003.
- Hyde County, North Carolina. *Multi-Hazard Mitigation Plan*.
- Narragansett, Rhode Island. *Strategy for Reducing Risks from Natural Hazards in Narragansett, Rhode Island: A Multi-Hazard Mitigation Strategy*. June 1999.
- Massachusetts Department of Environmental Management, Emergency Management Agency (MEMA) and Hazard Mitigation Team. *Natural Hazards Mitigation Planning: A Community Guide*. January 2003.
- Massachusetts Emergency Management Agency (MEMA). *Comprehensive Emergency Management Plan*. Revised November 2002.
- Nome (AK) Planning Commission. *City of Nome Hazard Mitigation Plan*. Approved 9/23/02 and Updated January 2003.
- Sandwich, Massachusetts. *Flood Hazard Mitigation Plan*.
- United States Army Corps of Engineers and United State Federal Emergency Management Agency. *Southern Massachusetts Hurricane Evacuation Study (USACE and FEMA, 1997)*

## Appendices

### Maps

**Map 1:** Risk and Vulnerability Assessment / Local Critical Facilities Map

**Map 2:** Hazard Risk Map I - Historical Tornadoes, Historical Earthquakes, Landslides & Shoreline Change

**Map 3:** Hazard Risk Map II - Average Annual Snowfall, Historical Hurricanes

**Map 4:** Hazard Risk Map III - Local Wildfire Risk Areas

### Documents

**Appendix A** - Response to Comments on Draft MHM (*TBD*)

**Appendix B** - Floodplain Regulations – Section IV of Eastham Zoning Bylaws

## **Maps**

**Map 1:** Risk and Vulnerability Assessment / Local Critical Facilities Map

**Map 2:** Hazard Risk Map I - Historical Tornadoes, Historical Earthquakes, Landslides & Shoreline Change

**Map 3:** Hazard Risk Map II - Average Annual Snowfall, Historical Hurricanes

**Map 4:** Hazard Risk Map III - Local Wildfire Risk Areas



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## **Appendix A**

### **Response to Comments on Draft MHM**

**COMMENT:**

**RESPONSE:**

**DRAFT**

## **Appendix B**

### **Floodplain Regulations Section IV of Eastham's Zoning By-Laws**

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## **SECTION IV -- FLOOD PLAIN ZONING<sup>2</sup>**

See definitions of flood plain zone designations in ARTICLE V of this SECTION.

- A. The installation of underground systems for the storage of petroleum products (including but not limited to oil, gasoline, kerosene, and any hazardous materials) shall be prohibited in the 100 year flood plain (Zones A, AO, AH, A1-30, A99, V and V1-30 on the Flood Insurance Rate Maps 250006-0005, prepared by the National Flood Insurance Program for the Town of Eastham). Storage system shall mean storage tank and all supply lines between storage tank and burner. Underground shall mean under the surface of the earth or under pavement, including cement floors of cellars or basements. Storage systems may be located in basements or cellars provided they are on or above the paved floor of the cellar or basement.
- B. Any new construction, alteration of structures or other development which is removed from the A or V zones by subsequent flood insurance map amendments shall only have to meet the requirements of its new zone designation.
- C. All subdivision proposals and other proposed new developments greater than fifty (50) lots or five (5) acres whichever is the lesser shall include in such proposals base flood elevation data.
- D. Subdivision proposals and proposals for other developments, including their utilities and drainage, are located and designed to be consistent with the need to minimize flood damage.

### **ARTICLE I -- STATEMENT OF PURPOSE, EXISTING REGULATIONS**

#### **SECTION A. -- STATEMENT OF PURPOSE**

The purposes of the Floodplain District are to:

1. Ensure public safety through reducing the threats to life and personal injury.
2. Eliminate new hazards to emergency response officials.
3. Prevent the occurrence of public emergencies resulting from water quality, contamination, and pollution due to flooding.
4. Avoid the loss of utility services which if damaged by flooding would disrupt or shut down the utility network and impact regions of the community beyond the site of flooding.
5. Eliminate costs associated with the response and cleanup of flooding conditions.
6. Reduce damage to public and private property resulting from flooding waters.

