

CITY OF GLOUCESTER HAZARD MITIGATION PLAN



Metropolitan Area Planning Council

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ACKNOWLEDGEMENTS AND CREDITS

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

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I. INTRODUCTION

Planning Requirements under the Federal Disaster Mitigation Act

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

Massachusetts has taken a regional approach and has encouraged the regional planning agencies to apply for grants to prepare plans for groups of their member communities. The Metropolitan Area Planning Council (MAPC) received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the City of Gloucester and 16 other communities to develop their local Hazard Mitigation Plans. The local Hazard Mitigation Plans produced under this grant are designed to meet the requirements of the Disaster Mitigation Act for each community.

What is Hazard Mitigation?

Natural hazard mitigation planning is the process of figuring out how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities.

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II. COMMUNITY PROFILE

Overview

Gloucester balances its' intertwined past and future with assurance and skill. The city, long renowned among artists for the purity of its light, has traditionally been the home of internationally known painters like Winslow Homer, Edward Hopper and Fitz Henry Lane and sculptors like Walker Hancock. In addition, the Cape Ann Symphony makes its home in Gloucester as does the critically acclaimed Gloucester Theatre Company, whose director and playwright, Israel Horovitz, is known on and off Broadway. But the beautiful harbor that attracts a sizeable artistic population is also a working harbor which is one of the top three fishing ports in the northeast. The picturesque fishing fleet, manned primarily by Portuguese and Italian residents of the city, supports a major fish packaging and freezing industry. Residents note emphatically that the city is not a bedroom community, offering work to many of its residents in five industrial parks which produce everything from T-shirts to electronics and engineering. Gloucester is equally proud of the diversity of its population, with working class and ethnic residents as well as established estates and newer summer visitors. Estimates indicate that summer residents push up the population by about a third, drawn by the physical beauty of its location, by the vigorous whale-watching industry, sea-side restaurants and colorful festivals. Understanding the value of its healthy working waterfront, Gloucester has sought to protect it by banning all residential development there. However, acknowledging that the fishing industry is changing rapidly, the city is planning to develop further a controlled tourism, working with the National Park Service on proposals to create an historic industrial fishing park which will feature a working fishing fleet. The city hopes to use its physical setting and history as a basis for balanced growth and change, without losing those characteristics most loved by its residents.

(Narrative based on information provided by the Massachusetts Historical Commission and is taken from the Community Profile on the website maintained by the Department of Housing and Community Development).

The City is governed by a City Council with an elected mayor. The City operates under a City Charter. The 2000 population was 30,273 people and there were 13,965 housing units.

The City maintains a website at <http://www.ci.gloucester.ma.us>

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Existing Land Use

The most recent land use statistics available from the state are based on aerial photography done in 1999. Table 1 shows the acreage and percentage of land in 21 categories. The land use category with the greatest percentage is forest, at 53.51% of the land area. If the four residential categories are aggregated, residential uses make up 25.8% of the area of the city.

**Table 1
1999 Land Use**

Land Use Type	Acres	%
Cropland	11.18	0.06
Pasture	45.79	0.27
Forest	9,201.82	53.51
Non-forested wetlands	140.48	0.82
Mining	14.70	0.09
Open land	482.16	2.80
Participatory recreation	227.08	1.32
Spectator recreation	10.29	0.06
Water recreation	160.24	0.93
Multi-family residential	63.86	0.37
High density residential (less than ¼ acre lots)	622.31	3.62
Medium density residential (¼ - ½ acre lots)	1,926.58	11.2
Low density residential (larger than ½ acre lot)	1,826.54	10.62
Salt water wetlands	1,135.27	6.60
Commercial	153.13	0.89
Industrial	220.20	1.28
Urban open	233.47	1.36
Transportation	247.74	1.44
Waste disposal	32.61	0.19
Water	435.61	2.53
Woody perennials	6.79	0.04
Total	17,197.84	100

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

Potential Future Land Uses

MAPC consulted with city staff to determine areas that were likely to be developed in the future. These areas are shown on Map 2, “Potential Development” and are described below. The letters in parentheses refer to the letters on Map 2.

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A. Annisquam Woods (14 Tufts Lane) - This is a 27 unit cluster residential development which has been approved for construction. There is a very extensive beaver dam on the pond. If the dam were to be breached it could undermine Washington Street because of the large volume of water. The major impact would be on Washington Street because there are very few structures downstream of the dam.

B. Sea Breezes Estates (187 Atlantic Avenue) – A preliminary cluster plan has been filed for a multi-unit residential project.

C. The Village at West Gloucester (36 Atlantic Avenue) – The Village at West Gloucester is a 34 unit cluster development that is under construction.

D. Concord Street Shopping Center - A special permit has been filed for a 45,000 square foot shopping center.

E. Walker Street Parcel – No formal proposal has been filed but the site is being marketed with the potential for residential subdivision.

F. Woodman Street Parcel- No formal proposal has been filed but there has been interest expressed for residential development of this 50+ acre parcel.

G. 602-604 Washington Street – A preliminary plan for a 10 lot subdivision has been filed.

H. Riverdale Place – This 14 lot subdivision is under construction.

I. 30 Witham Street – This 10+ acre parcel is residentially zoned and interest has been expressed to pursue a cluster development.

J. Old County Way/Thatcher Road – There has been a pre-application for a multi-unit townhouse development.

K. Brierneck (74 Thatcher Road) – This is a proposed 12 unit townhouse which has been proposed under Chapter 40B. The project was appealed by the Zoning Board of Appeals and approved by the Housing Appeals Committee.

L.126 Eastern Avenue - There is a pre-application for a multi- unit townhouse development on this site.

M. Gloucester Crossing (Route 128 and School House Road) – This is a mixed use development involving retail, an assisted living facility and a hotel. It is currently under construction.

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N. Blackburn Industrial Park – There are additional lots yet to be developed in the Blackburn Industrial Park.

O. 17 Pond Road – This 27 acre parcel is currently being mined for earth products. It is zoned General Industrial.

P. Western and Magnolia (555 Western Avenue/171 Magnolia Avenue) – There has been a pre-application and soil evaluations for a common septic system to support residential use of this 100 acre parcel.

Q. Woodlands/Magnolia Reach (Kennedy Road) – This 21 lot subdivision is under construction.

R. Industrial Park Expansion - There is a very preliminary conceptual plan for expanding the industrial park. Access would be via Kondelin Road and a new Route 128 interchange.

S. The Forge (Riverside Avenue) – An engineered site plan has been approved by the Conservation Commission for multi-unit residential use.

T. Hampton Inn Hotel Proposal (Essex Avenue) – A hotel special permit and Notice of Intent has been filed and are under review.

III. PUBLIC PARTICIPATION

Public participation occurred at two levels; the Upper North Shore Multiple Hazard Community Planning Team (regional committee) and the Gloucester Multiple Hazard Community Planning Team (local committee). In addition, the City held one meeting open to the general public to present the plan and hear citizen input.

Gloucester’s Participation in the Regional Committee

On March 14, 2008 a letter was sent notifying the communities of the grant award and announcing the first meeting of the Upper North Shore Regional Committee. The letter also requested that the Chief Elected Official designate two municipal employees and/or officials to represent the community. The following individuals were appointed to represent Gloucester on the regional committee:

The Upper North Shore Regional Committee met on the following dates:

- April 15, 2008
- September 30, 2008

The Local Multiple Hazard Community Planning Team

In addition to the regional committee meetings, MAPC worked with the local community representatives to organize a local Multiple Hazard Community Planning Team (local committee) for Gloucester. MAPC briefed the local representatives as to the desired composition of that team as well as the need for representation from the business community and citizens at large.

On September 11, 2008 MAPC conducted the first meeting of the Gloucester Multi-Hazard Mitigation Planning Team. Table 2 lists the attendees at each meeting.

Table 2 Attendance at the Gloucester Local Committee Meetings		
Date	Participants	Purpose
September 11, 2008	Dave Sargent, Shellfish Warden Max Schenk, Health Dept. Mike Hale, DPW Director Carol McMahan, Health Dept. Bill Sanborn, Bldg. Insp. Sarah Buck, Comm. Dev. Director	Introduce the project and discuss the scope of work.

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<p align="center">Table 2 Attendance at the Gloucester Local Committee Meetings</p>		
Date	Participants	Purpose
	Gregg Cadematori, Planning Nancy Ryder, Conservation Barry McKay, Fire Chief	
March 11, 2009	Max Schenk, Public Health Sanitarian Dave Sargent, Shellfish Constable Gregg Cademartori, Planning Director Nancy Ryder, Conservation	Review scope of work; begin data collection.
May 5, 2009	Gregg Cademartori, Max Schenk, Dave Sargent	Review hazard areas and obtain information on potential developments.
May 19, 2009	Margaret Whittaker	Discuss earthquake hazards.
June 9, 2009	Michael Hale, DPW	Review hazard areas and obtain information on dams.
December 7, 2009	Lisa Press, Conservation Max Schenk, Board of Health, Gregg Cademartori, Planning Carol McMahon, CAEPT	Review data, goals and objectives.
December 7, 2009	Phil Dench, Fire Chief	Review copies of dam emergency action plans.
June 1, 2010	Michael Hale, DPW	Review mitigation measures.
June 9, 2010	Max Schenk, Public Health Sanitarian Dave Sargent, Shellfish Constable Gregg Cademartori, Planning Director	Review mitigation measures.

The Public Meeting - The plan was presented to the Gloucester City Council on June 22, 2010.

IV. OVERVIEW OF HAZARDS AND VULNERABILITY

Overview of Hazards and Impacts

The Massachusetts Hazard Mitigation Plan 2007 (state plan) provides an in-depth overview of natural hazards in Massachusetts. The state plan indicates that Massachusetts is subject to the following natural hazards (listed in order of frequency); floods, heavy rainstorms, nor'easters, coastal erosion, hurricanes, tornadoes, urban and wildfires, drought and earthquakes.

Table 3 summarizes the hazard risks for Gloucester. This evaluation takes into account the frequency of the hazard, historical records and variations in land use. This analysis uses the same vulnerability assessment methodology used in the Commonwealth of Massachusetts State Hazard Mitigation Plan, 2007.

Table 3 Hazard Risks Summary		
Hazard	Frequency	Severity
Flooding	High	Serious
Winter storms	High	Serious
Hurricanes	Medium	Serious - extensive
Earthquakes	Low	Catastrophic
Tornadoes	Low	Extensive
Landslides	Low	Minor
Brush fires	Low	Minor
Dam failures	Low	Serious

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Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

Very low frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year)

Low frequency: events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year);

Medium frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year);

High frequency: events that occur more frequently than once in 10 years (greater than 10% per year).

Severity

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e. one or two communities); essential services (utilities, hospitals, schools, etc) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

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Flood Hazards

The state plan indicates that Massachusetts is one of the 10 states that account for 76% of all repetitive loss buildings in the United States. Flooding was the most prevalent serious natural hazard identified by local officials in Gloucester. Flooding is caused by hurricanes, nor'easters, severe rainstorms and thunderstorms.

Regionally Significant Storms

There have been a number of major storms that have resulted in significant flooding in northeastern Massachusetts over the last fifty years. Significant storms that triggered federal disaster declarations include:

1. August 1954
2. March 1968
3. January 1969
4. February 1978
5. April 1987
6. October 1991 ("The Perfect Storm")
7. October 1996
8. June 1998
9. March 2001
10. April 2004
11. May 2006
12. April 2007
13. January 2009
14. March 2010

Sea-level rise

Over the past five years, almost all communities in the Boston metropolitan region have prepared multi-hazard mitigation plans or are in the process of doing so. The vast majority of these plans have focused on a common set of natural hazards including flooding, brush fires, winter storms, dam failures, geologic hazards (landslides, earthquakes, sink holes), tornadoes and hurricanes. Sea level rise has not specifically been identified as a separate hazard for a number of reasons. The first is that sea level rise compounds flooding and may eventually impact the areas subject to flooding but it is essentially a cause of flooding, not a separate hazard. The second reason is that its effects can be mitigated by the same measures already used to mitigate flooding.

