

TOWN OF WARREN, RHODE ISLAND



# Natural Hazard Mitigation Plan

2013



Office of Planning & Community Development  
Town of Warren, Rhode Island

## State Hazard Mitigation Committee

The State Hazard Mitigation Committee identifies current hazard mitigation needs, reviews project applications, sets priorities and recommends updates. The Committee consists of representatives from the following state agencies:

- Rhode Island Emergency Management Agency (RIEMA), Hazard Mitigation and Floodplain Offices
- Rhode Island Division of Public Utilities and Carriers (PUC), Administration & Operations Office
- Building Code Commissioner, State of Rhode Island Building Committee Office
- Rhode Island State Fire Marshal's Office
- Rhode Island Coastal Resources Management Council (CRMC)
- Rhode Island Department of Transportation (RIDOT)
- Rhode Island Department of Environmental Management (RIDEM)
- Rhode Island Department of Business Regulations

## Table of Contents

<b>1.0</b>	<b>Hazard Mitigation Planning</b>	<b>4</b>
<b>2.0</b>	<b>Profile of Warren, Rhode Island</b>	<b>5</b>
<b>3.0</b>	<b>Risk Assessment</b>	<b>6</b>
	<b>3.1 Hazard Identification</b>	<b>6</b>
	<b>3.2 Hazard Profiles</b>	<b>6</b>
	<b>3.2.1 Flooding</b>	<b>6</b>
	<b>3.2.2 Winter Storms</b>	<b>9</b>
	<b>3.2.3 Hurricanes</b>	<b>11</b>
	<b>3.2.4 Tornadoes</b>	<b>13</b>
	<b>3.2.5 Wildfires</b>	<b>15</b>
	<b>3.2.6 Hailstorms</b>	<b>16</b>
	<b>3.2.7 Earthquakes</b>	<b>17</b>
	<b>3.2.8 Excessive Heat and Drought</b>	<b>18</b>
	<b>3.3 Summary of Potential Hazards for Warren</b>	<b>18</b>
<b>4.0</b>	<b>Warren’s Vulnerable Assets</b>	<b>20</b>
	<b>4.1 Critical Assets</b>	<b>20</b>
	<b>4.1.1 Special Population Centers</b>	<b>20</b>
	<b>Risk Assessment Matrix for Warren</b>	<b>21</b>
	<b>4.1.2 Residential, Commercial and Other Structures</b>	<b>25</b>
	<b>4.2 Summary of Vulnerable Critical Assets</b>	<b>28</b>
<b>5.0</b>	<b>Hazard Mitigation Policies and Actions</b>	<b>29</b>
<b>6.0</b>	<b>Plan Implementation and Maintenance</b>	<b>34</b>
	<b>6.1 Plan Adoption</b>	<b>34</b>
	<b>6.2 Implementation, Evaluation and Revision of Strategies</b>	<b>34</b>
<b>6.0</b>	<b>Technical Resources</b>	<b>38</b>
<b>7.0</b>	<b>Appendix</b>	<b>39</b>

## List of Maps

**Map 1** – Flood Zones

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**Map 2** – Storm Surge

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**Map 3** – School Location in Proximity to Storm Surge Areas

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**Map 4** – School Location in Proximity to Velocity Zone

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**Map 5** – Senior and Special Population Facilities in Proximity to Storm Surge Areas

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**Map 6** - Senior and Special Population Facilities in Proximity to Velocity Zone

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**Map 7** – Buildings in Storm Surge Areas

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**Map 8** – Town Facilities in Storm Surge Areas

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**Map 9** – Buildings in Flood Zones

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**Map 10** – Town Facilities in Flood Zones

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**Map 11** – Infrastructure in Flood Zones

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**Map 12** – Infrastructure in Storm Surge Areas

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**Map 13** – Natural Resource Buffer Areas (Protected and Not Protected)

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## 1.0 Hazard Mitigation Planning

Hazard mitigation planning is the development of a formal strategy for limiting the impacts from natural threats faced by a community. Local governments are *required* to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, provides the legal foundation for governments to reduce threats from natural hazards through mitigation planning. Adoption and implementation of this Plan will enable Warren to access credits under the Federal Emergency Management Agency's (FEMA) Community Rating System (CRS), which offers discounts on National Flood Insurance Program (NFIP) premiums for property owners in communities that choose to participate. In addition, adoption will increase the Town's competitiveness when applying for federal grants through FEMA and RIEMA, the Rhode Island State Emergency Management Agency.

In preparing this Multi-Hazard Mitigation Plan, the Town of Warren identified information resources most valuable in understanding risks facing the Town, including internal staff, federal and state agencies, university resources, GIS mapping and media. The Town Planning and Community Development Department researched events that Warren has experienced, as well as new potential hazards arising from changing sea conditions, climate shifts and development patterns. The Town then assessed potential consequences arising from these hazards in terms of how people, buildings and operations would be affected. The Town contacted planning departments of adjacent communities, local schools, elderly facilities, health organizations and emergency responders about response efforts through phone calls and email. Priorities were then established based on the relative risks to safety and welfare as well as costs to repair damage. The Town held a Public Workshop on January 23, 2012 to gather additional public experience and comments. When the plan was drafted, a Public Hearing was held with the Warren Planning Board on July 24, 2012. Their feedback is incorporated in this plan, and summarized in Section 8.0. The draft plan was posted on the home page of the Town's website for a month, with hard copies in the Town Clerk's office. No public comment was received from the workshop or the web posting.



**Figure 1. Mitigation Planning Overview created by FEMA.**

Source: [www.fema.gov/plan/mitplanning/overview.shtm](http://www.fema.gov/plan/mitplanning/overview.shtm)

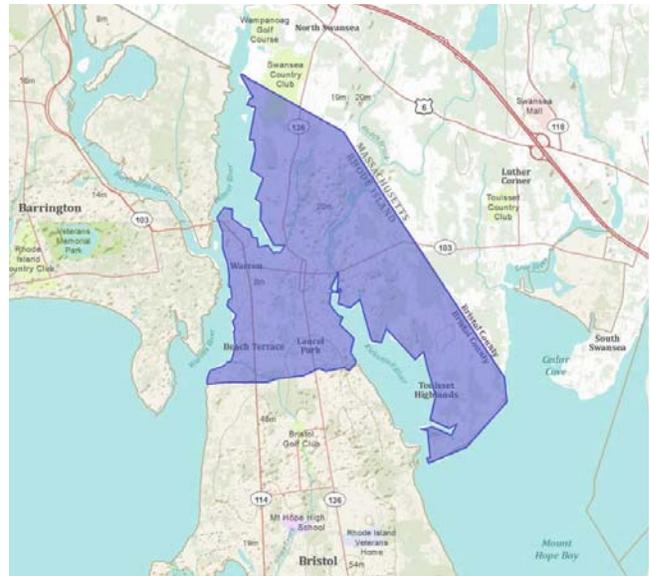
Warren's Hazard Mitigation Plan includes a detailed series of projects and strategies to address the diverse impacts to the natural coastline, infrastructure and structures, including changes to both

regulatory and planning procedures. This plan will form part of the Town's Comprehensive Community Plan. Implementation of this plan involves specific projects as well as adjustments to day-to-day organizational operations. In order to keep the Plan viable, the Town will conduct semi-annual evaluations and make revisions as needed.

## 2.0 Profile of Warren, Rhode Island

Situated among three rivers on Rhode Island's East Bay, Warren exhibits both the scenic beauty of its surrounding waters and a clear vulnerability to floods and hurricanes. Despite its 16 miles of coastline, the Town itself is quite small, around 6.5 square miles. Within this limited area is a diverse mix of historic downtown storefronts and homes, suburban style neighborhoods, rich agricultural land and a substantial amount of conserved open space.

Along the Warren River to the west, one can find structures dating before the town's establishment in 1787, along with the wharves and buildings from the shipbuilding industry of the mid-1800s. The sprawling Warren Manufacturing Company mill structure occupies much of the waterfront area of downtown. Surrounding the mill in downtown, the north end and along Main Street are the supporting mill houses remaining from the textile industry of the early 20<sup>th</sup> century. This area represents Warren's densest development.



**Figure 2. Vicinity of Warren, Rhode Island.**  
Source: [www.esri.com](http://www.esri.com)

Along the north end of the Route 136 Corridor are rural businesses, historic to modern residential developments and coastal wetlands. The northern and eastern portions of Warren are considerably more rural than the west, but pockets of dense summer cottages exist. Most notable among these areas are Touisset Point overlooking Mt. Hope Bay and the Touisset Highlands along the Kickemuit River. The attractiveness of both of these areas means that summer residences are becoming year-round housing, and existing houses are expanding to accommodate increased use. This area of Warren also contains considerable acreage for farming, conservation, schools and parks.

Central Warren, from the Laurel Park area northward to Child Street and westward to the Warren River generally exhibits a gridded street pattern of residential uses flanked by business uses along the main corridors of Metacom Avenue (Route 136) and Main Street (Route 114). Coastal residences along the Warren and Kickemuit rivers tend to reflect a historic, cottage-style development, while the neighborhoods between Main Street and Metacom Avenue reflect a post-World War II suburban style development.

According to the U.S. Census Bureau, the population of Warren declined nearly 7% from 2000 to 2010. Major employment sectors for the town include manufacturing, health care and food services, which represent about half of all town employment. Business activities are generally located on the waterfront, Main Street, Child Street, Metacom Avenue and Market Street. Many of these businesses are located in areas vulnerable to natural hazards.