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<sup>2</sup>Accepted at Annual Town Meeting, May 3, 1993, Article 28, sections reorganized, Annual Town Meeting, June 29, 1999, Article 27

7. Facilitate accurate insurance ratings and promote the awareness of flood insurance.

## **SECTION B. -- EXISTING REGULATIONS**

All development in the district including structural and non-structural activities whether permitted by right or by special permit must be in compliance with the following:

- 780 CMR 3107.0, of the Massachusetts Building Code which addresses floodplain and coastal high hazard areas.
- 310 CMR 10.0, Wetlands Protection Regulations, Department of Environmental Protection (DEP).
- 302 CMR 6.00, Inland Wetlands Restriction, DEP
- 302 CMR 4.00, Coastal Wetlands Restriction, DEP
- 310 CMR 15, Title 5, Minimum Requirements for the Subsurface Disposal of Sanitary Sewage, DEP
- Any variances from the provisions and requirements of the above referenced state regulations may only be granted in accordance with the required variance procedures of these state regulations.

## **ARTICLE II. B FLOODPLAIN DISTRICT BOUNDARIES AND BASE FLOOD ELEVATION DATA**

### **SECTION A. -- FLOODPLAIN DISTRICT BOUNDARIES AND BASE FLOOD ELEVATION DATA**

The Floodplain District is herein established as an overlay district. The District includes all special flood hazard areas designated on the Town of Eastham Flood Insurance Rate Map (FIRM) issued by FEMA (successor to the U.S. Department of Housing and Urban Development, HUD) for the administration of the NFIP dated July 2, 1992 as Zone A, AE, AH, A1-30, A99, V, V1-30, VE, and if available the FEMA Flood Boundary and Floodway Map dated July 2, 1992, both maps which indicate the 100-year regulatory floodplain. The boundaries of the District may be defined by the 100-year base flood elevations shown on the FIRM and further defined by the Flood Insurance study booklet dated July 3, 1986. The FIRM (and Flood Boundary and Floodway Map if available) and Flood Insurance Study booklet are incorporated herein by reference and are on file with the Town Clerk, Planning Board, Building Official and Conservation Commission.

## **ARTICLE III -- USE REGULATIONS**

Flood plain District I is established as an overlay district to all other districts. All development, including structural and non-structural activities, whether permitted by right or by special permit must be in compliance with Chapter 131, Section 40 of the Massachusetts General Laws and with the requirements of the Massachusetts State Building Code pertaining to construction in

floodplains (currently Section 2102). Additionally any required federal permits must be obtained prior to the issuance of a development permit in the Flood plain District as follows:

1. Within Zones AH and AO on the FIRM, require adequate drainage paths around structures on slopes, to guide floodwaters around and away from proposed structures.
2. Prohibit man-made alteration of sand dunes and salt marshes within Zones V1-30, VE, and V which would increase potential flood damage.
3. Provide that all new construction within Zones V1-30, VE and V be located landward of the reach of mean high tide.
4. Existing contour intervals of site and elevations of existing structures must be included on plan proposal.
5. There shall be established a routing procedure<sup>@</sup> which will circulate or transmit one copy of the development plan to the Conservation Commission, Planning Board, Board of Health, Department of Public Works, Building Inspector, Board of Appeals and Fire Department for comments which will be considered by the appropriate permitting board prior to issuing applicable permits.
6. The Building Inspector shall (a) review all proposed development within the flood district to assure that all necessary permits have been received from those governmental agencies from which approval is required by Federal or State law, including Section 404 of the Federal Water Pollution and Control Act Amendments of 1972, U.S.C. 1334, and (b) obtain and maintain records of elevation and floodproofing levels for new construction or substantial alteration within the flood district.

#### **ARTICLE IV. -- PERMITTED USES**

The following uses of low flood damage potential and causing no obstructions to flood flows are encouraged provided they are permitted in the underlying district and comply with other requirements:

1. Agricultural uses such as farming, grazing, truck farming, horticulture, etc.
2. Forestry and nursery uses.
3. Outdoor recreational uses, including fishing, boating, play areas, etc.
4. Conservation of water, plants, wildlife.
5. Wildlife management areas, foot, bicycle, and/or horse paths.
6. Temporary non-residential structures used in connection with fishing, growing, harvesting, storage, or sale of crops raised on the premises.
7. Buildings lawfully existing prior to the adoption of these provisions.

## **ARTICLE V. -- DEFINITIONS**

**ALTERATION** -- As applied to a building or structure, a change, modification, renovation or rearrangement in the structural parts or in the exit facilities or an enlargement whether by extending on a side or by increasing in height, or the moving from one location or position to another.