There is a program called The StormSmart Coasts program which was developed by the [Massachusetts Office of Coastal Zone Management](#) to help communities prepare for and protect themselves from coastal storms and flooding. Whenever possible, the program taps into existing resources and aims to provide Massachusetts communities with tried-and-true actions that they can take to reduce their risks. A review of the

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resources available on the web site indicate that the techniques suggested are essentially the same ones that are discussed elsewhere in this plan.

This hazard mitigation plan, once adopted, is good for five years. When the plan is updated, it is suggested that the City review the latest scientific data including any new mapping as well as any new regulations that may be put into place for dealing with coastal flooding.

Wind-related hazards

Wind-related hazards include hurricanes and tornadoes as well as high winds during severe rainstorms and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Gloucester.

Between 1858 and 2000, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. This equates to a frequency of once every six years. There was a Category 1 hurricane that tracked through western Gloucester in 1944 and a tropical storm recorded in 1878. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. However, the city does experience the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed through the city. The hazard mapping indicates that the 100 year wind speed is 120 miles per hour for most of the city and 110 miles per hour in the most western portion of the city bordering Essex. There have been no tornadoes recorded within the city limits.

Winter Storms

In Massachusetts, northeast coastal storms known as nor'easters occur 1-2 times per year. Winter storms are a combination hazard because they often involve wind, ice and heavy snow fall. The average annual snowfall throughout the city is 48.1-72.0 inches.

Fire Related Hazards

Brush fires are a fairly common hazard and tend to be concentrated in four areas: Great Magnolia Swamp, Dogtown, West Gloucester Watershed Land and the West Gloucester Woods. There have been some historically significant fires. In 1947 there was a fire that jumped the river. In 1997 there was a fire that burned for two weeks and shut down Route 128 for a period of time.

Geologic Hazards

Most city officials admitted that earthquakes were the hazard for which their community was least prepared. Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures which pre-date the most recent building code.

Portions of the city have been identified as having been built on fill and unconsolidated material, including the center of the city. This type of material is subject to liquefaction during an earthquake.

Regional Overview

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1627 to 1989, 316 earthquakes were recorded in Massachusetts. Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes, of magnitude 6.0 to 6.5 in 1727 and 1755. Other notable earthquakes occurred here in 1638 and 1663. (Tufts). Earthquake mapping for the region shows no earthquake epicenters recorded in Gloucester.

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

Landslides

The entire city has been classified as having a low risk for landslides.

Critical Facilities Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, hospitals, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). It also includes facilities that might pose a particular danger during a natural disaster such as a sewage treatment plant or chemical facility. These facilities are listed in Table 4 and are shown on all of the maps in Appendix B.

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The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community and how they relate to critical infrastructure.

There are 120 critical infrastructure sites in Gloucester.

Flooding – There are 35 critical infrastructure sites that are within a FEMA flood zone. There are 17 that are within locally identified flood hazard area.

Landslides - The entire city is considered to have a low risk for landslides and therefore, all critical infrastructures sites are at low risk for landslides.

Earthquakes – As with all of Massachusetts, Gloucester is not within a high risk area for earthquakes although it is within the vicinity of the Cape Anne fault.

Hurricane surge areas - Critical infrastructure was also mapped relative to hurricane surge areas. The following explanation of hurricane surge areas was taken from the US Army Corps of Engineers web site:

“Hurricane storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm. Along a coastline a hurricane will cause waves on top of the surge. Hurricane Surge is estimated with the use of a computer model called SLOSH. SLOSH stands for Sea Lake and Overland Surge from Hurricanes. The SLOSH models are created and run by the National Hurricane Center. There are about 40 SLOSH models from Maine to Texas.

The SLOSH model results are merged with ground elevation data to determine areas that will be subject to flooding from various categories of hurricanes. Hurricane categories are defined by the Saffir-Simpson Scale.”

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

There are thirteen (13) critical infrastructure sites within the hurricane surge zone.

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
1	Annisquam Kindergarten/ Nursery School	DayCare	No	No	0
2	Essex Community Nursery School	DayCare	No	No	0
3	Gloucester Afterschool @ Fuller School	DayCare	No	No	0
4	Goose Cove Nursery School	DayCare	No	No	0
5	Happy Day School	DayCare	No	No	0
6	Hartz Street Nursery School	DayCare	No	No	0
7	Horizon Children's Center	DayCare	No	No	0
8	Lanesville Preschool Center	DayCare	No	No	0
9	Pathways for Children/School Age Care	DayCare	No	No	0
10	Pathways For Children: Head Start	DayCare	No	No	0
11	The Shannah Montessori School, Inc.	DayCare	No	No	0
12	EOC-City Hall	EOC	No	No	0
13	Gloucester Fire Department	Fire Station	No	No	0
14	Gloucester Fire Department	Fire Station	No	No	0
15	Gloucester Fire Department	Fire Station	No	No	0
16	Gloucester Fire Department	Fire Station	No	No	0
17	Gloucester Police Department	Police Station	No	No	0
18	Gloucester City Hall	Town Hall	No	No	0

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
19	EOC-Secondary	EOC	No	No	0
20	City Hall-EOC	EOC	No	No	0
21	Cape Ann Medical Center Inc.	Medical	No	No	0
22	Gloucester Family Health Center	Medical	No	No	0
23	Eastern Point Day School	School	No	No	0
24	East Gloucester Elementary School	School	No	No	0
25	Gloucester High School	School	No	No	0
26	Saint Ann Elementary School	School	No	No	0
27	West Parish School	School	No	No	0
28	Veterans Memorial School	School	No	No	0
29	Milton L Fuller Elementary School	School	No	No	0
30	Ralph B O'Maley Middle School	School	No	Mill River	0
31	Faith Christian School	School	No	No	0
32	Beeman Memorial School	School	No	No	0
33	Plum Cove School	School	No	No	0
34	Emergency Dispensing Site	Emergency Dispensing Site	No	No	0
35	Gloucester Alternative School	School	No	No	0
36	Addison Gilbert Hospital	Hospital	No	No	0
37	Seacoast Nursing Home	Nursing Home	No	No	0
38	Greycliff at Cape Ann	Nursing Home	No	No	0
39	Central Grammar Apartments	Elderly Housing	No	No	0
40	Curtis B. Clark Building	Elderly Housing	No	No	0

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
41	Sheedy Park	Elderly Housing	No	No	0
42	McPherson Park	Elderly Housing	No	No	0
43	Poplar Park	Elderly Housing	No	Mill River	0
44	Lincoln Park	Elderly Housing	No	No	0
45	Day By Day Adult Care	ADC	No	No	0
46	Council on Aging Senior Center	Senior Center	AE	No	3
47	Action, Inc. Shelter	Sewer Pumping Station	No	No	0
48	Babson Water Treatment Plant	HazMat	No	Mill River	0
49	Matheson Tri Gas	HazMat	No	No	0
50	Americold Logistics	HazMat	AE	No	3
51	Americold Logistics	HazMat	No	No	0
52	Americold Logistics	HazMat	No	No	0
53	Gortons Seafood	HazMat	AE	No	0
54	Good Harbor Fish	HazMat	No	No	0
55	North Atlantic Fish	HazMat	AE	No	3
56	Cape Pond Ice	HazMat	AE	No	3
57	Allied Cold Storage	HazMat	AE	No	3
58	Allied Cold Storage	HazMat	No	No	0
59	National Fish Company	HazMat	AE	No	0
60	West Gloucester Treatment Plant	HazMat	No	Water treatment plant	0
61	Babson Reservoir	Water Supply	A	Mill River	0

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Table 4
Relationship of Critical Infrastructure to Hazard Areas

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
62	Lily pond	Water Supply	A	No	0
63	Wallace Pond	Water Supply	X500	No	0
64	Dykes meadow	Water Supply	A	No	0
65	Dykes meadow	Water Supply	A	No	0
66	Fernwood Lake	Water Supply	X500	No	0
67	Goose Cove Reservoir	Water Supply	A	No	0
68	Klondike Quarry	Water Supply	X500	No	0
69	Babson Reservoir Dam	Dam	A	Mill River	0
70	Lily Pond Dam	Dam	No	No	0
71	Upper Banjo Dam	Dam	X500	No	0
72	Wallace Pond Dam	Dam	X500	No	0
73	Haskell Brook Dam	Dam	No	No	0
74	Strangemen Pond Dam	Dam	X500	No	0
75	Fernwood Lake Dam-east	Dam	No	No	0
76	Fernwood Lake Dam-west	Dam	X500	No	0
77	Fernwood Lake Dam - north	Dam	X500	No	0
78	Goosecove Reservoir- south dam	Dam	No	No	0
79	Goosecove Reservoir- north dam	Dam	No	No	0
80	Goosecove Reservoir - Northwest Dike	Dam	A	No	0
81	Goosecove Reservoir- Southwest Dike	Dam	No	No	0
82	Babson WaterTreatment Plant	Water Treatment Plant	No	Mill River	0

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
83	West Gloucester Treatment Plant	WaterTreatment Plant	No	Water treatment plant	0
84	Fernwood Lake Dam-South Dike	Dam	X500	No	0
85	Dykes Dam	Dam	No	No	0
86	Buswell Pond Dam	Dam	No	No	0
87	Water Pollution Control Facility	WaterTreatment Plant	AE	WasteWater Treatment Plant	0
88	Water Pollution Control Facility	HazMat	AE	WasteWater Treatment Plant	0
89	Haskell Reservoir Dam	Dam	A	No	0
90	Haskell Reservoir	Water Supply	A	No	0
91	Haskell Reservoir	Water Supply	No	No	0
92	Klondyke Water Treatment Plant	WaterTreatment Plant	No	No	0
93	Klondyke Water Treatment Plant	HazMat	No	No	0
94	Plum Cove WaterTower	Stand Pipe	No	No	0
95	Blakcburn Water Tower	Stand Pipe	No	No	0
96	Gloucester City Hall Annex	Municipal	No	No	0
97	Department of Public Works	DPW	No	Mill River	0
98	Corliss Avenue Sewer Pump Station	Sewer Pumping Station	No	No	0
99	Good Harbor Sewer Pump Station	Sewer Pumping Station	No	No	3
100	Thatcher Road Sewer Pump Station	Sewer Pumping Station	AE	Good Harbor Beach	2
101	Parker Street Sewer Pump Station	Sewer Pumping Station	No	No	4

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
102	Blackburn Water Sewer Pump Station	Sewer Pumping Station	No	No	0
103	Commercial Street Sewer Pump Station	Sewer Pumping Station	No	No	3
104	Zeke Saunders Sewer Pump Station	Sewer Pumping Station	No	No	0
105	Riverside Avenue Sewer Pump Station	Sewer Pumping Station	No	No	0
106	Niles Beach Sewer Pump Station	Sewer Pumping Station	No	No	0
107	Beacon Marine Sewer Pump Station	Sewer Pumping Station	No	No	0
108	Witham Street Sewer Pump Station	Sewer Pumping Station	No	No	0
109	Pond Road Sewer Pump Station	Sewer Pumping Station	No	No	0
110	Heritage Way Sewer Pump Station	Sewer Pumping Station	No	No	0
111	DPW Sewer Pump Station	Sewer Pumping Station	AE	Mill River	0
112	Banjo Pond Sewer Pump Station	Sewer Pumping Station	No	No	0
113	Hodgkins Street Sewer Pump Station	Sewer Pumping Station	No	Mill River	4
114	Reynard Street Sewer Pump Station	Sewer Pumping Station	AE	Mill River	2
115	Rte 128 Bridge	Bridge	AE	No	0
117	Rte 127 Bridge	Bridge	AE	No	0
118	Electric Sub Station	Sub Station	No	No	0
119	Annisquam Village Church	Church	No	No	0
120	Assembly of God	Church	No	No	0
121	Calvary Baptist Church	Church	No	No	0
122	Cape Ann Bible Church	Church	No	No	0
123	Community Church of East Gloucester	Church	No	No	0
124	First Baptist Church	Church	No	No	0