## 3.0 Natural Hazard Risk Assessment

### • 3.1 Hazard Identification

The hazard identification process consisted of reviewing the previous plan (dated 2004), the RI State Hazard Mitigation Plan (2005), plans from adjacent and similar communities, information from the National Climatic Data Center and the National Weather Service, and relevant newspaper articles on natural hazards. The Town of Warren's Hazard Mitigation Committee consists of the Fire Chief/Emergency Management Coordinator, Building Inspector, Police Chief, Director of Public Works and Director of Planning & Community Development. The collective experience of these officials helps define and prioritize natural hazards for Warren. As a result of this process, eight natural hazards were identified as having the most potential to impact Warren: flooding, winter storms, hurricanes, hail storms, earthquakes, tornadoes, wildfires and excessive heat/drought. The most significant effects of natural hazards were inland and coastal flooding, high winds, ice and snow. While these hazards are the most frequently experienced, it is acknowledged that weather events such as hurricanes and tornadoes could create large scale, catastrophic disasters for coastal towns such as Warren. Moreover, sea level rise resulting from accelerated rates of global warming will affect the Warren over the next century, exacerbating some natural hazards and requiring a greater consideration for coastal development now to save lives and property in the future.

### • 3.2 Hazard Profiles

#### 3.2.1 Flooding

Flooding is the accumulation of large amounts of water in areas that are typically dry, usually from heavy rainfall (including thunderstorms, tropical storms and hurricanes), storm surges and melting snow. Warren is a lowland community with expanses of coastline along three rivers and encompassing substantial reservoirs of inland water. This coastal exposure makes Warren particularly susceptible to flooding. The town experiences three main types of flooding:

**Coastal Flooding:** This phenomenon occurs when surges of waves inundate the shores of bays, tidally influenced rivers, streams and inlets. The astronomical tide and meteorological forces such as nor'easters and hurricanes influence the movement of coastal water.

**River Flooding:** River floods result when streams and rivers overflow their banks, usually following large scale weather patterns that bring heavy rainfall for a prolonged

period over wide areas. This type of flooding may involve the overflow of small streams that eventually flow into larger basins.

**Flash Flooding:** Flash flooding occurs when quick, heavy rainfall occurs in inland (often urban) areas with poor drainage. The construction of “impervious surfaces”—that is, asphalt roads, parking lots, driveways, sidewalks, expansive roofs accelerates the potential for flash flooding because these surfaces do not allow natural absorption by open ground. As a result, storm drains are often overwhelmed, and water rushes to “low spots” such as basements and underpasses.

Flooding damages property and incapacitates utilities, leaving residents without power. Moreover, flooding impacts Town services which are called upon to pump out roads, remove debris, divert traffic and supply emergency shelters to those in need.

FEMA has designated flood zones for Rhode Island according to varying levels of flood risk. Each zone reflects the potential severity or type of flooding in the area. High risk areas of Warren are designated as Zone AE and Zone VE. Zone AE, or the 100 year Flood Zone, identifies areas with a one percent or greater chance of flooding in any given year and where the base flood elevation has been determined (see **Map 1: Flood Zones**). Zone VE identifies the Velocity Zone, which includes coastal areas with a one percent or greater chance of flooding with additional hazards associated with storm-induced waves, or velocity action (see **Map 2: Storm Surge Areas**). The Flood Insurance Rate Maps (FIRMs) for Warren that are currently available from FEMA and used for this Multi-Hazard Mitigation Plan were made effective November 9, 2008. Current flood zone mapping for Warren shows several areas in the VE Zone:

- The western coast along the Warren River (from Jacob’s Point along the Warren Waterfront area up to the southern corner of the American Tourister property).
- The western and eastern shoreline of the Kickemuit River (south of the “Broken Bridge”). The eastern shore of the Kickemuit River extends southward to the Touisset Marsh/Audubon property.
- Portions of Touisset Point, particularly the southernmost tip fronting Mt. Hope Bay and the Maple Road/Seaview Avenue coastline that faces Mt. Hope Bay.

Much of the Velocity Zone along the Warren River is located in the dense industrial, commercial and residential areas of the Warren Waterfront, which may worsen the effects of flooding. Areas of undeveloped coastal wetland can be found along Jacob’s Point, the Kickemuit River and the Touisset Marshlands. These areas help minimize the effects of localized flooding and buffer adjacent development.

#### **Previous Occurrences**

Warren regularly experiences storms and heavy rains that result in localized flooding. The National Climatic Data Center (NCDC) records 24 different flooding events in Bristol and Providence County

since 2000, with a total damage estimate of \$37.41 million. Several of the most significant recent floods to occur in Bristol County are highlighted in **Table 1** below. In March 2010, storms and periods of heavy rain resulted in significant flooding in Rhode Island and resulted in a Presidential Major Disaster Declaration for the state, including Bristol County. Warren saw substantial flooding in some areas. The Rhode Island Department of Transportation (RIDOT) closed areas more than 100 roads across the state due to the March floods; however, no road closings occurred in Warren. This area has been identified on the currently available FIRM as the 100 year Flood Zone. Finally, the National Flood Insurance Program (NFIP) documents 16 Repetitive Loss (RL) properties in Warren. A Repetitive Loss property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently, there are over 122,000 RL properties nationwide. Warren has 16 Repetitive Loss properties.

**Table 1. Flood Events in Bristol County, Rhode Island, 2000-2011**

Date	Type	Notes
March 2001	Flood	Heavy rain
March 2005	Flood	Heavy rain
Oct. 2005	Flood	Tropical storm
June 2006	Coastal Storm	River and coastal flooding
Oct. 2006	Flood	River and coastal flooding
March 2007	Coastal Storm	River flooding, poor drainage
Feb. 2008	Flood/Coastal storm	Heavy rain, poor drainage
March 2008	Coastal Flood	Inland storm, snowmelt, road washouts
Dec. 2008	Flood	Winter storm, flooding, wind
March 2010	Flood	Record rainfall and river flooding statewide
Aug. 2011	Flood	Hurricane Irene

**Source:** National Climatic Data Center, <http://www4.ncdc.noaa.gov/cgi-bin/wwcgi.dll?wwevent~storms>. RIDOT, [http://www.dot.state.ri.us/Flooded\\_streets\\_March2010.asp#Closures](http://www.dot.state.ri.us/Flooded_streets_March2010.asp#Closures).

#### **Probability of Future Flooding in Warren**

Based on previous occurrences, the likelihood of flooding in Warren in the future is certain. While it is difficult to predict flood events, FEMA has determined that properties in Zone AE and Zone VE have a 26% chance of flooding over the life of a 30 year mortgage. Flooding can be intensified by hurricane damage, where debris from high winds can block drainage and increase the potential for river flooding.

Flooding from dam failure represents another possible threat to localized areas of town. Inventoried dams in Rhode Island are classified by size and hazard rating by the Rhode Island Department of Environmental Management (RIDEM). The size classification provides a relative description of small, medium, or large dams, based on the storage capacity and height of the impounded water. The hazard classification relates to the probable consequences of failure or poor operation of the dam. Warren has four dams in the inventory:

1. Warren Reservoir Lower Dam(Child Street)

2. Warren Reservoir Upper Dam (north of Schoolhouse Road)
3. Manchester Pond (a Kickemuit River tributary)
4. Touisset Highland (a Kickemuit River tributary)

While the Manchester Pond dam and the Touisset Highland dam are regulated, they are not considered significant in the RIDEM 2009 Dam Inventory. The Warren Reservoir is both regulated and considered a significant hazard by the RIDEM inventory and both are located in the 100 year Flood Zone (Zone AE). Prior experience indicates that the Reservoir routinely floods its banks in heavy rainstorms, and can present potential threats to adjacent roads and properties.

In addition to dam failure, a rise in sea level between 3 and 5 feet is predicted by the RI Coastal Resources Management Council (CRMC) in the next century and should be planned for now as development continues along the waterfront. Sea level rise is a direct consequence of global climate change. Greenhouse gas emissions to the atmosphere increase surface warming which, in turn, warms ocean waters and accelerates the melting of glacial ice (RI CRMC, *Sea Level and Climate Change Policy*, Section 145). Even a 1 foot coastal rise would endanger a number of properties and assets in Warren, and FEMA maps do not account for future sea level rise. NOAA maintains two stations in Rhode Island that measure sea rise—Newport and Providence—which have measured sea level rise since the 1930s. The Newport Station records an increase of sea level of about .64 feet between 1930 and 2006. Because greenhouse gas emissions continue to rise, it is expected that this trend will accelerate in the coming decades—that is, the coastal sea level will rise higher and at a faster rate with each decade.

### **3.2.2 Winter Storms**

Winter storms are a regular occurrence in Warren, with snowfall ranging from a few inches to blizzard conditions, including sustained winds or frequent gusts up to 35 mph or greater. These storms bring considerable falling snow, broken tree limbs, loss of power, and reduced visibility to less than a quarter mile. Warren’s coastal location makes it somewhat less prone to heavy snowfall than inland communities, but virtually any area of town could be hit by a severe winter storm. Frequent impacts from winter storms include power outages and transportation problems, traffic accidents as well as school closings and business/civic service interruption. These conditions create hazards during storms and after snow melt and flooding occurs.

#### **Previous Occurrences**

Overall, Bristol County experiences storms with 6 or more inches on average less than twice in the winter season. According to the NOAA Climactic Data Center, Bristol County saw 20 storms involving snow and ice since 2001 that brought about \$375,000 in total property damage. The U.S. Weather Bureau defines a blizzard as a snow storm where winds exceed 35 mph and the temperature is 20 degrees Fahrenheit or below. A blizzard is severe when winds exceed 45 mph, snow is blowing and temperatures are 10 degrees Fahrenheit or below. Warren has experienced several notable blizzards and winter storms over the years (refer to **Table 2** below). A storm is

dubbed a “Nor’Easter” when a coastal warm front storm (typically in February) brings warm moist air from the tropics and moves north up the coast and a mass of polar air from Eastern Canada and the North Atlantic moves south. The warm air moves up and over the cold layer, creating snow. If the storm moves quickly, cold rain or snow will fall for six to eight hours. If the warm air stalls against a high pressure wall, the snowfall may last 12-24 or more hours as it did in the blizzards of 1888, 1969, 1978, and 1996. The Blizzard of 1978 is perhaps the most significant and memorable snowstorm to hit Rhode Island, resulting in a virtual shut down of commerce and transportation across the state for several days, 21 deaths, and millions of dollars of damages. A key aspect of blizzards is reduced visibility (to about a ¼ of mile) for at least three hours.