**AREA OF SPECIAL FLOOD HAZARD** -- is the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year. The area may be designated as Zone A, AO, AH, A1-30, AE, A99, VO, V1-30, VE, or V.

**BASE FLOOD** -- means the flood having a one percent chance of being equaled or exceeded in any given year.

**COASTAL HIGH HAZARD AREA** -- means the area subject to high velocity waters, including but not limited to hurricane wave wash or tsunamis. The area is designated on a FIRM as Zone V, V1-30, VE.

**DEVELOPMENT** -- means any manmade change to improved or unimproved real estate, including but not limited to building or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations.

**DISTRICT** -- means floodplain district.

**FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)** administers the National Flood Insurance Program. FEMA provides a nationwide flood hazard area mapping study program for communities as well as regulatory standards for development in the flood hazard areas.

**FLOOD BOUNDARY AND FLOODWAY MAP** -- means an official map of a community issued by FEMA that depicts, based on detailed analyses, the boundaries of the 100-year and 500- year floods and the 100-year floodway. (For maps done later than 1987, floodway is designated on FIRM.)

**FLOOD INSURANCE RATE MAP (FIRM)** -- means an official map of a community on which FEMA has delineated both the areas of special flood hazard and the risk premium zones applicable to the community.

**FLOOD INSURANCE STUDY** -- means an examination, evaluation, and determination of flood hazards, and, if appropriate, corresponding water surface elevations, or an examination, evaluation and determination of mudslide (i.e., mudflow) and/or flood-related erosion hazards.

**FLOODWAY B** means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation.

**LOWEST FLOOR** -- means the lowest floor of the lowest enclosed area (including basement or cellar). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building's lowest

floor, PROVIDED that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of NFIP Regulations 60.3.

**MANUFACTURED HOME** -- means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For floodplain management purposes the term A manufactured home A also includes park trailers, travel trailers, or other similar vehicles placed on a site for greater than 180 consecutive days. For insurance purposes, the term A manufactured home A does not include park trailers, travel trailers, and other similar vehicles.

**MANUFACTURED HOME PARK OR SUBDIVISION** -- means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

**NEW CONSTRUCTION** -- means, for floodplain management purposes, structures for which the >start of construction= commenced on or after the effective date of a floodplain management regulation adopted by a community. For the purpose of determining insurance rates, NEW CONSTRUCTION means structures for which the >start of construction= commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later.

**ONE-HUNDRED-YEAR FLOOD** - see BASE FLOOD.

**REGULATORY FLOODWAY** - see FLOODWAY.

**SPECIAL FLOOD HAZARD AREA** -- is the land in a community's flood plain subject to a one percent or greater change of flooding in any given year. The area may be designated on the FIRM as Zone A, AO, A1-30, AE, A99, AH, V1-30, VE.

**STRUCTURE** -- means, for flood plain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home. For insurance coverage purposes, STRUCTURE means a walled and roofed building, other than a gas or liquid storage tank, that is principally above ground and affixed to a permanent site, as well as a manufactured home on foundation. For the latter purpose, the term includes a building while in the course of construction, alteration, or repair, does not include building materials or supplies intended for use in such construction, alteration, or repair, unless such materials or supplies are within an enclosed building on the premises.

**SUBSTANTIAL IMPROVEMENT** -- means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either (a) before the improvement or repair is started, or (b) if the structure has been damaged and is being restored, before the damage occurred. For the purpose of this definition, Asubstantial improvement@ is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of a building commences, whether or not that alteration affects the external dimensions of the structure.

**ZONE A** -- means the 100-year flood plain area where the base flood elevation (BFE) has not been determined. To determine the BFE, use the best available federal, state, local or other data.

ZONE A1-30 and ZONE AE B means the 100-year flood plain where the base flood elevation has been determined.

ZONE AH and ZONE AO B means the 100-year flood plain with the flood depths of 1 to 3 feet.

ZONE A99 -- means areas to be protected from the 100-year flood by federal flood protection system under construction. Base flood elevations have not been determined.

ZONE V -- means special flood hazard area along a coast subject to inundation by the 100-year flood with the additional hazards associated with storm waves. Base flood elevations have not been determined.

ZONE V1-30 and ZONE VE (for new and revised maps) -- means a special flood hazard area along a coast subject to inundation by the 100-year flood with additional hazards due to velocity (wave action). Base flood elevations have been determined.

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