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
125	First Church of Christ Scientist	Church	No	No	0
126	Gloucester United Methodist Church	Church	No	No	0
127	Holy Family Parish - St. Ann's Church Independent Christian Church (Unitarian Universalist)	Church	No	No	0
128	Jehovah's Witnesses	Church	No	No	0
129	Lighthouse Baptist Church	Church	AE	No	3
130	Orthodox Congregational Church of Lanesville	Church	No	No	0
131	Our Lady of Good Voyage	Church	No	No	0
132	Safe Harbor Christian Church	Church	No	No	0
133	St. Anthony's Chapel	Church	No	No	0
134	St Paul's Lutheran Church	Church	No	No	0
135	St Johns Episcopal Church	Church	No	No	0
136	Trinity Congregational Church	Church	No	No	0
137	Union Congregational Church	Church	No	No	0
138	West Gloucester Trinitarian Congregational	Church	No	No	0
139	Annisquam Village Church	Cellphone Tower	No	No	0
140	Blackburn Drive Cell Tower	Cellphone Tower	No	No	0
141	Water Tower	Cellphone Tower	No	No	0
142	Kondelin Road Cell Tower	Cellphone Tower	No	No	0
143	Sprint Cell Tower	Cellphone Tower	No	No	0
144	Verizon AT&T Cell Tower	Cellphone Tower	No	No	0
145	Omnipoint Cell Tower 1	Cellphone Tower	No	No	0

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**Table 4
Relationship of Critical Infrastructure to Hazard Areas**

ID	NAME	TYPE	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Hurricane Surge Areas (Category#)
147	Omnipoint Cell Tower - Hospital	Cellphone Tower	No	No	0
148	ATT Cell Tower - Annisquam Village Church	Cellphone Tower	No	No	0
149	Sudbay Dealership Cell Tower	Cellphone Tower	No	No	0
150	Stone Bridge	Bridge	AE	Washington Street Causeway	1
151	ComCast Dish Farm	Communications	No	No	0
152	Cell Tower	Cellphone Tower	No	No	0
153	Cell Tower	Cellphone Tower	No	No	0
154	Mill River Dam	Dam	AE	Mill River	0
155	Lower Banjo Pond Dam	Dam	No	No	0
156	West Pond Outlet Dam	Dam	No	No	0

Explanation of Columns in Table 4.

Column 1: ID #: The first column in Table 6 is an ID number which appears on the maps that are part of this plan. See Appendix B.

Column 2: Site Name: The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.

Column 3: Site Type: The third column indicates what type of site it is.

Column 4: FEMA Flood Zone: The fifth column addresses the risk of flooding. A “No” entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone as follows:

Column 5: Locally Identified Areas of Flooding: The locally identified areas of flooding were identified by town staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, “Hazard Areas”.

Column 6: Hurricane surge area: This column indicates whether the site is located within a hurricane surge area and the potential degree of inundation in the event of a hurricane. A “1” in this column indicates the lowest potential for inundation and a “5” indicates the highest potential for inundation.

Potential Damages to Existing Development

Introduction to HAZUS -MH

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

“HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.

HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations.”

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data.

Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the communities that are a part of this study, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is “subject to a great deal of uncertainty.”

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

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damages from the hazards. If interested, communities can build a more accurate database and further test disaster scenarios.

HAZUS-MH Results for Hurricanes - According to the State Hazard Mitigation Plan, between 1851 and 2004, there were 15 hurricanes. 60% were Category 1, 33% were Category 2 and 7% were Category 3. For the purposes of this plan, a Category 3 and a Category 4 storm was chosen to illustrate damages. The Category 3 storm was Hurricane Edna and the Category 4 storm was Hurricane Gloria. The reason is to present more of a “worst case scenario” that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 5 - Estimated Damages from Hurricanes		
	Category 2	Category 4¹
Building Characteristics		
Estimated total number of buildings	10,055	10,055
Estimated total building replacement value (Year 2002 \$) (Millions of Dollars)	\$2,740	\$2,740
Building Damages		
# of buildings sustaining minor damage	8	717
# of buildings sustaining moderate damage	1	82
# of buildings sustaining severe damage	0	4
# of buildings destroyed	0	1
Population Needs		
# of households displaced	0	32
# of people seeking public shelter	0	9
Debris		
Building debris generated (tons)	38	3,391
Tree debris generated (tons)	504	10,175
# of truckloads to clear building debris	1	135
Value of Damages (Thousands of dollars)		
Total property damage	197.75	17,853.70
Total losses due to business interruption	1.01	1,909.90
¹ No Category 4 or 5 hurricanes have been recorded in New England. A Cat. 4 hurricane was included to help the communities understand the impacts of a hurricane beyond what has historically occurred in New England.		

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HAZUS-MH Results for Earthquakes

The HAZUS earthquake module allows users to define a number of different types of earthquakes and to input a number of different parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this plan two earthquakes were selected: a 1963 earthquake with a magnitude of 5.0 and an earthquake with a magnitude of 7.0.

Table 6 Estimated Damages from Earthquakes		
	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	10,063	10,063
Estimated total building replacement value (Year 2002 \$)(Millions of dollars)	2,739	2,739
Building Damages		
# of buildings sustaining slight damage	512	3,136
# of buildings sustaining moderate damage	108	3,449
# of buildings sustaining extensive damage	13	1,359
# of buildings completely damaged	1	509
Population Needs		
# of households displaced	19	1,852
# of people seeking public shelter	4	459
Debris		
Building debris generated (tons)	NA	NA
# of truckloads to clear building debris	NA	NA
Value of Damages (Millions of dollars)		
Total property damage	59.60	752.34
Total losses due to business interruption	2.45	119.29

Estimated Damages from Flooding

MAPC did not use HAZUS-MH to estimate flood damages in Gloucester. In addition to technical difficulties with the software, the riverine module is not a reliable indicator of flooding in areas where inadequate drainage systems contribute to flooding even when those structures are not within a mapped flood zone. In Gloucester, much of the flooding is due to deficiencies in the drainage system. In lieu of using HAZUS, MAPC developed a methodology to give a rough approximation of flood damages.

Gloucester is 26.66 square miles or 17,062 acres. Approximately 1,783 acres have been identified by local officials as areas of flooding. The number of structures in each flood area was estimated by overlaying the Gloucester Buildings Footprint coverage developed by the City of Gloucester, on the flood hazard areas. Using a size threshold, smaller structures such as sheds and garages were eliminated, leaving primarily residential and commercial buildings. The building count from this process was used in the remaining calculations. HAZUS uses a value of \$ 272,402 per structure for the building replacement value. This was used to calculate the total building replacement value in each of the flood areas. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% as suggested in the FEMA September 2002 publication, "State and Local Mitigation Planning how-to guides". (Page 4-13). The range of estimates for flood damages is between \$33,178,564 and \$165,892,818. These calculations are not based on location within the floodplain or a particular type of storm (i.e. 100 year flood).

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Table 7
Estimated Damages from Flooding

ID	Flood Hazard Area	Approximate Area in Acres	# of Structures	Replacement Value	Low Estimate of Damages	High Estimate of Damages
	Northeast					
1	Gloucester(Lanesville/Annisquam)	190.045	190	\$51,756,380	\$5,175,638	\$25,878,190
2	Coffins Beach	141.811	100	\$27,240,200	\$2,724,020	\$13,620,100
3	Wingersheek	59.944	1	\$272,402	\$27,240	\$136,201
4	Good Harbor Beach Watershed	93.502	60	\$16,344,120	\$1,634,412	\$8,172,060
5	Back Shore Coastal	59.044	21	\$5,720,442	\$572,044	\$2,860,221
6	Back Shore Inland	193.028	183	\$49,849,566	\$4,984,957	\$24,924,783
7	Eastern Point	290.601	119	\$32,415,838	\$3,241,584	\$16,207,919
8	Magnolia Shore	90.845	74	\$20,157,748	\$2,015,775	\$10,078,874
9	Magnolia Harbor	4.815	3	\$817,206	\$81,721	\$408,603
10	Long Wharf	22.234	2	\$544,804	\$54,480	\$272,402
11	Causeway Street	11.508	2	\$544,804	\$54,480	\$272,402
12	Essex Ave south of the Blynman Canal	31.221	14	\$3,813,628	\$381,363	\$1,906,814
13	Mill River	186.083	161	\$43,856,722	\$4,385,672	\$21,928,361
14	Duck Pond	15.317	18	\$4,903,236	\$490,324	\$2,451,618
15	Washington Street Causeway	40.879	35	\$9,534,070	\$953,407	\$4,767,035
16	Newall Stadium	13.956	9	\$2,451,618	\$245,162	\$1,225,809
17	The Boulevard and Draw Bridge	20.088	42	\$11,440,884	\$1,144,088	\$5,720,442
18	East of Babson Street Reservoir	136.040	0	\$0	\$0	\$0
19	Water treatment plant	5.093	5	\$1,362,010	\$136,201	\$681,005
20	Walker Creek Cedarwood and Fenley	54.786	18	\$4,903,236	\$490,324	\$2,451,618
21	Great Harbor Swamp	8.595	4	\$1,089,608	\$108,961	\$544,804

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Table 7
Estimated Damages from Flooding

ID	Flood Hazard Area	Approximate Area in Acres	# of Structures	Replacement Value	Low Estimate of Damages	High Estimate of Damages
22	Cedarwood and Fenley	16.944	36	\$9,806,472	\$980,647	\$4,903,236
23	Sleepy Hollow and Bungalow Road	71.610	91	\$24,788,582	\$2,478,858	\$12,394,291
24	Stoneybrook and Folly Cove	25.289	30	\$8,172,060	\$817,206	\$4,086,030
	Totals	1783.28	1218	\$331,785,636	\$33,178,564	\$165,892,818

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Potential Impacts to Future Development

The city has identified twenty parcels where development is expected to occur in the future. Of these twenty parcels, thirteen are partially within flood hazard areas.

Table 8	
Relationship of Future Development Parcels to Flood Hazard Areas	
Parcel	Flood zone
A. Annisquam Woods	Partially within X500 zone
B. Sea Breeze Estates	Partially within the AE zone
C. The Village at W. Gloucester	No
D. Concord Street Shopping Center	Partially within the AE and A zone
E. Walker Street Parcel	No
F. Woodman Street Parcel	No
G. 602 Washington Street	No
H. Riverdale Place	Mill River Flood Hazard Area; partially within AE zone
I. 30 Witham Street	No
J. Old Country Road	Partially within AE zone
K. 74 Thatcher Road	Good Harbor Beach Watershed Hazard Area; mostly within AE zone
L. 126 Eastern Avenue	Partially within the X500 zone
M. Gloucester Crossing	Partially within the X500 zone
N. Blackburn Industrial Park	Partially within the X500 zone
O. 17 Pond Road	No
P. Western and Magnolia	Partially within X500 zone
Q. Woodlands/Magnolia Reach	No
R. Industrial Park Expansion	Partially within X500 zone
S. Forge Site Redevelopment	Partially with 100 year zone
T. Hampton Inn Hotel	Partially within 100 year zone.

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V. HAZARDS AND EXISTING MITIGATION MEASURES

Flood-Related Hazards

The general scope of flooding in Gloucester was described in the Open Space and Recreation Plan (1998-2003) as follows:

“Areas within the city that are subjected to storm action and flooding include the Atlantic Ocean along the coastline, the Mill River from the Babson Reservoir to the Mill Pond Bridge, and several low lying areas adjacent to the Annisquam River. The coastal areas are subject to periodic flooding and wave surge that accompany coastal storms. Some of the more significant storms in the Gloucester area include those of December 1909 and 1959, February 1972 and 1978, January 1979 and 1987, and October 1991. There have been a total of 21 repetitive loss claims filed by property owners within the years of 1979 to 1992.”