**Table 2: Significant Snowstorms for Bristol County, RI, 1993-2009**

Date	Snowfall (inches)	Notes
Dec. 1993	6-9	School cancelled; slow commute
Jan. 7, 1994	NA	No information
Jan. 8, 1994	6-7	Snow became freezing rain; severe traffic accidents, power outages
Feb. 8, 1994	6-10	
Feb. 11, 1994	8-13	Closings; major traffic problems
Feb. 1995	NA	No information
Jan. 1996	12-24	Closed schools, businesses, transportation disrupted
Feb. 1996	6-8	Evening storm, travel conditions slow
Mar. 2, 1996	6-11	
Mar. 7, 1996	7	Heavy, wet snow on powerlines
Apr. 1996	7	Heavy, wet snow on powerlines
Jan. 11, 1997	6	Minor (fast moving storm)
Jan. 31, 1997	Ice	Ice meant skidding on roads; bridge closings around state
Mar. 1997	6-8	Heavy, wet snow; high winds; downed tree limbs; power outages
April. 1997	19	Heavy, wet snow; downed trees/limbs, power outages; schools closed
Feb. 1999	8-13	Closed schools, hazardous road conditions
Mar. 1999	6-9	Poor travelling conditions; schools/businesses shut down
Feb. 2000	6-8	Transportation problems; most flights cancelled; heavy traffic
Jan. 2001	6-7	
Feb. 2001	Ice	Freezing rain; holiday week meant fewer traffic problems
Dec. 2002	7-8	
Feb. 7, 2003	8-11	Minor fender-benders
Feb. 17, 2003	16-17	Few problems (holiday)
Mar. 2003	7-8	Minor traffic problems (fast moving storm)
Dec. 2003	15	Major transportation problems
Dec. 2004	7-8	50 mph winds; car accidents from lack of visibility/slick roads
Jan. 2005	18	Heavy snow, high winds, coastal flooding
Feb. 2005	7-8	
Mar. 2005	6-9	Heavy winds
Feb. 2006	9-14	Blizzard
Dec. 2007	8-10	Early dismissals created traffic—made roads hard to plow
Dec. 2008	10-11	

Dec. 2009	18-21	Flights cancelled; schools closed; roads unplowable
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Source: National Climatic Data Center, <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

### Probability of Future Events

Given the consistency of winter storms, the probability of future winter storm events is certain. Based on historical data, Warren should expect snowfall of at least 10 inches every 6 years, although consecutive years of heavy snowfall occur.

### 3.2.3 Hurricanes

NOAA (National Oceanic and Atmospheric Administration) defines a hurricane as the most severe category of the meteorological phenomenon known as the "tropical cyclone." Tropical cyclones rotate counterclockwise and spur thunderstorms. At low wind speeds (38 mph or less), this occurrence is called a "tropical depression." When winds reach 39-73 mph, it is called a "tropical storm." Hurricanes occur when the winds exceed 74 mph. These seasonal storms are created by low pressure depressions moving over warm, tropical waters and occur over the Atlantic Ocean between June and October (most typically in September in Rhode Island). Hurricanes are measured on the Saffir/Simpson Hurricane Intensity Scale (see **Table 3** below). While strong winds from hurricanes can pose a threat to life and property, the greatest threat posed by hurricanes in Rhode Island is generally heavy rainfall and flooding caused by storm surge. NOAA defines storm surge as "an abnormal rise of water generated by a storm, over and above the predicted astronomical tides." When coupled with normal tides, storm surge can raise the mean water level 15 feet or more.

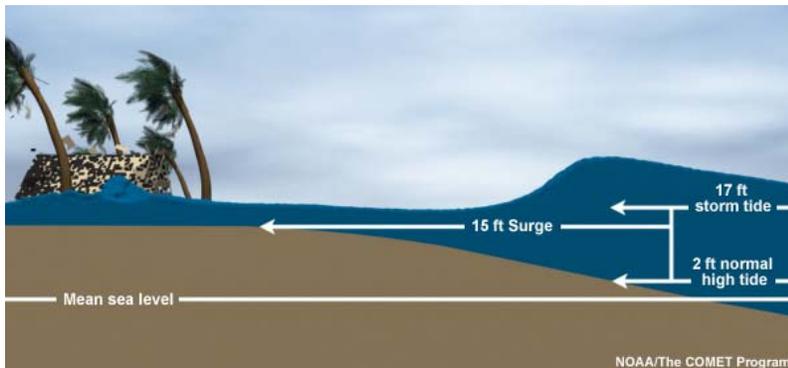
**Table 3: Saffir/Simpson Hurricane Intensity Scale**

Hurricane Category	Wind Speed	Storm Surge (ft. above sea level)	Damage Potential
1	74-95	4-5	Minimal-Damage primarily to shrubbery and trees; some signs damaged.
2	96-110	6-8	Moderate-Some trees toppled, some roof coverings damaged
3	111-130	9-12	Extensive-Large trees toppled, structural damage to roofs, small homes and utility buildings
4	131-155	13-18	Extreme-Extensive damage to roofs, windows, doors, roof systems on small buildings completely fail, some curtain walls fail.
5	>155	>18	Catastrophic-Roof damage is considerable and widespread, window and door damage severe, extensive glass failures, entire buildings could fall.

Source: National Weather Service, National Hurricane Center, <http://www.nhc.noaa.gov/sshws.shtml>

The New England District of the U.S. Army Corps of Engineers, using data from the National Hurricane Center, developed maps depicting the worst case scenario for hurricane surge inundation

for Category 1 through 4 hurricanes striking the coast of Rhode Island (please see **Map 2: Storm Surge**). Hurricane surge values were developed using the SLOSH (Sea Lake and Overland Surge from Hurricanes) model, which estimates storm surge heights through hypothetical measures of pressure, size, forward speed, track and winds. Warren’s coastal location and low elevation make it susceptible to hurricane hazards and the town’s small size means that the majority of properties are vulnerable to hurricane impacts. Across town, elevations vary from 4 meters above sea level at Town Beach to 19 meters (62 feet) above sea level at the Touisset Marsh.



**Figure 3.** Illustration of storm surge rising over sea level and normal high tides.

**Source:** NOAA National Hurricane Center website at <http://www.nhc.noaa.gov/surge/>.

Storm surge and hurricanes can also greatly contribute to coastal erosion. Erosion from hurricanes impacts housing, beaches and infrastructure like streets and sidewalks. The amount of erosion from storms is directly related to their number, intensity and duration. Beaches protect the shoreline, but storms erode the beach, putting vulnerable properties at even greater risk. A home constructed in the V-zone, or velocity zone, is likely to be destroyed as the beach erodes and the barrier or headland is washed over by high water in a storm.

**Previous Occurrences**

Rhode Island has experienced seven significant hurricanes (see **Table 4** below) in the 20<sup>th</sup> century, starting with the unnamed hurricane of 1938.

**Table 4: Significant Hurricanes in Rhode Island in the 20<sup>th</sup> Century**

Date	Name	Category	Total Property Damage (millions)	Deaths
Sept. 1938	NA	3	100	262
Sept. 1944	NA	3	2	0
Aug. 1954	Carol	2	200	19
Sept. 1954	Edna	2	0.1	0
Aug. 1955	Diane	Tropical Storm	175	0
Sept. 1960	Donna	2	19.8	2
Sept. 1985	Gloria	2	19.8	2
Aug. 1988	Chris	Tropical Storm		
Aug. 1991	Bob	2	115	0
Aug. 1994	Beryl	Tropical Storm		
July 1996	Bertha	Tropical Storm		
Oct. 1996	Josephine	Tropical Storm		

Sept. 1999	Floyd	Tropical Storm		
Sept. 2000	Gordon	1		
Aug. 2004	Hermine	Tropical Storm		
Aug. 2004	Charley	4	17.3 billion	1
June 2007	Barry	Tropical Storm		
Sept. 2008	Hanna	1		
Aug. 2011	Irene	1		

Sources: RI Hazard Mitigation Plan (2005), Town of Warren Hazard Mitigation Plan (2004), National Weather Service Forecast Office, Boston, MA, <http://www.erh.noaa.gov/box/hurricane/tropicalCycloneReview.shtm>

### Probability of Future Hurricanes in Warren

The probability that Warren will be hit by a hurricane is certain. According to the National Hurricane Center, six Atlantic tropical storms mature into hurricanes in an average year. The RI State Hazard Mitigation Plan indicates that Rhode Island is particularly vulnerable to hurricanes because of its location and features, such as Narragansett Bay, which can act as a funnel for hurricane surges. The State plan indicates that in any given year, the probability of a hurricane reaching Rhode Island is 6%.

### 3.2.4 Tornadoes

Tornadoes develop from thunderstorms and hurricanes when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The winds produced from hurricanes and wildfires have also been known to produce tornadoes. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. The average tornado moves southwest to northeast, but tornadoes have been known to move in any direction.

According to FEMA, every state is at some risk from tornadoes. Rhode Island is located in FEMA Wind Zone II, which is associated with maximum winds of 160 mph, and is also located in a hurricane-susceptible region. Tornado damage severity is measured by the Fujita Tornado Scale, which assigns numerical values based on wind speeds. The Fujita Scale ranges from F0 (winds of 4- to 72 miles per hour) to F5 (winds of 261 to 318 mph). Winds of 113 to 157 mph, such as are generally associated with Wind Zone II, are identified as an F2 on the Fujita Scale, and can cause considerable damage: roofs can be torn from houses and trees snapped or uprooted.