Areas of Flooding

Information on flood hazard areas was taken from several sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix B. The second was discussions with local officials. The locally identified areas of flooding described below were identified by city staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, “Hazard Areas”. The numbers do not reflect priority order.

Area #1: Northeast Gloucester (Lanesville/Annisquam)

Priority: Low

This is a stretch of rocky coastline that is in the velocity zone. The effects of wave action are felt beyond the area designated as the velocity zone on the FEMA Flood Insurance Rate Map. City staff met with FEMA after the Mothers Day storm to provide them with input to the update of the FIRM maps. Northeast Gloucester consists of two neighborhoods; Lanesville and Annisquam as well as a public beach. The area experiences northwest winds in the winter. The major mitigation measure would consist of regulatory control of redevelopment.

Area #2: Coffins Beach

Priority: Medium

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Coffins Beach is a barrier beach, part of which falls within the ACEC. This area has had periodic losses of dunes due to wave and wind action although the long-term trend indicates that accretion is occurring. This area is under redevelopment pressure as cottages are converted to significantly larger year-round homes. There is also an area of salt marsh in this location. This area experiences significant environmental changes on a regular basis. There is also a lot of wind damage to trees and building exteriors. Access to this area is via Atlantic Avenue. This road floods annually and at times has become impassable.

This area experiences many of the same issues as Northeast Gloucester except that the homes are served by on-site septic systems rather than public sewers. Many of the homes were built on dunes. Due to the dynamic nature of the barrier beach/dune complex and exposure to Ipswich Bay, homes are at risk.

Area #3: Wingersheek

Priority: Low

Wingersheek is a barrier beach located at the mouth of the Annisquam River. The dynamic environment is very similar to that of the Coffins Beach area although few if any homes are at risk as the dominant land use is a public beach.

Area #4: Good Harbor Beach Watershed

Priority: Medium to high.

Good Harbor Beach is a barrier beach which has experienced periodic erosion over the years. The barrier beach is flanked to the north and south by residential neighborhoods set on rocky headlands. A couple of homes have made repetitive damage claims due to damage from intense coastal storms.

In 2005 the Office of Coastal Zone Management released a study entitled “ Assessment of Potential and Actual Sources of Nonpoint Source Pollution in the Good Harbor Drainage Area”. Although the purpose of this report was to assess pollution rather than flooding, a number of relevant findings came out of the study. The study found that the outfall below Barn Lane was almost totally blocked by sediment. An outfall on Witham Street was also found to be clogged and in disrepair. The outfalls on Route 128 near the corner of Bass Avenue and behind the Hartz Street pump station are totally blocked with sediment. It is clear that this salt marsh system is being impacted by unmitigated stormwater from upgradient areas.

Area #5: Back Shore (Coastal)

Priority: Medium.

This coastal area faces southeast and bears the brunt of intense coastal storms. There are sections of the road which run parallel to the shoreline that have had to be rebuilt due to storm damage. There are several structures in the FEMA velocity zone. To limit future risks in this area, strict adherence to coastal floodplain construction standards for development and redevelopment should be required.

Area # 6: Back Shore Inland

Priority: Medium.

The land south of the intersection of Grapevine Road and Atlantic road floods every spring due to poor drainage infrastructure and high ground water conditions. Flooding in the Back Shore area is partly due to historic filled wetlands and loss of floodplains. Because flooding is due to filled wetlands there are few options for mitigation. In the center of this neighborhood there is a large area of heath vegetation which is prone to brush fires.

Area #7: Eastern Point

Priority: Low to medium.

This is a neighborhood of low density larger homes in estate settings. This area has a high concentration of pocket wetlands. Drainage issues are minor when compared to other areas, and coastal properties are protected by coastal engineering structures which are regularly maintained by property owners.

Area #8: Magnolia Shore

Priority: Low to medium

There are no filled wetlands or floodplains. Coastal storms cause flooding and road closures of Hesperus Avenue and at Dollivers Neck, where the road can become impassable.

Area #9: Magnolia Harbor

Priority: Low

The major causes of flooding are the southeast winds and damages from coastal surges. This area experienced major damage in the blizzard of 1978 including road closures.

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The sea walls along Shore Road were rebuilt. One house was put on pilings. Mitigation measures in this area would include strict adherence to floodplain construction standards for new construction and redevelopment.

Area #10: Long Wharf

Priority: Low

This is a public landing owned by the city and the state. There is also a road that provides access to one house. The road is regularly overtopped no less than monthly by tidal action and storm surges. This landing is used heavily by boaters and fishermen. There are large potholes in the road and holes in the timber pilings. Some of the damage is caused by the freeze-thaw cycle.

The filled jetty at this location needs to be constantly maintained. The damages here are all property damage with no risk to humans.

Area #11: Causeway Street

Priority: Low to medium

Causeway Street is parallel to Route 128 which was built on filled land through a salt marsh. The dips in Route 128 are where the salt marsh settled. Causeway Street floods at least twice a year. During some high tides, flooding has been severe enough to close one lane of Route 128. When flooding occurs, the city has to deploy manpower to block off Causeway Street, although this does not impact many residents as alternate access is available.

Area #12: Essex Avenue South of the Blynman Canal

Priority: High.

This area contains a mix of residential, commercial, and municipal use including the City's sole wastewater treatment plant. Much of the developed land on either side of the road in this area is within the FEMA floodplain, and much of it was formerly salt marsh prior to development.

Given this area is home to critical infrastructure for wastewater, stormwater, and drinking water, it is of the highest priority. The city is in the midst of significant investments to separate stormwater from wastewater (combined sewer overflow CSO separation) and to its wastewater plant. Finally, in the wake of recent drinking water distribution issues significant water distribution work is also planned including mainline connections and upgrades.

Area #13: Mill River:

Priority: Medium to High. (This is an area subject to multiple hazards (flooding, potential dam failure and brush fires).

This area is home to the DPW yard and a retirement village and includes the Babson Reservoir. The retirement village had to be evacuated during the Mothers Day storm. The reservoir is managed by the DPW and the dam that created the reservoir is considered to be the second most dangerous dam in the city. It would be vulnerable in the event of an earthquake. This is also an area with extensive phragmites which catch fire easily.

There is severe flooding on both sides of Alewife Brook. Flooding in this area is controlled to some extent by a tide gate. The City has obtained a grant from NOAA and CLF for a permitted expansion of the tide gate. This project entails the installation of another tide gate downstream to increase the opening and increase the ability to shut out the tides in advance of a storm so that the full capacity of Mill Pond would be available for flood storage.

The Babson Reservoir Dam is a high hazard dam and an area of rapid recharge. There are water quality issues as well

The DPW yard has flooded with four feet of water. There is hazardous material on the site and a sewage pump station. This whole area needs to be redeveloped. The DPW Director believes that city offices should be consolidated at this location. There is currently a facilities planning group looking into this. The DPW could fill the area and raise it out of the floodplain. The Mill River is also silted in with 2 feet of silt. One potential mitigation measure would be to undertake stream restoration of Alewife Brook to Mill Pond. This would involve creating additional storage capacity by raising portions of the back yards of residences that abut Mill Brook. The City also has a grant to expand the tide gate. However, recent improvements to the Babson Reservoir Dam which allow the City to control the water level may adequately mitigate flooding in this area.

Area #14: Duck Pond

Priority: Medium to high.

Dennison Street washes out during flooding about every other year. The road has still not been repaired since the last wash out (Mothers Day storm). This impedes access to a small number of homes. Suggested mitigation measures include installing a larger culvert, reinforcing the road edges and putting a grate over the culvert to prevent people from throwing debris that clogs the culvert. The best mitigation would be to

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remove the road and put a bridge in its place. The capacity of the culvert also needs to be increased and the structure should be self-regulating rather than manually operated.

Further study may be necessary to determine how best to mitigate this area. The drainage structures in this area are privately owned and the DPW Director does not believe that enlarging the culvert and putting a grate on it will stop the accumulation of vegetation which is the main source of clogging of the culvert.

Area #15: Goose Cove Causeway (Washington Street)

Priority: Medium to high

The causeway creates a tidal restriction and water overtops the road which is causing it to begin to collapse. There are sinkholes in the road. This causeway is the major access to North Gloucester (along with Dennison Street) without having to go through Rockport. Dennison Street and the Goose Cove (Washington Street) Causeway tend to flood at the same time so if both roads were to be closed, traffic would have to go through Rockport. The best mitigation would be to replace the causeway with a bridge. This is a small state owned bridge which needs work and affects access to Wards 4 and 1.

Area #16: Newell Stadium

Priority: Low

This is a football stadium that was built below sea level on a filled salt marsh. There is a sea wall but the stadium still floods. The sea wall impacts a navigable channel, the Blynham Canal. The high school was built on fill and might be particularly vulnerable during an earthquake. The only impacts are to the grassy fields.

Area #17: The Boulevard and Drawbridge

Priority: High

The Boulevard was built on unconsolidated material and is subject to being washed out by wave action. Many of the City's utilities such as water, sewer and cable lines are in the roadbed. The road is subject to sinkholes caused primarily by water main breaks and in one instance, a truck fell into a sinkhole. There is no long term management plan for this area. The City needs to maintain the sea walls. The Drawbridge is one of two ways off the island and is critical for access. Due to the unconsolidated material, the Boulevard could be particularly vulnerable during an earthquake. The city is currently permitting the Blynman/Fort Stage Park sea wall improvements.

Area #18: East of Babson Reservoir

Priority: Medium

There is a beaver pond and wetlands east of Babson Reservoir. Flooding from the beaver dams on the pond is washing out the commuter rail bed and the fire roads that serve Dogtown. The MBTA has not yet addressed this issue. The city is concerned that if the substructure of the commuter rail tracks is undermined and a train derails full of fuel, the fuel would spill into the water supply reservoir. The City maintains the fire roads.

Area #19: Water Treatment Facility

Priority: Low

The water treatment plant floods because it's built on a filled wetland. Lily Pond is an alewife run and the City is removing the fish ladder. There is also a dam which has been undermined and a culvert that gets clogged. There is a Little River Restoration report that addresses some of these issues.

Area #20: Walker Creek

Priority: Low

This area is included within the ACEC and has many of the same issues as area #19. There is a tidal restriction at Concord Street where there is scouring on the sides of the banks. This could be alleviated by increasing the size of the culvert. The mill dam which is privately owned creates a tidal restriction. The dam cannot easily be removed because there is habitat area. It would be necessary to do a study of Concord Street to identify potential mitigation measures. This is not an area that is densely populated.

Area#21: Great Harbor Swamp

Priority: Medium

The Great Harbor Swamp was filled to accommodate construction of the city center. Maplewood Avenue experiences inland flooding. The filling consists of unconsolidated material. There have been some recent drainage improvements (check with Frank in engineering) and there are projects that are on-going. There is also a project to eliminate CSOs in this area and plans for additional drains which should divert some of the flows.

Area #22: Cedarwood/Fenley

Priority: Medium

Historical development of this neighborhood resulted in the loss of wetlands and floodplains. The flooding could be mitigated by floodplain restoration and improved maintenance of the culverts. DPW has removed some of the fill and is daylighting a portion of the stream but there are some issues regarding ownership. There is also a need to educate residents and enforce regulations to reduce the dumping of yard waste into the stream. This area also suffers from failed septic systems and is a public health concern. There was a plan to extend sewers to a number of areas with failing septic systems (The Daylor Ward 52 Wastewater and Land Use Plan). The Health Department has begun sending out upgrade letters to residents informing them that they have two years to upgrade their sewer systems.

Area #23: Sleepy Hollow/Bungalow Road

Priority: High because of access.

This area was formerly a cranberry bog which was filled in to allow the construction of cottages. The road floods annually but every other year it floods to the extent that it becomes impassable. The road has been closed for one week at a time on occasion. On one occasion the road became impassable and a house burned down because the Fire Department was unable to reach it. There is a culvert that has collapsed. There was a permit issued for its replacement but the DPW has not yet been able to schedule the work.

There is a pond that has a tidal influence and an eel run. The DPW will be installing a box culvert but they haven't been able to yet because there is a short window of opportunity between the eel run and beach traffic.

Area #24: Stony Brook/Folly Cove

Priority: Low

The flooding in this area impacts some homes. There is flooding on the brook and the wetlands that feed the brook on Langsford Road. The City has replaced some drain lines which should alleviate the problems.

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Repetitive Loss Structures

There are twenty-four (24) repetitive loss structures in Gloucester. These properties are shown on all of the maps in Appendix B. As defined by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of \$1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see <http://www.fema.gov/business/nfip/replps.shtm>.

Six of the repetitive loss properties are in West Gloucester while the remaining 18 are in East Gloucester. There is a small cluster of properties in the Rocky Neck neighborhood. Table 9 shows the number of properties by the number of losses for which a claim was filed.

Number of losses	Number of properties
2	10
3	6
4	4
5	2
6	1
7	1

The property with seven losses is on Witham Street and is within an identified flood hazard area (Good Harbor Beach). The property with 6 losses is on Dollivers Neck within the Magnolia Shore flood hazard area. The property with 5 losses is on Wise Place but is not within an identified flood hazard area.

The three years with the most damage claims were 1987 (11 claims), 1991 (19 claims) and 1992 (11 claims).

Existing Multi-Hazard Mitigation Measures

There are several mitigation measures that impact more than one hazard. These include the Comprehensive Emergency Management Plan (CEMP), the Massachusetts State Building Code and participation in a local Emergency Planning Committee.

Comprehensive Emergency Management Plan (CEMP) – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of

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natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan.

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

Local Emergency Planning Committee (LEPC) – Gloucester is a member of the Cape Ann Emergency Planning Team which has received provisional status as an LEPC. The Cape Ann Emergency Planning Team includes Gloucester, Essex, Rockport and Manchester-by-the-Sea.

Existing Flood Hazard Mitigation Measures

Participation in the National Flood Insurance Program (NFIP) – FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at <http://www.fema.gov/business/nfip/statistics/pcstat.shtm>. The reporting period goes up through July 31, 2009. The following information is provided for the City of Gloucester.

Table 10	
Flood Insurance Policies and Premiums	
Flood insurance policies in force (as of July 31, 2009)	450
Coverage amount of flood insurance policies	\$114,853,100
Premiums paid	\$543,967
Total losses (all losses submitted regardless of the status)	288
Closed losses (Losses that have been paid)	231
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	57
Total payments (Total amount paid on losses)	\$5,019,417.08

Source: at <http://www.fema.gov/business/nfip/statistics/pcstat.shtm>

Street sweeping – The city conducts street sweeping from March through November. The street sweeping begins with an initial sand pick-up on all streets and additional sweeping is done on a ward-based schedule with some of the sweeping done at night. The city owns its own equipment and does the work in-house. The city has a new sweeper but would like a second one. Each sweeper costs approximately \$200,000. Manpower is also an issue because the DPW is under-staffed.

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Catch basin cleaning – There are approximately 3,000 catch basins in the city. Under the Phase II stormwater plan, some of these are being rebuilt. The city owns a vactor truck and does the work in-house. The city would like to be able to clean the catch basins more often but lacks sufficient manpower. The DPW sometimes has to react to emergency situations rather than being able to focus on prevention. There are a few inlet screens in low-lying areas that the city will clean out when a storm is forecast.

Roadway Treatments – The city uses a lot of sand on the roads but the DPW is trying to use less sand because it ultimately has to spend more money to sweep the streets and remove the sand. The city prohibits the use of salt on the road adjacent to Klondike Reservoir.

Tide gates – There are a number of tide gates which are being replaced as part of a program to eliminate Combined Sewer Overflows. The city removes debris from tide gates when necessary.

Water main breaks – The city's water distribution system was installed in three general time periods; Pre WW I, the depression era (Works Progress Administration) and Post WW II. All parts of the system are aging and in need of rehabilitation or replacement. Approximately 62% of the system consists of unlined cast iron pipes which are very brittle.

A lot of the valves have been replaced and in 2004, the city conducted an inventory and mapping program using GPS and exercised all the valves. There is a flushing program but no regular valve exercise program.

Zoning Bylaw

The City of Gloucester Zoning Ordinance (issued October 2008 with amendments to date incorporated) designates two zoning districts specifically related to coastal areas.

The RC-40 district is the Coastal Residential District with a minimum lot area of 30,000 square feet. This district consists of Eastern Point and that area on the southeast side of the middle portion of Hesperus Avenue.

The MI Marine Industrial District is essentially Gloucester's Inner Harbor. Residential uses generally are not allowed.

Section 5.5 of the zoning ordinance contains lowland requirements. The following areas are exempted: The area bordering Gloucester Harbor north and east of a line from the mouth of the Blynman Canal to the intersection of Farrington Avenue and Eastern Point Boulevard.

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The lowland requirements prohibits the issuance of building permits for principal buildings on land less than 10 feet elevation above U.S.G.S datum except on approval of a Special Permit for an exception by the City Council. These exceptions can be granted only if the applicant can prove that the development will not pose a hazard to health and safety. These requirements are in place because the following conditions are presumed to be hazardous:

- a) Floor level of any structure for human occupancy less than 12 feet elevation.
- b) Individual sewage disposal systems subject to inundation in the event of coastal flooding to ten feet elevation.
- c) Methods of filling or excavation subject to displacement by coastal flooding to ten feet elevation.
- d) Water supplies subject to interruption or contamination in the event of coastal flooding to ten feet elevation.

Wind-Related Hazards

There was a Category 1 hurricane that tracked through western Gloucester in 1944 and a tropical storm recorded in 1878. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. However, the city does experience the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed through the city. The hazard mapping indicates that the 100 year wind speed is 120 miles per hour for most of the city and 110 miles per hour in the most western portion of the city bordering Essex. There have been no tornadoes recorded within the city limits.

There was a severe wind/rain storm on February 23, 2010 that caused well over a million dollars of uninsured damage in Gloucester. New Hampshire was declared a federal disaster area due to this storm but the monetary damages did not reach the threshold in Massachusetts. Several large motels lost complete roofs in this storm and Cape Ann sustained major tree and power line damage. The Emergency Operations Center was active from February 23 – 27th.

Existing Wind Hazard Mitigation Measures

Massachusetts State Building Code – The city enforces the Massachusetts State Building Code whose provisions are generally adequate to mitigate against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornadoes given the extremely low probability of occurrence. If a tornado were to occur in Gloucester damages would be extremely high due to the prevalence of older construction and the density of development.

Tree trimming - The city does not have a forestry division but does employ an arborist. It also has a bucket truck with a brush attachment as well as a chipper but no stump

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grinder. The city contracts out the stump grinding but does compost the ground up material

Winter-Related Hazards

Winter hazards include regular snowfalls and blizzards. The average annual snowfall for the entire city is 48.1 – 72 inches. The most severe winter storm was the blizzard of 1978.

Existing Winter Hazard Mitigation Measures

There are no specific measures beyond regular salting and sanding of the roads and local plowing.

Snow removal – The city uses Stage Fort Park as a snow disposal area. The snow contains road sand and trash but is placed in the park in such a way that the snow melt does not run off into the ocean.

Fire-Related Hazards

Brush fires are a fairly common hazard and tend to be concentrated in four areas. There have been some historically significant fires. In 1947 there was a fire that jumped the river. In 1997 there was a fire that burned for two weeks and shut down Route 128 for a period of time.

The Fire Department's web page states that April is the worst month for brush fires. When the snow pack recedes, last year's dead grass, leaves and wood are dangerous tinder. Winds also tend to be strong and unpredictable. The Fire Department recommends burning during wet, snowy conditions.

Due to staffing cuts, routine clearing of existing fire roads in the woods has been curtailed. As a result, many of the roads are overgrown and not passable by vehicle. Also, because of the severe spring storms, there has been a great deal of tree fall in several areas, posing a real concern for forest and watershed land fires.

Area #25: Great Magnolia Swamp – This is a wooded area in the southwestern portion of the City. The southern portion of the Great Magnolia Swamp abuts a residential neighborhood with the potential for fires to impact this neighborhood.

Area # 26 : Dogtown – Dogtown is a large area of watershed land. There is flooding in Dogtown but this is not a concern because there are no residents. This is an area with frequent brush fires which are often started by teens who start bonfires. The area has a lot of fuel including briar growth. In addition, the area is exposed to wind from all directions. The City used to do controlled burning in this area and the area does need to

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be managed to reduce the fire risk. What happens in Dogtown impacts water quality in the City.

Area #27: West Gloucester Watershed Land – This is a large wooded area which includes Dykes Pond and Lily Pond. There is very little residential development near this area.

Area #28: West Gloucester Woods – This wooded area is also relatively isolated from residential development.

Although not specifically identified as a brush fire hazard area, the Mill River flood area has an area of phragmites which has a tendency to catch fire. This area could be mitigated by using NOAA funding for phragmites removal.

Existing Fire Hazard Mitigation Measures

Permits required for outdoor burning - The Fire Department requires permits for outdoor burning. There is an application process which includes a fee and a site inspection. The applicant is also given written rules. The open burning season runs from January 15 to May 1. Rules and regulations are posted on the City of Gloucester Fire Department's web page.

Subdivision review - The Fire Department is involved in reviewing site plans for subdivisions to ensure that there is adequate access for fire trucks and an adequate water supply. The Fire Department then makes recommendations to the Planning Board.

Dam Failures

There are approximately fifteen dams within the City limits. These dams serve a variety of purposes. Many of these dams are old and in disrepair. Depending on what is located downstream, dam failures can pose a serious threat to life and property. In general, there are nine categories of potential hazards that can lead to dam failure. These include:

- Flow erosion
- Slope protection damage
- Embankment leakage, piping
- Foundation leakage, piping
- Sliding
- Deformation
- Deterioration

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- Reduction of crest elevation
- Dam overtopping

Overview of Emergency Action Plans

MGL Chapter 253 and 302 CMR 10.00 requires that dam owners prepare, maintain and update Emergency Action Plans for all High Hazard Potential dams and certain Significant Hazard Potential dams. EAPs generally contain six basic elements:

- Notification Flowchart
- Emergency Detection, Evaluation, and Classification
- Responsibilities
- Preparedness
- Inundation Maps
- Appendices

In general, regulations require notification of residents and property owners within the inundation area when a dam emergency is imminent. Notification is to be made by telephone followed up by notification in person by the local police department of residents who were not able to be reached by phone. None of the EAPs reviewed for this plan included a list of residents and their telephone numbers.

More information on Emergency Action Plans can be found at:

<http://www.mass.gov/dcr/pe/damSafety/emergencyaction.htm>

Of the approximately 15 dams in the City, the following dams have been identified as being of particular concern.

Area #29 - West Pond Dam – This pond was created by a privately-owned earthen dam although the City has been unable to determine who actually owns it. There is a neighborhood association that wants to see the dam improved and made safe. Due to siltation, the pond does not hold much water but there could be public safety issues downstream in the event of a dam failure, depending on the amount of rain and the amount of slurry that would result. Further study would be necessary to evaluate the potential impacts and to determine ownership of the dam.

Area #30 – Haskell Brook Dam – Weston and Sampson updated an Emergency Action Plan in June 2007. This dam is also classified as a high hazard. Six areas to be evacuated include:

1. The area along Forest Lane between Haskell Pond and Route 133.
2. The area along the first half of Lincoln Street starting at Route 133.
3. The area along Walker Street between Lincoln and Sumner Streets.

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4. The area along Sumner Street between Walker Street and Concord Street.
5. The area along Concord Street between the bridge over Walker Creek and the intersection with Sumner Street.
6. The area between Walker Creek and Concord Street extending approximately 1,0000 feet north of the intersection with Sumner Street.

A review of the inundation map indicates a substantial number of structures compared to the other dams.