**Table 5: Fujita Tornado Measurement Scale**

Category	Wind Speed	Damage Potential
F0	Gale (40-72 mph)	Light damage to chimneys, branches, signs
F1	Moderate (73-112 mph)	Moderate damage to roof surfaces, moving cars are pushed off the road
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses, train cars pushed over, large trees snapped or uprooted, cars lifted or thrown
F3	Severe (158-206 mph)	Roofs and walls torn off well-constructed houses, trains overturned, most trees uprooted

F4	Devastating (207-260 mph)	Well-constructed houses leveled, structures with weak foundations blow off some distance, cars thrown
F5	Incredible (261-318 mph)	Strong frame houses lifted off foundations and carried considerable distance to disintegrate, auto-sized missiles fly through the air in excess of 100 yards.

Source: National Oceanic and Atmospheric Administration, <http://www.outlook.noaa.gov/tornadoes/fujita.htm>.

**Previous Occurrences**

From 1985 to 2009, the NCDC reports 7 tornado events in Providence and Bristol County (none of them strong). On July 23, 2008, an F1 scale tornado began off Rumstick Point in Barrington and then moved inland to Warren at Hanley Farm Road. It then moved eastward across the Kickemuit River in the Touisset Highlands section of Warren, crossed over the Cole River and continued to Ocean Grove, Swansea.



Photo of a funnel cloud off Rumstick Point by Nicholas Caisse of Barrington, printed in *The Boston Globe*, July 24, 2008.

The tornado’s path was 4.2 miles long and the tornado itself was only 40 yards wide. Most of the damage had a rating of EF0 on the Fujita Scale with windspeeds of 65 to 75 mph. One section of Warren near Route 136 and Harris Avenue (including Overhill Road in the Laurel Park area) reflected EF1 damage—wind speeds in that area were estimated at 90 mph. The majority of damage was to trees, some which fell onto power lines and houses, and swirling debris. A large tree near Harris Avenue was lifted and thrown 40 feet onto Route 136. Damage was estimated at \$45,000. No injuries were reported (Source: CBS3 Springfield at <http://www.cbs3springfield.com> based on Police and Fire reports).

**Probability of Future Events**

Tornadoes are a rare occurrence in Rhode Island, but a risk exists in hurricane season (June through October) and tornadoes have occurred in Warren recently. Thus, the probable occurrence assigned to tornados is moderate. Unfortunately, there is no long-term forecasting system that can accurately predict the likelihood of a tornado event in Rhode Island. The National Oceanic and Atmospheric Administration’s Storm Prediction Center constantly monitors changing weather conditions and is able to provide short-term tornado predictions—these predictions are produced in a matter of minutes, rather than days, which limits responders ability to prepare. In the case of the 2008 tornado, the National Weather Service issued a special marine warning for Narragansett Bay, followed by a severe thunderstorm warning fifteen minutes later. A tornado warning was issued

after another 15 minutes. Broadcasting tornado warnings through an extensive communication network is now the best means for mitigating tornado hazards.

### 3.2.5 Wildfires

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. Heavy fuel contributes to the size and spread of the fire, as do steep slopes and dry, windy weather conditions.



In April 2008, a manmade fire set in the Audubon property spanning both Warren and Bristol quickly spread across the marshes towards Jacob's Point.

The fire began near Hanley Farm Road in Warren and spread southward, bounded by the East Bay Bike Path. Much of the damage impacted the Audubon Boardwalk in Bristol, which cost about \$1 million to construct.

(Source: *Providence Journal*, Meaghan Wims and Alex Kuffner, April 18, 2008).

Larger deciduous forested tracts are located on the northern and eastern side of the Town, especially in the Touisset area, along the Kickemuit Reservoir and on both sides of Route 136. In Touisset, much of this forest is wetland, but these areas can still be impacted by wildfire. In central Warren, other patches of forest can be found on the Narragansett Grid easement, which runs north to south, along the bike path, South Cemetery and the properties north of Franklin Street.

#### Previous Occurrences

Significant wildfires have not been known to occur in Warren, although occasional brush fires have occurred in the wooded parts of town. In 2008, a manmade fire spread across Jacob's Point in Warren, creating significant damage to the Audubon properties and threatening nearby housing (see photo, above).

**Probability of Future Events**

The probability of a future wildfire varies with seasonal and daily weather conditions, and site-specific vegetation composition. For the purposes of this plan, a forest fire is considered a moderate risk. Much of Warren is relatively flat, including wooded areas. This flat topography, along with the overall humid weather, puts Warren at a lower risk for future wildfire. Overall, Rhode Island generally exhibits a humid continental climate with hot, rainy summers and chilly winters and thus often has a low or medium (Class 1 or 2) fire class rating. However, dry, windy weather does occur, and fire conditions can be exacerbated by drought, particularly during the summer months. The peak fire season for the state is typically between mid-March and mid-May, when higher fire class ratings do occur periodically.

**3.2.6 Hailstorms**

Hail is a showery precipitation in the form of irregular pellets or balls of ice more than 5mm in diameter. Hail is often associated with severe thunderstorms and occurs primarily during the summer months in Rhode Island. While significant hailstorms are infrequent in Warren, there is a potential for a hailstorm of any magnitude anywhere in town. Hail can not only damage cars and buildings, but can devastate farm fields during the growing season.

**Previous Occurrences**

Hailstorms have been infrequent in Warren. The National Climatic Center does not list any hailstorms for the town of Warren (although Barrington experienced three and Bristol experienced one in the last decade). Hail sizes were listed at .75 inches to 1.5 inches in diameter. Hail also was produced by Hurricane Irene in October 2011.

**Probability of Future Events**

The probability for a hailstorm in Warren is moderate. No long-term forecasting system exists for determining the probability of a future hailstorm in Warren.

**3.2.7 Earthquakes**

An earthquake is caused by the breaking and shifting of rock beneath the Earth's surface. Earthquakes strike suddenly, violently and without warning at any time of the year. Earthquakes are measured on the Richter Scale, which is a logarithmic measurement of the amount of energy released by an earthquake. The Richter Scale ranges from 1 to 10. Earthquakes with a magnitude of at least 4.5 are strong enough to be recorded by sensitive seismographs all over the world. The intensity of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys and ultimately, total destruction. The intensity scale currently used in the U.S. is the Modified Mercalli Scale. The scale is composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction. Different levels are designated by Roman numerals but the scale does not have a mathematical basis; instead it is an arbitrary ranking based

on observed effects. There are no significant geologic fault lines in Rhode Island or New England, and the U.S. Geological Survey (USGS) Earthquake Hazards Program identifies all of Rhode Island as occurring in a low seismic risk area (<2%g peak acceleration). Historically, earthquakes originating in other states have been felt in various parts of Rhode Island. Should an earthquake strike or its effects be felt in Warren, old masonry structures that do not meet current earthquake codes could potentially be at risk of damage or collapse.

### Previous Occurrences

Historically, Rhode Island has experienced earthquakes on a regular basis, including the earliest citation of a violent earthquake in June of 1638 (see **Table 6**, below). Additional earthquakes were felt in 1658, 1727, 1732, 1755, 1783, 1791, 1848 and 1860. Few details are noted about these earthquakes. A number of earthquakes were cited by settlers in Rhode Island in the 17<sup>th</sup> century. These quakes were believed to have originated elsewhere, some as far away as Quebec. In 1883, an earthquake believed to have been centered on Rhode Island was felt (Intensity V effects) from Bristol to Block Island. The largest earthquake to be felt in Rhode Island occurred in 1976 and had Intensity VI effects and measured 3.5 on the Richter Scale.

**Table 6: Earthquakes in Rhode Island**

Date	Epicenter	Richter Scale	Notes
Feb. 1883	RI	NA	New London, Fall River; Intensity V from Bristol to Block Island
Feb. 1925	Quebec	7	Intensity V at Block Island, Providence and IV at Charlestown
Nov. 1929	Newfoundland	7.2	Marine earthquake, minor vibrations felt
Nov. 1935	Quebec	6.25	Intensity IV at Block Island, Providence, Woonsocket
Dec. 1940	New Hampshire	NA	Intensity V at Newport; Intensity IV at Central Falls, Pascoag, Providence, Woonsocket
Oct. 1963	MA	4.5	Intensity V at Chepachet
Dec. 1965	NA	NA	Intensity V felt in Warwick: windows, doors shaken.
Feb. 1967	NA	2.4	Intensity V felt Middletown, Newport, N. Kingstown—no damage
Feb. 1973	NA	NA	Noises (boom/explosion) but no damage
June 1973	Maine	5.2	Intensity at IV in Charlestown; I to III in Bristol, East Providence, Providence
Mar. 1976	NA	3.5	Intensity VI effects to Newport
Aug. 2011			

Source: USGS, [http://earthquake.usgs.gov/earthquakes/states/rhode\\_island/history.php](http://earthquake.usgs.gov/earthquakes/states/rhode_island/history.php)

### Probability of Future Events

The USGS Earthquake Hazards Program identifies all of Rhode Island as occurring in a low seismic risk area (<2%g peak acceleration), therefore the probability of a significant earthquake occurring in

the future is low. Marine earthquakes, which generate tsunamis, are most commonly felt in the Pacific Ocean. Therefore, the probability of future events in Rhode Island is considered low.

### **3.2.8 Drought**

According to the National Oceanic & Atmospheric Administration (NOAA), all types of drought originate from a lack of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple months), the drought is considered short-term. But if the weather or atmospheric circulation pattern becomes entrenched and the precipitation deficits last for several months to several years, the drought is considered to be a long-term drought. Precipitation in Rhode Island, measured at T.F. Green Airport, averages about 40 inches per year. Historically, the driest year occurred in 1965, with less than 26 inches of rainfall. Dry weather occurs most commonly in late spring and the first half of summer, with rainfall less than an inch within 4 to 6 weeks. Often droughts occur over several years (as was the case in the mid-1960s). These periodic “droughts of record” occur every 20 years or so in Rhode Island. In these years, concerns are raised about water supplies, and in the case of Warren, endangered crops.

#### **Previous Occurrences**

According to the RI Water Resources Board, Rhode Island has had at least 6 major droughts since 1929.