Water overtopping the dam during rain events in February and March of 2010 caused scouring on the downstream side of this dam. The City plans to locate a new low level outlet structure located in the spillway and partially drain the pond in order to determine the dam's overall structural integrity.

Area #31 – Haskell Pond Dam – An inspection/evaluation report for this dam was prepared by Weston & Sampson in December 2006. This dam was determined to be in fair condition. The inspection/evaluation report contained recommendations for routine maintenance, minor repairs and remedial measures to bring the dam into compliance with current dam safety regulations.

The remedial measures include cutting all trees on the downstream slope of the embankment and the design and installation of a mineral filter and drainage system at the toe of the dam to control seepage. The cost for the remedial measures (design, permitting and construction) would be approximately \$100,000 -\$200,000.

There is also an Emergency Action Plan for this dam.

Area #32 – Wallace Pond Dam – This dam has been classified by DEP as a high hazard dam which is in fair condition. Weston & Sampson prepared an inspection/evaluation report in December 2006. The report included a number of recommendations for routine maintenance and minor repairs as well as remedial measures that are needed to bring the dam into compliance with current dam safety regulations. The remedial measures include improvements to the primary spillway, improvements to the discharge channel and the design and installation of a mineral filter and drainage system at the downstream toe of the embankment. The cost of these remedial measures would be \$100,000 - \$300,000 for design, permitting and construction.

In June 2007 Weston and Sampson updated a 1994 Emergency Action Plan (EAP) for the dam. This EAP identified the inundation area/area to be evacuated as being situated between Wallace Pond Dam and Route 133 with the addition of several houses just north of Route 133 along the east bank of the Little River. Although there is no list of properties within the inundation zone, it appears from the map that there are 18 structures shown.

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Area #33 – Fernwood Lake Dams

There is a series of dams and dikes that impound Fernwood Lake. This system consists of an East, West and North dam. The lake is a backup water supply for the city but is primarily a recreational lake. The dams were constructed beginning in 1877 and have not received significant modifications or rehabilitation since then.

East Dam – The East Dam is classified as an intermediate size, high hazard dam which is in poor condition. Weston & Sampson prepared a Phase II Inspection Report in June 2009. The report noted numerous deficiencies including exposed tree roots, irregular grading, standing water with iron staining, and dampness and corrosion of some pipes.

The report identified a number of rehabilitation measures recommended to bring the dam into compliance with dam safety regulations. The cost of design and permitting is in the range of \$45,000 - \$60,000 and construction costs would be in the range of \$210,000 - \$270,000.

West Dam - The West Dam is classified as an intermediate size, high hazard dam and is considered to be in poor condition according to the Phase II Inspection Report prepared by Weston & Sampson in June 2009. Earlier inspection reports noted numerous deficiencies such as tree roots exposed, animal burrows and shifting of stones. The inspection report also included a seismic evaluation which concluded that the dam would not be stable in the event of an earthquake although it would not be susceptible to liquefaction because of the bedrock foundation.

The report further went on to outline rehabilitation measures that are recommended to bring the West Dam into compliance with dam safety regulations. Weston & Sampson estimated that the cost of design and permitting as \$45,000 - \$60,000 and construction costs to be in the range of \$185,000 - \$300,000.

North Dam – The North Dam is also classified as an intermediate size, high hazard dam which is considered to be in poor condition. The dam was also the subject of a Phase II Inspection Report prepared by Weston & Sampson in June 2009. The report noted a number of deficiencies including wet areas indicating seepage, vegetation growing on the crest and embankment and erosion. The seismic evaluation indicated that the walls of the dam would not be stable during an earthquake but that the bedrock foundation made the dam not susceptible to liquefaction.

The report recommended a number of rehabilitation measures that would be necessary to bring the dam into compliance. Design and permitting would cost \$60,000 - \$75,000 and construction would be \$425,000 - \$550,000.

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The Fernwood Lake Dams and Dikes were also the subject of an Emergency Action Plan prepared by Weston and Sampson in 2007. The plan for this dam complex included information about earthquakes and also did an analysis of inundation based on wet weather and fair weather.

The plan recommended that, in the event of an earthquake, that Weston and Sampson should be contacted and retained to immediately conduct a general visual inspection of the dam to determine if there is a potential for an emergency situation. If not emergency situation is detected, frequent (minimum of bi-weekly) inspections of the dam should be made for a minimum of one month.

North Dam – The inundation area for a fair weather breach of the dam includes portions of Route 133 and Stanwood and Winthrop Avenues, including the mud flats that are downstream of Winthrop Avenue. The wet weather breach is similar but with a higher peak discharge.

West Dam – A breach of the West Dam will flow into the Wallace Pond watershed and cause overtopping of the Wallace Pond Dam. It is likely that the Wallace Pond Dam will also fail. The area between West Dam and the Wallace Pond Dam is uninhabited so flooding is not a concern. However, the EAP notes that discharge from Wallace Pond flows through the railroad underpass on Wallace Court, across Magnolia Avenue to the Little River tributary and downstream to Route 133. A discharge of this magnitude would cause flooding of Magnolia Avenue from Wallace Court to Route 133. Because of the constriction of the railroad underpass, flood depths in the underpass will be close to 5.9 feet and the flood wave across Magnolia Avenue will be particularly dangerous because it will have significant velocity and energy.

East Dam – The flood wave from a breach of East Dam will flow into Upper Banjo Pond immediately downstream, overtopping the dam crest with more water than the spillway can handle, thus causing this dam to fail as well. While the inundation area between East Dam and Upper Banjo Pond Dam is uninhabited, the concern is the flooding that will occur along Route 133 and around the perimeter of Lower Banjo Pond Dam.

Area #34– Goose Cove Reservoir Dams

The Goose Cove Reservoir North Dam is an earthen structure that belongs to a system of four separate structures located around Goose Cove Reservoir; the North Dam, Northwest Dike, South Dam and Southwest Dike. The North Dam is classified as a large, high hazard dam which is in fair condition. Weston & Sampson prepared an inspection/evaluation report in December 2006. It recommended that the Emergency Action Plan be updated, identified a number of routine maintenance tasks as well as recommendations for minor repairs. The report also identified a number of remedial measures that are necessary to bring the dam into compliance with dam safety

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regulations. These include removing trees and brush and filling/regarding the embankment and abutments. The cost of the remedial measures would be approximately \$30,000 - \$50,000.

All four structures are included in the June 2007 Emergency Action Plan prepared by Weston and Sampson. Each structure has a different inundation area and each is classified as a high hazard dam.

North Dam – The inundation area extends from North Dam across Dennison Street and Holly Street to Goose Cove. At Goose Cove, the flood wave is adequately dissipated. The area that would need to be evacuated would include homes along Dennison Street directly downstream of the dam and homes along Holly Street at Goose Cove.

Northwest Dike – The inundation area extends from the northwest dike across Holly Street to Goose Cove. At Goose Cove, the flood wave is adequately dissipated. The area to be evacuated would include homes along Holly Street.

South Dam – The inundation area extends from South Dam to Mill Pond. At Mill Pond the flood wave is adequately dissipated. The area to be evacuated includes Goodwin Road, Macumber Road, Finch Lane, Cherry Street and Reynard Street.

Southwest Dike – The inundation area extends from the Southwest Dike across Holly Street to the Mill River. At the Mill River, the flood wave is adequately dissipated. The inundation area includes homes and businesses at the intersection of Washington Street and Holly Street.

Area #35 – Mill River Culvert and Tide Gate (Mill Pond Dam) -The reservoir is managed by the DPW. The dam that created the reservoir was replaced by a tide gate. The City is in the process of installing a second tide gate. This project will go out to bid in June 2010. The tide gate is expected to cost \$60,000.

Area #36 – Babson Reservoir Dam – The Babson Reservoir Dam impounds Babson Reservoir which is used as a water supply for the city. It is classified as a high hazard dam. The dam was the subject of a Phase II inspection report prepared by Weston & Sampson in 2009. This inspection found the dam to be in poor condition. The Phase II report examined the existing conditions of the dam with a visual dam safety inspection, review of subsurface geotechnical investigation and engineering analyses, as well as an analysis of the watershed hydrology and spillway hydraulics. Several deficiencies were identified and documented. The report also included an analysis of alternatives for remediating the dam. The report concluded that the dam is currently not capable of meeting current dam safety regulations.

The recommended dam rehabilitation measures are described on Page 30 of the report and include hydraulic improvements, upstream and downstream slope improvements,

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crest improvements, rehabilitation of concrete structures as well as the gatehouse. The report did not include any cost estimates because the rehabilitation measures were still in the conceptual design phase.

The City has recently undertaken approximately \$1.9 million dollars of improvements at the dam. Trees have been removed. The valves that control pipes under the dam have been replaced which has given the city the ability to control the level of the dam. In the long-term, the spillway will need to be repaired and Weston & Sampson recommended that the toe of the dam be built up. The report estimates that design fees for dam rehabilitation would be approximately \$150,000 - \$180,000. Permitting fees would be around \$40,000 and construction costs would be \$1,300,000 - \$1,600,000. The total for dam rehabilitation would be approximately \$1,820,000.

There is also a June 2007 Babson Reservoir Dam Emergency Action Plan by Weston and Sampson.

Area #37: Langsford Pond Beaver Dam – This is a privately owned dam.

This is a residential development (Annisquam Woods) which has been approved for construction. There is a very extensive beaver dam on the pond. If the dam were to be breached it could undermine Washington Street because of the large volume of water. The major impact would be on Washington Street because there are very few structures downstream of the dam.

The Essex County Greenbelt Association has a conservation restriction in this area. They have been issued a permit by the Conservation Commission to install a beaver deceiver to lower the level of the pond and relieve the pressure on the dam. There does not appear to be any problem with the culvert.

Area #38: Upper Banjo Dam- This is a privately owned dam that has been classified as a high hazard dam. The Office of Dam Safety has required the owner to maintain a certain water level in Upper Banjo Pond. This dam could potentially pose a threat if there were any changes in the current operations of the dam.

Existing Dam Failure Mitigation Measures

The Comprehensive Emergency Management Plan – The CEMP addresses dam safety.

Permits required for construction – State law requires a permit for the construction of any dam.

DCR dam safety regulations – All dams are subject to the Division of Conservation and Recreation's dam safety regulations.

Geologic Hazards

Most municipal officials acknowledged that earthquakes were the hazard for which their community was least prepared. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the city pre-dates the most recent building code. Massachusetts in general has a low risk for earthquakes.

According to the DPW there have not been any sink holes or landslides in the City. Some water mains have had to be installed on 30-40 foot piles because they run through an area of peat. This is true for water mains in the vicinity of area 21. Gloucester is an area with a very shallow depth to bedrock and very little topography which minimizes the risk for landslides.

In the course of identifying flood hazard areas city staff pointed out a number of areas that might also be at a higher risk in the event of an earthquake. These are as follows:

Causeway Street - This is an area where the road was built on unconsolidated materials and may be at a higher risk in the event of an earthquake.

Mill River - The reservoir is managed by the DPW and the dam that created the reservoir is considered to be the second most dangerous dam in the city. It would be vulnerable in the event of an earthquake.

Newell Stadium - The high school was built on fill and might be particularly vulnerable during an earthquake.

The Boulevard and Drawbridge - The Boulevard was built on unconsolidated material and is subject to being washed out by wave action. Due to the unconsolidated material, the Boulevard could be particularly vulnerable during an earthquake.

Existing Geologic Hazard Mitigation Measures

Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is “to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake”. This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be “prudent and economically justified” for the protection of life safety. The code also states that absolute safety and prevention of damage, even in

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an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
MITIGATION MEASURES RELATING TO MULTIPLE HAZARDS				
Comprehensive Emergency Management Plan (CEMP)	Every community in Massachusetts is required to have a CEMP. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies.	City-wide.	Emphasis is on emergency response.	None.
Massachusetts State Building Code	The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.	City-wide.	Most effective for new construction.	None.
Participation in the Cape Ann Emergency Planning Team which has received provisional status as an LEPC.	Includes the communities of Gloucester, Essex, Rockport and Manchester-by-the-Sea.	Regional.	Provides a forum for regional cooperation on issues related to natural and man-	None.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
			made disaster.	
FLOOD RELATED HAZARDS				
Participation in the National Flood Insurance Program	Homeowners in the floodplain can purchase flood insurance.	Areas identified on the FIRM maps.	Effective for homeowners who have policies.	Encourage all eligible homeowners to obtain insurance
Street sweeping	March through November. Begins with an initial sand pick-up on all streets and additional sweeping is done on a ward-based schedule. at night. The city owns its own equipment and does the work in-house.	City-wide.	Effective.	None.
Catch basin cleaning		City-wide.	Effective.	The city would like to be able to clean the catch basins more often but lacks sufficient

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
				manpower. The DPW sometimes has to react to emergency situations rather than being able to focus on prevention
Roadway treatments	The city uses primarily sand on the roads. The city prohibits the use of salt on the road adjacent to Klondike Reservoir.	City-wide.	Effective.	The DPW is trying to use less sand because it ultimately has to spend more money to sweep the streets and remove the sand.
Tide gates	There are a number of tide gates which are being replaced as part of a program to eliminate Combined Sewer Overflows. The city removes debris from tide	Site specific.	Effective.	Replacement of tide gates will increase effectiveness.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
	gates when necessary.			
The RC-40 Coastal Residential Zoning District.	This district has a minimum lot area of 30,000 square feet.	This district consists of Eastern Point and that area on the southeast side of the middle portion of Hesperus Avenue.	Effective.	None.
MI Marine Industrial Zoning District.	Residential uses are not allowed.	The Inner Harbor.	Effective.	None.

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Table 11
Existing Mitigation Measures

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
Section 5.5 of the zoning ordinance – lowland requirements.	The lowland requirements prohibits the issuance of building permits for principal buildings on land less than 10 feet elevation above U.S.G.S datum except on approval of a Special Permit for an exception by the City Council.	City-wide except for lands bordering Gloucester Harbor north and east of a line from the mouth of Blynman Canal to the intersection of Farrington Avenue and Eastern Point Boulevard.	Effective.	None.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
Dam Failures Comprehensive Emergency Management Plan	The CEMP addresses dam safety issues.	Plan is city-wide.	Emphasis is on emergency response.	
State permits required for dam construction.	State law requires a permit for the construction of any dam.	State-wide.	Most effective for ensuring initial construction meets the code.	
DCR dam safety regulations	The state has enacted dam safety regulations mandating inspections and emergency action plans.	State-wide.	Enforcement is an issue.	
WIND-RELATED HAZARDS				
Comprehensive Emergency Management Plan (CEMP)	The City has developed a CEMP that addresses hurricane/tornado concerns.	City-wide	Effective primarily for emergency	None.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
			response; less geared towards mitigation.	
The Massachusetts State Building Code	The City enforces the Massachusetts State Building Code.	City-wide	Effective for most situations except severe storms.	None.
Tree trimming program	The city does not have a forestry division but does employ an arborist. The city contracts out the stump grinding.	City-wide.	Effective for most emergency situations.	More funding for tree trimming.
WINTER-RELATED HAZARDS				
Regular salting and sanding of the roads and local plowing/snow disposal.	The city uses Stage Fort Park as a snow disposal area. The snow contains road sand and trash but is placed in the park in such a way that the snow melt does not run off into the ocean.	Selected areas.	Effective.	None.

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**Table 11
Existing Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness /Enforcement	Improvements/ Changes Needed
FIRE RELATED HAZARDS				
Permits required for outdoor burning	There is an application process which includes a fee and a site inspection and written regulations. The season for outdoor burning is January 15 to	City-wide.	Effective.	None.
Subdivision review	The Fire Department is involved in reviewing site plans for subdivisions to ensure that there is adequate access for trucks and an adequate water supply.	City-wide.	Effective.	None.
GEOLOGIC HAZARDS				
The Massachusetts State Building Code	The City enforces the Massachusetts State Building Code.	City-wide.	Effective for most situations.	

VI. HAZARD MITIGATION GOALS AND OBJECTIVES

The Gloucester Local Multiple Hazard Community Planning Team met on December 7, 2009. At that meeting, the members were given two options for developing hazard mitigation goals: brainstorming without the benefit of a draft set of goals or reviewing a draft set of goals developed by the planning team at MAPC. The community chose to review the draft set of goals. The set of goals as presented was unanimously approved by the community planning team.

1. Prevent and reduce the loss of life, injury and property damages resulting from all major natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
 - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
 - Review zoning regulations to ensure that the ordinance incorporates all reasonable hazard mitigation provisions.
 - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.
4. Prevent and reduce the damage to public infrastructure resulting from all hazards.
 - Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
 - Maintain existing mitigation infrastructure in good condition.
5. Encourage the business community, major institutions and non-profits to work with the city to develop, review and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
 - Continue to participate in the Southern Essex Regional Emergency Planning Committee.

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7. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
8. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.
9. Take maximum advantage of resources from FEMA and MEMA to educate city staff and the public about hazard mitigation.

VII. POTENTIAL MITIGATION MEASURES

What is hazard mitigation?

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

<http://www.fema.gov/government/grant/hmgp/index.shtm>

<http://www.fema.gov/government/grant/pdm/index.shtm>

<http://www.fema.gov/government/grant/fma/index.shtm>

Identification and Evaluation of Potential Mitigation Measures

Process for Setting Priorities

Setting priorities was an iterative process that occurred over the course of several meetings. The method used was to reach consensus through discussion, rather than taking a vote. Priority setting was based on local knowledge of the hazard areas, cost information and an assessment of benefits. Prior to discussing priorities, the local committee reviewed the STAPLE/E criteria. These criteria were also used to evaluate the high priority projects.

Mitigation Measures Recently Completed or Underway

A number of flood hazard areas that were previously identified have been mitigated by projects that have been recently completed and several others have been initiated and are in the early stages of design. These are listed below.

Great Harbor Swamp – The city is currently completing major drainage improvements and separating combined sewers. This project should serve to alleviate flooding in this area.

Essex Avenue south of the Blynman Canal – The city is currently undertaking a project to separate combined sewer overflows and to improve its wastewater treatment plant.

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The first phase consisted of work on Outfall 002. This phase is almost completed and cost \$4 million. Work on outfalls 004,005,006 is under design.

The Boulevard and Drawbridge - The city is currently permitting the Blynman/Fort Stage Park sea wall improvements. This project consists of the sea wall west of the drawbridge. The project is \$2.5 million and will be paid for by the Seaport Advisory Board.

Potential Flood Hazard Mitigation Measures

High Priority Flood Hazard Mitigation Measures

Sleepy Hollow/Bungalow Road – Flooding in this area is partially caused by a collapsed culvert. The DPW has received a permit to replace it but has had difficulty scheduling the work because it would need to be done after the eel run and before summer beach traffic begins. The permits will need to be re-submitted. Flooding in this area is made worse by a beaver dam on the pond and has contributed to flooding on the road. The property owners association is considering hiring a trapper to control the beavers and to take action to lower the level of the pond. The culvert project will cost approximately \$35,000 but flooding from the beaver dam will need to be addressed in order for the culvert replacement to function.

Medium Priority Flood Hazard Mitigation Measures

Coffins Beach – There is currently no appropriate mitigation measure because of restrictions on what can be done at Coffins Beach due to its status as a barrier beach.

Good Harbor Beach Watershed – A 2005 study (“Assessment of Potential and Actual Sources of Nonpoint Source Pollution in the Good Harbor Drainage Area”) indicated the outfall below Barn Lane was almost totally blocked by sediment. There was an outfall on Witham Street that was found to be clogged and in disrepair. Additionally, outfalls on Route 128 near Bass Avenue and the Hartz Street pump station blocked with sediment.

While some work has been done in this area, more improvements will be undertaken as part of the City’s Phase II stormwater requirements.

Back Shore Coastal – The most effective mitigation measure for this area is strict adherence to coastal floodplain construction standards for development and redevelopment.

Back Shore Inland – This area floods because of historic filled wetlands. One possible mitigation measure would be to construct wetlands to replace those that were lost. A

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hydrologic study would be needed to determine if a constructed wetland would be feasible based on drainage patterns.

Mill River – This is an area that is subject to multiple hazards including flooding, potential dam failure and brush fires. There is a high hazard dam at the Babson Reservoir, flooding of the DPW yard and an extensive area of phragmites which catch fire easily. While a number of individual mitigation measures have been identified, the city believes that this area needs to be redeveloped in a comprehensive manner and has appointed a facilities planning committee to look into this possibility.

To date, the following flood hazard mitigation measures have been identified in addition to controlling the level of the Babson Reservoir:

Installation of a second tide gate downstream – The City has obtained a grant from NOAA and CLF for the installation of a second tide gate. This tide gate would allow the city to shut out the tides in advance of a storm so that the full capacity of Mill Pond would be available for flood storage. This project will be bid out in June 2010 at a cost of \$60,000.

Raise back yards of two properties in the Mill Pond Area – There are two properties where regarding the back yards would create additional flood plain storage area.

Daylight Alewife Brook to Mill Pond – There is severe flooding on both sides of Alewife Brook. While this is controlled to some extent by the tide gate and maintaining the level of Babson Reservoir, additional storage capacity is needed for flood waters. Daylighting Alewife Brook would provide more natural floodplain.

Prepare a study of flooding in the Duck Pond Flood Hazard Area– Dennison Street washes out about every other year. Mitigation measures that have been suggested include installing a larger culvert, reinforcing the road edges and installing a grate over the culvert to prevent debris accumulation. There needs to be a study of the drainage in this area to determine the most effective mitigation measures.

Prepare a study of the Goose Cove Causeway area– A portion of the causeway is currently being repaired. A study would be necessary to determine the best mitigation measure for flooding in this area.

East of Babson Reservoir – Flooding caused by beaver dams is washing out the commuter rail bed as well as the fire roads that serve Dogtown. The MBTA needs to address this issue.

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Cedarwood/Fenley – The DPW is currently removing some fill and daylighting a portion of the stream in this area. Additional mitigation would include improved maintenance of the culverts as well as education about and enforcement of regulations to reduce the dumping of yard waste into the stream.

Lower Priority or Longer-Range Flood Hazard Mitigation Measures

This category of potential mitigation measures includes a number of areas for which there is likely no mitigation measure due to being a barrier beach. It also includes areas where mitigation is primarily the responsibility of individual property owners or area where the severity, frequency and number of affected properties is low. Although designated as a lower priority, these area experience flooding which does warrant attention.

Northeast Gloucester (Lanesville/Annisquam) – Regulatory control of redevelopment.

Wingaersheek – No mitigation measures have been identified because it is a barrier beach.

Eastern Point – Mitigation is primarily through improvements made by individual property owners.

Magnolia Shore – No mitigation measures have been identified.

Magnolia Harbor- Mitigation is primarily strict adherence to floodplain construction standards for new construction and redevelopment.

Long Wharf – No mitigation measures have been identified. .

Causeway Street – No mitigation measures have been identified.

Newell Stadium – No mitigation measures have been identified because the major impacts are to the playing fields.

Water Treatment Facility – No mitigation measures have been identified.

Walker Creek – A study of this area would be necessary to identify potential mitigation measures.

Dam Safety Mitigation Measures

Babson Reservoir Dam - The City has recently undertaken approximately \$1.9 million dollars of improvements at the dam. Trees have been removed. The valves that control

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pipes under the dam have been replaced which has given the city the ability to control the level of the dam. In the long-term, the spillway will need to be repaired and Weston & Sampson recommended that the toe of the dam be built up. The report estimates that design fees for dam rehabilitation would be approximately \$150,000 - \$180,000. Permitting fees would be around \$40,000 and construction costs would be \$1,300,000 - \$1,600,000. The total for dam rehabilitation would be approximately \$1,820,000.