#### **Probability of Future Events**

The probability of a substantial, long-term drought in Warren is low but present.

## **• 3.3 Summary of Potential Hazards for Warren**

Flooding represents the most likely natural hazard to impact Warren. Flooding can result from improper drainage during even moderate storms, but is most apparent during heavy storms and periods of melting snow and ice. Flood damage can be exacerbated during the high wind conditions of hurricanes, tornadoes and winter storms, when debris accumulates and blocks drainage. Based on the SLOSH models, even Category 1 and Category 2 hurricanes will produce storm surges that inundate large areas of town. Belcher’s Cove shorelines will be greatly impacted by a Category 1 hurricane, but the densely developed North End neighborhood may see the considerable damage to housing structures. Other developed areas include the Warren Waterfront reaching toward Main Street and neighborhoods within the reach of the Upper Kickemuit Reservoir and along Schoolhouse Road. Businesses and residents along Market Street will also feel storm surge impacts with a lower level hurricane. At higher categories of hurricanes, the reach of storm surge will be even greater in these areas and extend inland to Main Street, Franklin Street and further along Schoolhouse road into Swansea, MA. Because Warren has such extensive coastlines and inland waters, special

attention should be paid to mitigating flood hazards through strategic land conservation of coastal buffers, enforcement of regulations for flood hazards and infrastructure improvements.

Lower risk natural hazards for Warren include hailstorms, earthquakes, tornadoes and wildfires. These phenomena have occurred in the area before and most likely will again, but the estimate of their harm to public safety, housing and other infrastructure is comparatively low.

## 4.0 Warren's Vulnerable Assets

Local municipalities are required by 44 CFR Part 201.6(c)(2)(ii) to include a description of the jurisdiction's vulnerability to each of the hazards previously identified and described in this plan. Vulnerability is defined as the exposure or susceptibility of the Town to the effects of the identified hazards. The vulnerability assessment process helps identify vulnerable points in the community's infrastructure and population. All buildings listed in the Warren Tax Assessor's database, including residential and commercial structures, as well as outbuildings, warehouses and industrial structures are considered in the assessment. Public infrastructure, such as bridges, roads and utilities, natural resources and areas subject to environmental vulnerability (such as beaches prone to erosion), are also assessed for vulnerability. Finally, special populations (children, elderly and disabled populations) are assessed for their proximity to hazards.

- **4.1 Vulnerability of Critical Assets**

**Table 7** below identifies Warren's Critical Assets, including transportation systems, emergency centers, utility infrastructure, special population centers such as nursing homes and schools, and natural resources, such as beaches and coastal parks. The table also identifies the approximate location of each critical asset, which natural hazards each asset is vulnerable to, and where feasible, an estimate of effects from each vulnerable asset.

### 4.1.1 Vulnerability of Special Population Centers

Warren has several special population centers, including 7 education facilities ranging from pre-school to middle school, 3 elderly nursing home and/or rehabilitation centers, the Senior Center and Kickemuit Village (senior housing), several group homes for adults with developmental and mental health disabilities. The populations using or inhabiting these facilities may require additional assistance in the event of a natural hazard. Rhode Island Building Code requires residential and commercial structures in the Warren area to be able to withstand 110 mile per hour winds, or a Category 2 hurricane. Most of the facilities housing Warren's special populations were built in the 1960s and 1970s. All special needs population centers may be vulnerable to wind-borne damage from higher caliber hurricanes.

#### Schools

5 of Warren's 7 public and private schools are located in a storm surge inundation area (refer to **Map 3**) based on the SLOSH worst case scenario model. The schools most at risk are The Garden School on Cutler Street and the Raggedy Ann Nursery, which are at risk from storm surge associated with a Category 1 hurricane. Also vulnerable is Child Care Connection, which is at risk in a Category 3 Hurricane and Hugh Cole Elementary and the East Bay Collaborative, which are at risk in a Category 4 hurricane. Kickemuit Middle School is located just outside the inundation area, but the fields to the south are located in surge area. Most of Warren's schools are located outside of the Velocity Zone and the 100-year Flood Zone (see **Map 4**), except for Raggedy Ann Preschool at 210 Metacom Avenue. This school is situated in the 100-year Flood Zone.

**Table 7. Risk Assessment Matrix for Warren**

Critical Asset	Location	Ownership	Primary Natural Hazards	Primary Problem/Effect
<b>Special Population Centers</b>				
Senior Center/Kickemuit Village	20 Libby Lane	Public	Flooding, winter storms, wind damage	Public safety. Property damage. Disruption of services.
Crestwood Nursing Home	568 Child Street	Private	Flooding, wind damage	Public safety. Property damage. Disruption of services. Economic loss.
The Willows	47 Barker Avenue	Private	Flooding	Public safety. Property damage. Disruption of services. Economic loss.
Grace Barker Nursing Home	54 Barker Avenue	Private	Flooding	Public safety. Property damage. Disruption of services. Economic loss.
Warren Skilled Nursing and Rehabilitation	642 Metacom Avenue	Private	Wind damage, winter storms	Public safety. Property damage. Disruption of services. Economic loss.
Preferred Health Care Services	633 Metacom Avenue	Private	Wind damage, winter storms	Public safety. Property damage. Disruption of services. Economic loss.
Almy Avenue Group Home	71 Almy Avenue	Private	Flooding, wind damage, winter storms	Public safety. Property damage. Disruption of services. Economic loss.
Daniel Childs House	767 Main Street	Private	Flooding, wind damage, winter storms	Public safety. Property damage. Disruption of services. Economic loss.
Edgemont Sheltered Care Home	24 Buffalo Avenue	Private	Flooding, wind damage, fire	Public safety. Property damage. Disruption of services. Economic loss.
Corliss Institute	292 Main Street/ 20 Norbert Street	Private	Flooding, wind damage, fire	Public safety. Property damage. Disruption of services. Economic loss.

<b>Schools</b>				
Hugh Cole Elementary	50 Asylum Road	Public	Flooding, winter storms, wind damage, fire	Public safety. Property damage. Disruption of services.
Kickemuit Middle School	525 Child Street	Public	Flooding, winter storms, wind damage	Public safety. Property damage. Disruption of services.
East Bay Educational Collaborative	317 Market Street	Private	Flooding, winter storms, fire	Public safety. Property damage. Disruption of services.
Child Care Connection	410 Child Street	Private	Wind damage, winter storms, fire	Public safety. Property damage. Disruption of services.
Raggedy Ann Nursery School	210 Metacom Avenue	Private	Flooding, wind damage, winter storms	Public safety. Property damage. Disruption of services.
The Garden Playschool	84 Cutler Street	Private	Flooding, wind damage, winter storms	Public safety. Property damage. Disruption of services.
<b>Govt./Emergency/Operating Centers</b>				
Government Center	1 Joyce Street	Public	Wind damage	Property damage. Disruption of services. Public safety risk if access is compromised.
Town Hall	514 Main Street	Public	Wind damage	Property damage. Disruption of services.
DPW/Transfer Station	Birchswamp	Public	Wind damage, fire	Public safety. Property damage. Disruption of services.
Community Center (Mary V. Quirk)	Main Street	Public	Wind damage, flooding	Public safety. Property damage. Disruption of services.
Fire Station	Townwide	Public	Flooding	Property damage. Disruption of services. Public safety risk if access is compromised.
Warren Animal Shelter	Wood Street	Public	Flooding, wind damage, winter storms, fire	Animal safety/well-being. Property damage. Disruption of services. Service cost for emergency relocation.

<b>Dams</b>				
Upper Kickemuit Reservoir		Public	Flooding	Property damage. Infrastructure damage.
Lower Kickemuit Reservoir		Public	Flooding	Property damage, infrastructure damage.
<b>Utilities</b>				
Sewer Department/sewer system	Water Street and through most of Warren	Public	Flooding, debris from wind damage	Risk to public health. Economic loss. Disruption of services.
Pump Stations	Townwide		Flooding	Risk to public health. Economic loss. Disruption of services.
Water Supply	Townwide	Public	Flooding, severe weather	Risk to public health. Economic loss. Disruption of services.
<b>Transportation</b>				
Warren River Bridge	Main Street/Warren River	Public	Flooding, wind damage from debris, ice/winter storms	Public safety. Disruption of access. Economic loss. Disruption of services.
Evacuation Routes	Main Street/Metacom Avenue and connecting streets	Public	Flooding, wind damage debris	Public safety. Disruption of access. Economic loss. Disruption of services.
Child Street/Kickemuit Reservoir Pass	Child Street	Public	Flooding, wind damage debris	Public safety. Disruption of access. Economic loss. Disruption of services.
<b>Natural Resources</b>				
Town Beach/Burr's Hill	Water Street	Public	Flooding, wind damage debris, ice	Coastal erosion, damage to archaeological site
Jamiel's Park	80 Wood Street	Public	Flooding, debris from ice/winter storms	Property damage. Coastal erosion. Disruption of services
Audubon - Touisset	Touisset Road	Private	Flooding	Coastal erosion.
Warren Bike Path	Long Lane to Kickemuit	Public	Flooding, debris from wind, winter storms, ice	Property damage, disruption of access.
East Bay Bike Path	West Warren	Public	Flooding, debris from wind, winter storms, ice	Property damage, disruption of access.

### **Senior/Elder Care Facilities**

Of Warren's three elderly facilities, the most vulnerable are the **Grace Barker Nursing Home** and **The Willows** on Barker Avenue, which are located in a Category 1 Hurricane area (see **Map 5**). Most of the buildings in **Kickemuit Village** are located in a Category 3 Hurricane Area, although 1 building on the eastern shore is located in a Category 2 Hurricane area. **Crestwood Nursing Home** is located just outside of the Category 4 Hurricane area. Grace Barker Nursing Home and The Willows are both located in the 100-year Flood Zone (see **Map 6**). Kickemuit Village has land in the Velocity Zone and the 100-year Flood Zone, but none of the buildings are located in these zones. Similarly, Corliss Institute's buildings appear to be out of the Velocity and 100-year Flood Zone, but their land along the East Bay Bike Path is in the 100-year Flood Zone. Snow and ice storms would not impact Warren's special needs population in terms of structural damage; however, severe winter weather would limit the mobility of these populations and may impede emergency responder's ability to access the buildings. Power outages, fallen trees or debris may create further hazards.

Assisted living centers for either the elderly or disabled are scattered throughout Warren. **Riverwood Mental Health Services Inc.** maintains administrative offices at 25 Railroad Avenue, and offers outpatient assistance as well as permanent supportive housing (apartment assistance) for three sites in Warren. The office on Railroad Avenue is located in a Category 4 Hurricane area. The **Main Street Apartments**, owned by East Bay Housing/Riverwood MHS, consists of 10 units for the disabled. Most of this property is located in a Category 3 Hurricane area.

St. Mary of the Bay Church operates a group home for young women on **945 Main Street** through the North American Family Institute. Also on Main Street is the Corliss Institute at 292 Main Street. Corliss' main offices are located in a Category 2 Hurricane area, while some of its rear properties (along the East Bay Bike Path) in the Category 1 Hurricane area.

### **Critical Facilities**

Warren maintains six fire stations around Town, Town Hall and the Government Center (which houses the Police Department and the Central Fire Station). These facilities are supplied with emergency generators and are staffed in natural hazard conditions. Kickemuit Middle School, on Child Street (Route 103), is the main emergency shelter during major storms and disasters. The Town Hall is occasionally used as an emergency shelter as well and is located along a major evacuation route, and admits pets during emergencies in certain areas of the building. None of these facilities is located in a floodplain.

#### **4.1.2 Vulnerability of Residential, Commercial and Other Structures**

According to the Warren Tax Assessor's database, 3,586 structures are located in Warren. These include all residential, commercial and industrial structures as well as significant outbuildings. Of these structures, 3,199 are residential, 203 are commercial and 24 are industrial. Remaining buildings include farm buildings, utility buildings, government buildings and "other improved" structures.

**Residential Structures**

FEMA flood zones AE (the 100 year flood zone) and VE (Velocity Zone) are the areas projected to be most impacted by hurricanes and large storms. The AE Zone requires flood insurance. In Warren, 333 residential structures are located in the AE Zone. In the AE Zone, 189 residential structures are single family homes and another 143 are multi-family or apartments. Although building age is not necessarily an indicator of sturdiness, 258 of these structures (78%) were built before 1950. Moreover, 10 are specifically in the waterfront district. The combined tax value of these structures (excluding land) in the AE Zone is \$57,800,900.

The Velocity Zone involves inundation by the 100 year flood and additional hazards associated with storm waves. Warren has about 76 residential properties in the Velocity Zone. In western Warren, the Velocity Zone extends inward over waterfront parcels often reaching the East Bay Bike Path. About 29 (38%) of the residential structures in the Velocity Zone are located on town’s western half along the Warren River, from the southern border of the American Tourister Mill complex toward the Bristol line. The remainder of the properties wraps around the Kickemuit River’s eastern and western shores or line Mt. Hope Bay, with most properties (47 or 62%) located on the Touisset peninsula. 42 of all residential properties in the Velocity Zone (55%) were built in 1950 or earlier. The combined value of all residential structures in the Velocity Zone (excluding land) is \$16,257,000. Tax values for both the AE Flood Zone and the VE Flood Zone total \$74,057,900.

**Table 8: Residential Structures Most At Risk from Hurricanes**

Structure Type	Total Number of Structures in Warren	Number of Structures in the AE Zone	Number of Structures in the VE Zone	Tax Value of Residential Structures in the AE and VE Zones
Single Family	2,534	189	66	\$ 44,354,200
Multi-Family	601	137	8	\$ 27,703,700
Apartments	27	4	0	\$ 1,150,600
Seasonal/Beach	21	1	2	\$ 229,600
Residential Condo	11	2	0	\$ 618,800
<b>Total</b>	<b>3,194</b>	<b>333 (10%)</b>	<b>76 (2%)</b>	<b>\$ 74,057,900</b>

About 44% of residential structures in Warren are located in an area predicted to be impacted by storm surge up to 18 feet (1,399 structures total). The potential reach of storm surge is mapped by FEMA and was last updated in 2008. Property owners within the storm surge areas should maintain coverage through the National Flood Insurance Program. According to FEMA, 468 policies are currently active in Warren, with total premiums of \$516,825. Total coverage in force is \$88,190,300. Since 1978, 124 claims have been made through the NFIP, with \$962,496 paid for damage.

**Table 9: Residential Structures Most at Risk from Storm Surge**

Structure Type	Total Number of Structures in Warren	Number of Structures in Storm Surge Area 1	Number of Structures in Storm Surge Area 2	Number of Structures in Storm Surge Area 3	Number of Structures in Storm Surge Area 4
Single Family	2,534	246	228	196	202

Multi-Family	601	163	125	115	102
Apartments	27	3	8	6	5
<b>Total</b>	<b>3,162</b>	<b>412</b>	<b>361</b>	<b>317</b>	<b>309</b>

**Development Trends and Future Build Out**

Based on the Town’s 2008 Build Out Analysis (the potential for development based on zoning and site conditions), Warren has the potential for 1,415 single family units possible. In the R40 zoning district (which includes much of the rural eastern half of Warren), there are 112 existing lots that have the potential for creating about 450 additional lots and 506 additional units. A few of these properties front the Palmer River, Kickemuit Reservoir and the Kickemuit River, which could exacerbate flood hazards. In 2011, the town purchased a conservation easement on 63 acres of farmland along the Kickemuit River, reducing the build out potential for this area. Of all new residential units in Warren it is estimated that 32% would be within R40 zoning district. In the R20 zoning district there are five existing lots that have the potential for an additional 68 units, or an increase of 46% of units in that zone. However, the overall effect is < 5% of total new units in Warren. In the R10 zoning district there are 253 existing lots that have the potential for an additional 607 units, or an increase of 28% units in that zone. Of all new residential units in Warren it is estimated that 43% would be within R10. In the R6 zoning district there are 71 existing lots have the potential for an additional 147 units, or an increase of 14% of units in that zone. Of all new residential units in Warren approximately 10% would be within R6. The other zoning districts (R15, R30, VB and W) are projected to create a total of 50 new lots or 57 additional units. Of all new residential units in Warren a total of 3% would be within the R15, R30, VB and W zones combined. These districts have little potential for new residential development under this scenario. Warren has seen little residential development since 2008 with the decline of the housing market and the economy overall.

**Vulnerability of Non-Residential Structures**

203 Commercial structures exist in Warren overall with a total building tax value of \$76,243,900. Commercial structures in the AE Zone are located close to the Warren River, along Belcher’s Cove on Market Street and on western side of Market Street toward Swansea. As indicated in the table below, 39 structures are located in the AE Zone, with a total Tax Value of \$14,641,400. Relatively few commercial structures exist in the Velocity Zone (7) and all of these are located on the Warren River in the Waterfront District. Tax Values of these structures total \$534,100. Thus, about 20% of the value of Warren’s commercial structures is located in areas with high risk for flooding, storm surge and high winds.

In Warren, 24 total industrial buildings exist with a total tax value of \$25,657,200. Only 3 structures are in the AE Zone (tax valued at \$2,221,800). An additional 7 buildings are in the Velocity Zone (tax valued at \$2,940,500) and all are located in the Waterfront District. Total Tax values for these properties are \$5,162,300.

The remaining non-residential structures in Warren include municipal buildings and utility structures. Approximately 154 land parcels of local, state and federal property exist in Warren and include schools, parks and bike paths, municipal buildings, cemeteries and other government uses covering a total of 430 acres. Only 27 of these parcels actually contain buildings, and these properties have a total tax value of \$37,391,000. Of these structures, only 3 occur in the AE Zone, the Warren Animal Shelter, Veteran's Field improvements and the State-owned facility on Market Street near Jamiel's Park. The State building on Market Street is tax valued at \$864,500. The Town-owned buildings in the AE Zone are of minimal value, but the Animal Shelter's importance in emergency operations is discussed further in the other sections. Only one government building occurs in the Velocity Zone, the Wastewater Treatment Facility on Water Street. This structure has significant value, \$2,947,700.

Church and non-profit structures also maintain 29 buildings in Warren, with only 3 structures in the AE Zone and none in the VE Zone. Holy Spirit Church near Jacob's Point, has two structures in the AE Zone with a tax value of \$101,100. In addition, Our Lady of Fatima's structures have the highest tax value in the AE Zone (and in Warren overall), with a tax value of \$9,421,600.

**Table 10: Non-Residential Structures Most at Risk from Hurricanes**

Structure Type	Total Number of Structures in Warren	Number of Structures in the AE Zone (100 Year Flood)	Number of Structures in VE Zone (100 Year Flood plus Storm Winds)	Tax Value of Non Residential Structures in the AE and VE Zones
Commercial	203	39 (19%)	7	\$15,175,500
Industrial	24	3 (13%)	7 (29%)	\$5,162,300
Utility	5	4	0	\$2,628,900
Government	27	3	1	\$3,946,700
Church/Non-Profit/Private School	29	3	0	\$9,522,700
<b>Total</b>	<b>228</b>	<b>52</b>	<b>15</b>	<b>\$36,436,100</b>

**Table 11: Non-Residential Structures Most at Risk from Storm Surge**

Structure Type	Total Number of Structures in Warren	Number of Structures in the AE Zone (100 Year Flood)	Number of Structures in VE Zone (100 Year Flood plus Storm Winds)	Tax Value of Non Residential Structures in the AE and VE Zones
Commercial	203	39 (19%)	7	\$15,175,500
Industrial	24	3 (13%)	7 (29%)	\$5,162,300
Utility	5	4	0	\$2,628,900
Government	27	3	1	\$3,946,700
Church/Non-Profit/Private School	29	3	0	\$9,522,700
<b>Total</b>	<b>228</b>	<b>52</b>	<b>15</b>	<b>\$36,436,100</b>

## **4.2 Summary of the Vulnerability of Warren's Critical Assets**

The main hazards for Warren's critical assets are flooding, storm surge and the effects of winter storms. Because of the attractiveness of the coastline, development along the shores is desirable not just for residences but also for senior facilities and special population uses. Caution should be taken in supporting such development, as sea rise and climate change is expected to accelerate in the coming decades. These conditions will exacerbate flooding effects and create burdens on emergency response as well as risking property damage, infrastructure and public safety.