Prepare a study of West Pond Dam – This pond was created by a privately-owned earthen dam although the City has been unable to determine who actually owns it. There is a neighborhood association that wants to see the dam improved and made safe. Due to siltation, the pond does not hold much water but there could be public safety issues downstream in the event of a dam failure, depending on the amount of rain and the amount of slurry that would result. Further study would be necessary to evaluate the potential impacts and to determine ownership of the dam.

Fernwood Lake East Dam – Implement the safety improvements that have been identified by Weston & Sampson.

Fernwood Lake West Dam – Implement the safety improvements that have been identified by Weston & Sampson.

Fernwood Lake North Dam – Implement the safety improvements that have been identified by Weston & Sampson.

Wallace Pond Dam – This dam has been classified by DEP as a high hazard dam which is in fair condition. Weston & Sampson prepared an inspection/evaluation report in December 2006. The report included a number of recommendations for routine maintenance and minor repairs as well as remedial measures that are needed to bring the dam into compliance with current dam safety regulations. The remedial measures include improvements to the primary spillway, improvements to the discharge channel and the design and installation of a mineral filter and drainage system at the downstream toe of the embankment. The cost of these remedial measures would be \$100,000 - \$300,000 for design, permitting and construction.

Haskell Brook Dam - This dam has started to erode and there have been instances when water overtopped the dam and flooded out the road. The city has gone before the Conservation Commission to allow inspection of the dam to determine the extent of the erosion. Future mitigation measures will need to be determined after the inspection has been completed.

Haskell Pond Dam – Implement the remedial measures that have been recommended by Weston & Sampson.

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Goose Cove Reservoir North Dam – A report prepared by Weston & Sampson identified a number of remedial measures that are necessary to bring the dam into compliance with dam safety regulations. These include removing trees and brush and filling/regarding the embankment and abutments. The cost of the remedial measures would be approximately \$30,000 - \$50,000.

Fire Hazard Mitigation Measures

Although not specifically identified as a brush fire hazard area, the Mill River flood area has an area of phragmites which has a tendency to catch fire. This area could be mitigated by using NOAA funding for phragmites removal.

Geologic Hazard Mitigation Measures

Gloucester is part of the North Shore – Cape Ann Emergency Preparedness Coalition. One of the requirements is to prepare a multi-year training and exercise plan. The Cape Ann Coalition has decided to use an earthquake as the natural disaster around which to base their training drills. A table top exercise was planned for September 2009 but was delayed because of the need to respond to the H1N1 flu emergency. Planning is expected to resume in January 2010. This will be followed by a series of drills followed by a full scale earthquake exercise.

Measures to ensure continued compliance with National Flood Insurance Program requirements

A) Continuation of Open Space Protection and Land Acquisition

Although Gloucester already has a significant amount of protected land, further protection of open space in the wake of development is important in order to ensure future development does not increase vulnerability to natural hazards, such as flooding. The city should continue its efforts for open space protection and purchases as prioritized in the Open Space Plan.

B) Regulatory Revisions for Stormwater Management

The current subdivision and site plan requirements do have basic standards for stormwater management, but they could be updated to reflect more current trends to help prevent flooding from new development and redevelopment. In particular, the regulations should include:

- Requirements for aggressive and legally-binding operation and maintenance agreements, with enforcement mechanisms, for private drainage facilities.
- Regulatory controls to encourage Low-Impact Development (LID) practices.

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C) Become Fully “Storm Ready”

The city can take additional measures to become “storm ready” with respect to its alerting systems. One possible method that is available is a television notification system. By subscribing to a service, the town would have the ability to overwrite any TV programming to alert residents of an impending emergency or bad weather.

Introduction to Potential Mitigation Measures (Table 12)

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

Priority – The designation of high, medium or low priority was done at the meeting of the Local Multiple Hazard Community Planning Team meeting. The designations reflect discussion and a general consensus developed at the meeting but could change as conditions in the community change.

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

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

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed or is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local

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committee responsible for its implementation should begin to explore the funding sources in more detail.

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

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

Massachusetts Emergency Management Agency (MEMA) – The grants page <http://www.mass.gov/dem/programs/mitigate/grants.htm> has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

United States Department of Agriculture – The USDA has programs by which communities can get grants for fire fighting needs. See the link below for some example.

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Table 12					
Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
Mitigation Measures Recently Completed or Underway					
Complete CSO work at Essex Avenue south of the Blynman Canal	High	DPW	2011	\$4 million for Phase One. Phase II will consist of an additional 3 outfalls with an approximate cost of \$12 million.	City
Complete sea wall improvements at The Boulevard and Drawbridge	High	DPW	2012	\$2.5 million	Seaport Advisory Board
Great Harbor Swamp drainage improvements and combined sewer separation project.	High	DPW	2012		City

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Table 12 Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
High Priority Mitigation Measures					
Replace the culvert at Sleepy Hollow/Bungalow Road (City)	High	DPW	2012	\$35,000 for the culvert.	City
Work with the neighborhood association to reduce flooding caused by the beaver dam on Sleepy Hollow Pond.	High	Neighborhood Association	2012	To be determined.	Private
Medium Priority Mitigation Measures					
Good Harbor Beach Watershed: upgrade drainage system as part of the City's Phase II stormwater requirements.	Medium	DPW	On-going	To be determined.	City; FEMA grants
Ensure strict adherence to coastal floodplain construction standards for development and redevelopment in the Back Shore Coastal area,	Medium	Planning and Comm. Development Dept., Bldg. Dept.	On-going	Staff time	City
Study the feasibility of constructing	Medium	Cons. Comm.;	2013	To be determined.	City funds.

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Table 12 Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
compensatory wetlands in the Back Shore Inland area to replace historic filled wetlands.		DPW.			
Mill River Flood Hazard Area					
1) Install tide gate on the Mill River.	Medium	DPW	2011	\$100,000	Division of Marine Fisheries grant.
2) Raise back yards of two properties in the Mill Pond area.	Low	DW	2014	To be determined.	City.
3) Daylight Alewife Brook to Mill Pond	Medium	DPW	2014	To be determined.	City.
Prepare a study of flooding in the Duck Pond Flood Hazard area.	Medium	DPW	2014	\$25,000	City funds
Cedarwood and Fenley Flood Hazard Area					
<ul style="list-style-type: none"> • Maintain culverts. • Educate residents about the problems caused by dumping yard waste. 	Medium	DPW	On-going.	Staff time.	City funds.

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Table 12 Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
<ul style="list-style-type: none"> Enforce anti-dumping regulations. 					
Dam Failure Mitigation Measures					
Babson Reservoir Dam - Implement the dam rehab. measures outlined in the June 2009 Phase II report by Weston & Sampson.	High	DPW	On-going	\$180,000 design. \$40,000 permitting. \$1,600,000 construction.	City; FEMA grants.
Make safety improvements to Fernwood Lake East Dam.	Medium	DPW	On-going	\$45,000 - \$60,000 for design and permitting; \$210,000 - \$270,000 for construction.	City; FEMA grants
Make safety improvements to Fernwood Lake West Dam.	Medium	DPW	On-going	\$45,000 - \$60,000 for design and permitting; \$185,000 - \$300,000 for construction.	City; FEMA grants

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Table 12 Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
Make safety improvements to Fernwood Lake North Dam.	Medium	DPW	On-going	\$60,000-\$75,000 for design and permitting; \$425,000 -\$550,000 for construction.	City; FEMA grants.
Make safety improvements to Wallace Pond Dam.	Medium	DPW	On-going	\$200,000-\$300,000 for design, permitting and construction.	City, FEMA grants
Make safety improvements to Haskell Pond Dam.	Medium	DPW	On-going	\$100,000 -\$200,000 for design, permitting and construction.	City, FEMA grants
Prepare a study of West Pond Dam	Low	DPW	2014	\$25,000	City
Mitigation Measures related to the National Flood Insurance Program					
Continuation of open space protection and land acquisition	NFIP	Conservation Commission,	On-going	Varies from city staff time to	City, gifts and grants.

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Table 12					
Potential Mitigation Measures					
Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
		City Council.		purchase price of selected parcels	
Regulatory revisions for stormwater management.	NFIP	Conservation Commission, Planning Board.	Short-term.	City staff time.	City, state grants.
Become fully “Storm Ready”/TV alert notification system.	NFIP	Fire Dept.	Short-term.	\$5,000 - \$15,000.	City and/or public safety grants.

VIII. REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

Regional Partners

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the City of Gloucester, Massachusetts Department of Transportation (MASS DOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and numerous competing priorities.

Inter-Community Considerations

Because Gloucester has only one border (with Rockport) there are few immediate inter-community issues. Gloucester is part of the Cape Ann Emergency Planning Team which includes Rockport, Manchester and Essex. This organization works closely together and includes: Fire, Police, Public Works, Schools, Emergency Management Services, Hospitals, Public Health and Administration function.

IX. PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Gloucester Hazard Mitigation Plan was adopted by the City Council on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

Plan Maintenance

MAPC worked with the Gloucester Hazard Mitigation Planning Team to prepare this plan. This group will continue to meet on an as-needed basis to function as the Local Hazard Mitigation Implementation Group, with one municipal official designated as the coordinator. Additional members could be added to the local implementation group from businesses, non-profits and institutions.

Implementation Schedule

Bi-Annual Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a biannual survey in years two and four of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress and updating the plan.

Develop a Year Four Update – During the fourth year after initial plan adoption, the coordinator of the Hazard Mitigation Implementation Team will convene the team to begin to prepare for an update of the plan, which will be required by the end of year five in order to maintain approved plan status with FEMA. The team will use the information from the year four biannual review to identify the needs and priorities for the plan update.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – FEMA’s approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the city’s approved plan status and its eligibility for FEMA mitigation grants. Because of the time required to secure a planning grant, prepare an updated plan, and complete the approval and adoption of an updated plan, the local Hazard Mitigation Planning Team should begin the process by the end of Year 3. This will help

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the city avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

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

Integration of the Plans with Other Planning Initiatives

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

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

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

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X. LIST OF REFERENCES

In addition to the specific reports listed below, much of the technical information for this annex came from meetings with City department heads and staff.

Zoning Ordinance

Commonwealth of Massachusetts, MacConnell Land Use Statistics, 1999.

Federal Emergency Management Agency, Flood Insurance Study and Rate Maps for Gloucester, MA, January 1986.

Metropolitan Area Planning Council, Geographic Information Systems Lab

Metropolitan Area Planning Council, Regional Plans and Data

U.S. Army Corps of Engineers, SLOSH Modeling and Maps

HAZUS-MH: Hurricane Event Report.

HAZUS-MH: Earthquake Event Report.

Phase II Inspection Report, Fernwood Lake West Dam, June 2009, Weston & Sampson.

Phase II Inspection Report, Fernwood Lake East Dam, June 2009, Weston & Sampson.

Phase II Inspection Report, Fernwood Lake North Dam, June 2009, Weston & Sampson.

Phase II Inspection Report, Babson Reservoir Dam, June 2009, Weston & Sampson.

Phase I Follow-Up Inspection, Babson Reservoir Dam, December 2009, Weston & Sampson.

Goose Cove Reservoir North Dam, Inspect/Evaluation Report, December 2006, Weston & Sampson.

Wallace Pond Dam, Inspection/Evaluation Report, December 2006, Weston & Sampson.

Haskell Pond Dam, Inspection/Evaluation Report, December 14, 2006, Weston & Sampson.

City of Gloucester Harbor Plan & Designated Port Area Master Plan, July 2009.

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Mill Pond Habitat Restoration Project, Chapter 91 License Application, City of Gloucester, Department of Public Works. Prepared by The Louis Berger Group, Inc.

Blynman Canal Seawall – Northeast Side: Existing Conditions Report. Prepared for the City of Gloucester Engineering Department by Vine Associates, Inc. August 2007.

Assessment of Potential and Actual Sources of Nonpoint Source Pollution in the Good Harbor Drainage Area. December 31, 2005.