Critical assets could be impacted by other hazards, such as earthquakes, tornadoes and wildfires. Reducing these risks will require adherence to the Rhode Island Building Code and the International Building Code, which prescribe that all structures in Warren must withstand wind speeds of 110 miles per hour or a Category F1 tornado. Finally, wooded parcels scattered throughout Warren are in close proximity to houses and schools. These structures may present some risk from wildfire damage, but based on historic occurrences, this risk is low.

## 5.0 Hazard Mitigation Policies and Actions

Town staff in Warren assessed the risks to the town and developed mitigation actions that address a mix of structural initiatives (building code enforcement, repair and retrofit of existing structures, and removal of vulnerable structures) and nonstructural initiatives (educational programs, preventing construction in high-hazard areas, enforcing regulations) to minimize the effect of future hazards. By creating this strategy and making it part of the Town's Comprehensive Planning, Warren has established an ongoing process that will make hazard mitigation a routine part of municipal government. Based on the activities planned for in the **2004 Hazard Mitigation Plan**, adopted by the Town of Warren, the following actions have been addressed as follows:

**Table 12: Status of Actions from the 2004 Hazard Mitigation Plan**

2004 HMP Action	Description	Status	Timeframe
Action 1	Complete survey of main roads/properties that flood	Complete	Short Term
Action 2	Work with RIDOT to begin drainage improvements	Complete	Long Term
Action 3	Inspect historic structures/private buildings for code compliance	Initiated	Long Term
Action 4	Implement public education series focusing on flood hazards, building regulations and fire prevention for property owners	Initiated Fire hazards emphasized so far.	Medium Term
Action 5	Expand tree-trimming program	Initiated	Medium Term
Action 6	Monitor sewer lines via camera for leaks	Initiated	Medium Term
Action 7	Repair/replace infrastructure problems	Initiated	Medium Term
Action 8	Develop a town wide inventory of small streets that flood/wash out	Initiated	Short Term
Action 9	Begin drainage improvements with innovative water catchments in areas subject to annual flooding	Initiated	Long Term
Action 10	Protect wetlands, marshes and other fragile areas along Town rivers/streams by purchasing land, cleaning up areas and restoring wetlands	Not initiated. Zoning ordinance should be updated to protect wetlands and streams.	Long Term
Action 11	Purchase high output emergency generators for 3 of the Town's emergency shelters	Completed	Medium Term
Action 12	Purchase generators for the Government Center and Town Hall.	Initiated	Medium Term
Action 13	Establish a satellite communications center for the Fire Department as a separate building, or as a self-contained portion of a building	Completed	Medium Term
Action 14	Upgrade marine communication equipment to ensure safety along the Town's waterways.	Not Initiated	Long Term
Action 15	Complete parcel mapping and street centerline using GIS.	Complete	Long Term
Action 16	Flood proof structures located in the flood zone. As required by NFIP standards, after flooding or storm surge, losses over 50% of structural value must be brought to state/federal code.	Ongoing	Medium Term

Action 17	Discourage variances from flood regulations for new construction located in a flood zone. In National Historic District, establish aesthetic criteria for new structures in the flood plain.	Initiated	Short Term
Action 18	Retrofit/replace communication tower at Town Hall to withstand high winds.	Initiated	Long Term
Action 19	Inspect public housing (Housing Authority and other non-profit housing) and implement flood mitigation measures.	Ongoing	Medium Term
Action 20	Periodically inspect and evaluate school buildings for code compliance.	Not initiated. Schools should have scheduled inspections.	Long Term
Action 21	Replace and elevate bridge at Warren/Barrington Town line.	Complete	Long Term
Action 22	Protect Warren’s water sources and distribution method for clean water supply through the expansion of distribution lines to reservoirs in MA as approved by State Referenda.	Not initiated	Long Term

As indicated by the table, most of the Actions proposed by the 2004 plan have been initiated and some completed. Others are programmatic (and therefore ongoing) or the result of actions from other agencies over which the Town does not have full control. In updating the Hazard Mitigation Policies and Actions, the Town removed completed actions and added new actions that address new concerns arising from accelerated climate change and sea level rise.

• **5.1 Updated Mitigation Actions**

The Risk Assessment Matrix, presented in Table 12, was created in 2004 and several hazard mitigation actions are carried over in the 2012 plan. The new matrix reflects updated priorities, including response to climate change and accelerated sea rise. Priorities are indicated as: High, Medium and Low, based on their ability to affect mitigation of probably hazards in Warren. These priorities have been updated, with an increased emphasis on planning for climate change. This matrix also is based on historic damage, safety of the population, property protection and overall consistency with the strategies presented in the updated Comprehensive Plan and the Emergency Operations Plan. Time frames are defined as short (1 month to a year), medium (1 to 3 years) and long term (3 years to an ongoing process). The goals of the 2012 plan include:

1. Strengthen planning efforts to identify, clarify and communicate natural hazards and use them for public information and outreach.
2. Ensure that the regulatory structure through the Building Inspections, Planning and Zoning review reduces exposure to natural hazards, particularly in coastal areas, wetlands, streams and waterways.

3. Protect property through structural projects and maintenance as well as the acquisition of land that serves as a natural buffer.
4. Protect essential public services.

These goals are implemented through a series of actions, based on the 2004 plan but intended to address each of the five goals above. The Town of Warren has participated in the National Flood Insurance Program (NFIP) since 1972, and will continue to comply with NFIP requirements.

<b>Goal 1: Strengthen planning efforts to identify, clarify and communicate natural hazards and use them for public information and outreach.</b>
<b>Action 1.1:</b> Maintain GIS records of major flood events to locate patterns of flooding for future mitigation activities, including secondary roads.
<b>Priority:</b> High
<b>Lead Department:</b> Planning and Community Development
<b>Time Frame:</b> Short term with quarterly updates.
<b>Benefit:</b> Future mitigation planning
<b>Cost:</b> \$6,000 per year (as part of GIS program)
<b>Action 1.2:</b> Expand public education efforts focusing on flood hazards, building regulations and fire prevention for property owners. Include education on home insurance coverage for natural hazards and measures that homeowners can take to reduce their home insurance deductibles and personal liability for wind damage during hurricanes or severe storms.
<b>Priority:</b> High
<b>Lead Department:</b> Planning and Community Development
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Future mitigation planning
<b>Cost:</b> \$1,000 per year (tax bill mailing, website, printed flyers)
<b>Action 1.3:</b> Educate the public on tree species appropriate for property protection and proper upkeep.
<b>Priority:</b> High
<b>Lead Department:</b> Public Works, Tree Commission
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Future mitigation planning
<b>Cost:</b> \$500 per year (website, printed flyers)
<b>Action 1.4:</b> Maintain information connections with state and federal agencies on sea level rise and its impacts on Warren property and public infrastructure.
<b>Priority:</b> High
<b>Lead Department:</b> Public Works, Planning and Community Development
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Future mitigation planning
<b>Cost:</b> \$0
<b>Action 1.5:</b> Pursue funding for hazard mitigation planning and implementation
<b>Priority:</b> Medium
<b>Lead Department:</b> Planning and Community Development
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Future mitigation planning

<b>Cost:</b> Variable. Depends on grant matching requirements
<b>Goal 2: Ensure that the Town’s regulatory structure reduces exposure to natural hazards, and is built into Building Inspections, Planning and Zoning review.</b>
<b>Action 2.1:</b> Inspect and evaluate structures and privately owned buildings/facilities for code compliance
<b>Priority:</b> High
<b>Lead Departments:</b> Planning and Community Development, Building and Zoning, Public Works
<b>Time Frame:</b> Short Term--Comprehensive Plan, Zoning Ordinance in rewrite.
<b>Benefit:</b> Public safety
<b>Cost:</b> Variable. Incorporated within Comprehensive Plan, Planning Board Subdivision Regulations, Zoning Ordinance revisions.
<b>Action 2.2:</b> Review best practices and implement hazard mitigation policies for historic structures and utilize the Town’s tax credit program for historic property improvements
<b>Priority:</b> Medium
<b>Lead Department:</b> Planning and Community Development, Building and Zoning
<b>Time Frame:</b> Short Term--Comprehensive Plan, Zoning Ordinance in rewrite.
<b>Benefit:</b> Preservation of historic and cultural assets
<b>Cost:</b> \$2,000 in staff time
<b>Action 2.3:</b> Discourage variances from flood regulations for new construction located within a flood zone.
<b>Priority:</b> High
<b>Lead Department:</b> Building and Zoning
<b>Time Frame:</b> Short Term--Comprehensive Plan, Zoning Ordinance in rewrite.
<b>Benefit:</b> Public safety and property protection
<b>Cost:</b> \$5,000 in staff, legal contractors’ time
<b>Action 2.4:</b> Ensure that housing and structures primarily used by Special Populations are routinely inspected <i>with the establishment of an annual inspection schedule</i> and that future construction of Special Population facilities is not located in areas of known flooding and/or storm surge.
<b>Priority:</b> High
<b>Lead Department:</b> Building and Zoning
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety and property protection
<b>Cost:</b> \$3,000 in staff time
<b>Goal 3: Protect property through structural projects and maintenance as well as the acquisition of land that serves as a natural buffer.</b>
<b>Action 3.1:</b> Work with RIDOT to <b>complete</b> drainage improvements through the installation of innovative water catchments and removal technology in areas subject to severe flooding. With RIDOT, pursue immediate corrective action on evacuation routes that are obstructed by frequent and significant flooding, in particular, Route 114 at the Warren Bridge.
<b>Priority:</b> High
<b>Lead Department:</b> Public Works, Planning and Community Development
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety, property protection, protection of infrastructure
<b>Cost:</b> Variable depending on RIDOT programming and funding.
<b>Action 3.2:</b> Continue tree-trimming program and planting programs for severe weather-resistant

tree species. Identify trees that may cause wind damage to emergency shelters, power sources or power lines and have them removed.
<b>Priority:</b> High
<b>Lead Department:</b> Public Works, Tree Commission
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety, protection of infrastructure
<b>Cost:</b> \$3,000-\$10,000
<b>Action 3.3:</b> Pass a Tree Ordinance that defines how utility companies and the Town must trim trees to maintain tree strength and symmetry to withstand high wind events.
<b>Priority:</b> Medium
<b>Lead Department:</b> Public Works
<b>Time Frame:</b> Medium Term
<b>Benefit:</b> Public safety, protection of infrastructure
<b>Cost:</b> \$2,000 in staff time, legal contracting
<b>Action 3.4:</b> Protect wetlands, marshes and other fragile areas along Town rivers and streams by purchasing land, cleaning up areas and restoring wetlands that serve as natural buffer.
<b>Priority:</b> High
<b>Lead Department:</b> Planning and Community Development
<b>Time Frame:</b> Short Term--part of Comprehensive Plan, Zoning Ordinance in rewrite.
<b>Benefit:</b> Public safety, protection of property, protection of infrastructure
<b>Cost:</b> TBD. The Town maintains a Local Open Space Bond authority, but sensitive property acquisition can be supported by grant funding as well.
<b>Action 3.5:</b> Plan projects for high flood areas for green infrastructure improvements to reduce water retention (pervious pavement, bioswales).
<b>Priority:</b> Medium
<b>Lead Department:</b> Public Works
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety, protection of infrastructure, protection of private property
<b>Cost:</b> \$200,000 per project (depending on scale), eligible for State Revolving Fund loans.
<b>Goal 4: Protect public services and infrastructure.</b>
<b>Action 4.1:</b> Continue monitoring sewer lines to identify maintenance and replacement needs and repair sewer lines where leakages are found.
<b>Priority:</b> High
<b>Lead Department:</b> Public Works, Sewer Department
<b>Time Frame:</b> Short Term
<b>Benefit:</b> Protection of infrastructure, public safety
<b>Cost:</b> Monitoring estimated at \$15,000 annually. Repairs estimated at \$1.5 million or more. Grant funding can support both monitoring and repairs.
<b>Action 4.2:</b> Continue to meet the national requirements for the Fire Department.
<b>Priority:</b> High
<b>Lead Department:</b> Fire Department
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety
<b>Cost:</b> TBD
<b>Action 4.3:</b> Upgrade marine communication and equipment procedures to ensure safety along the Town's waterways.

<b>Priority:</b> Medium
<b>Lead Department:</b> Harbormaster
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety, protection of property, protection of infrastructure
<b>Cost:</b> TBD
<b>Action 4.4:</b> Protect Warren’s water sources and distribution method for clean water supply.
<b>Priority:</b> High
<b>Lead Department:</b> Bristol County Water Authority
<b>Time Frame:</b> Long Term
<b>Benefit:</b> Public safety, protection of property, protection of infrastructure
<b>Cost:</b> TBD

## 6.0 Plan Implementation and Maintenance

### Section 6.1 Plan Adoption

Upon completion by the Warren Hazard Mitigation Committee, the Warren Hazard Mitigation Plan was forwarded to the Warren Planning Board for review and recommendation. On July 24, 2012, the Planning Board found that the plan was in keeping with the Town of Warren Comprehensive Plan and recommended that the Town Council adopt the plan as the official hazard mitigation plan for the Town of Warren. The Plan was forwarded to FEMA for final review and revisions were completed in January 2013. On \_\_\_\_\_, 2013, the Warren Town Council held a public hearing at which the Warren Hazard Mitigation Plan was officially adopted. Formal adoption of this plan by the Town Council and approval by the State of Rhode Island and the Federal Emergency Management Agency (FEMA) will improve the Town’s rating through the FEMA Community Rating System (CRS). Adoption of this plan will also assist the Town in applications for federal and state level grants to be utilized in mitigation efforts.

### Section 6.2 Implementation, Evaluation and Revision of Strategies

#### Implementation

By assigning a time frame to each recommended mitigation action the Town of Warren is setting parameters for implementation of needed projects. The Town of Warren Hazard Mitigation Committee recognizes the importance of establishing a workable time schedule for implementation to insure that actions are coordinated within governmental departments, on the local, state and federal level. The assigned time frame for implementation provides a method for project tracking and enables the committee to develop progress reports for each action item. Understanding the importance of hazard mitigation as a long-term planning goal, the Town of Warren includes reference to the Warren Hazard Mitigation Plan in the Warren Comprehensive Plan. At the time of the Hazard Mitigation Plan’s

adoption, it will be officially incorporated in the Warren Comprehensive Plan by reference, and the full legal weight of the comprehensive plan will support this hazard mitigation plan. The Hazard Mitigation Committee will work hand-in-hand with the Fire Chief, who serves as both a member of the committee and as the Warren Emergency Management Director. The Town Planner will serve as the Hazard Mitigation Plan lead, coordinator and point person for the public. Warren has historically utilized the background training and skills of the Fire Chief and the Fire Department to implement hazard mitigation strategies, emergency operations procedures and post disaster evaluation – this will continue under the implementation of this plan, and through the annual evaluation and revision process.

To ensure compliance with the NFIP, the Town incorporates flood management into its local regulations:

1. *Warren Comprehensive Community Plan, Policy 8, see below:*

<b>Policy 8: Manage and protect floodplains)</b>	Planning Board, DPW
<ul style="list-style-type: none"> <li>• Action 8.1 Protect and enhance natural floodplain function to protect property</li> </ul>	DPW, Conservation Commission
<ul style="list-style-type: none"> <li>• Action 8.2 Adopt standards that meet the National Flood Insurance Program</li> </ul>	Town Council, Planning Board
<ul style="list-style-type: none"> <li>• Action 8.3 Amend land use regulations to accommodate development under requirements of 100 year floodplain.</li> </ul>	Town Council, Planning Board

2. *Zoning Ordinance (Article XVII Special Flood Hazard and Fringe Lands), see Appendix for full text.*
3. *Rhode Island State Building Code.* The code defines standards for flood hazard at Section 3107.0 B. These provisions are enforced through the Town’s Building Inspector’s Office and are in compliance with the NFIP.
4. *Capital Improvement Plans (CIP)/Annual Town Budget.* Each year, the Town of Warren incorporates Fire prevention, drainage projects, stormwater management and green infrastructure projects into its annual budget.

These regulations limit development in hazardous areas and integrate NFIP requirements. The Warren Comprehensive Community Plan is currently being updated, after which the Zoning Ordinance will also be rewritten for consistency. These documents will integrate and cross-reference hazard mitigation standards.

**Evaluation**

The Town of Warren, through the Hazard Mitigation Committee will meet bi-annually (July 1<sup>st</sup> and December 1<sup>st</sup>) to review flood maps and internal procedures and to insure that the mitigation actions laid out in this plan are being implemented in the time frame set forth and approved. This schedule is more frequent than previous Hazard Mitigation Plans (which were reviewed annually). The committee will monitor and document the progress of action implementation and report its findings to the Planning Board and Town Council. Both the Planning Board and Town Council will involve the public in the plan maintenance process by holding an annual advertised public meeting to discuss the results and findings.

### **Revision**

The strategies established in this plan will be updated upon evaluation and best available data (the town has HAZUS capabilities). Review and revision of the strategies based on the committee's evaluation occur annually, after any major disaster, or as funding for mitigation projects becomes available. Actions identified in this plan will also be reviewed on a regular basis by the Town Planner in order to initiate grant applications for various mitigation items. As the plan is implemented and local strategies or priorities change, the Town will amend the Warren Hazard Mitigation Plan and, after approval on the local level, will submit the amended plan to RIEMA for review. In this way the State will remain abreast of the Town's current strategies and the progress of implementation. Public workshops and hearings will be held prior to the enactment of any document amendments. The public hearing process calls for all proposed changes to be publicly advertised three weeks prior to public hearing, and the amendments will be presented for public review at the Town Clerk's office, Town Library and via the Town website.

### **Communication**

Historically, the Town of Warren has not provided a consistent means for communication with public prior to natural hazards (this was noted by the Planning Board as well during its review of this plan). The Town must provide reminders to residents through the website, newspaper, mailers, tax bill inserts and other media. The Warren population, like many places, must utilize multiple media sources to impact public awareness. This communication will become especially important as FEMA distributes the new floodplain maps, effective in February 2014. These map drafts are already available for public review on the Town's website. Areas of town, such as the North End neighborhood, may be subject to greater flood insurance requirements because of these new maps (and more accurate data on actual flood-prone areas). The Town has not provided outreach to these neighborhoods, but the Town has located several existing FEMA brochures that will provide options for homeowners, and will develop new brochures to convey information. Technical trainings through RIEMA may further answer technical questions and help the public deepen their knowledge of flood risks.

### **Funding Improvements**

An array of funding can be drawn to finance improvements to mitigate hazards. The Town of Warren can budget for such projects in its Capital Improvements Plan and finance improvements locally through bonds. Grants such as the State Revolving Fund and the USDA NRCS programs have already funded stormwater management and buffer conservation projects in Town, and can be utilized in the future. State Department of Transportation projects (often through the Federal Highway Administration), through their planning and street improvement grants can address stormwater runoff and flood management as part of their scope. Department of Urban Development Community Development Block Grant can fund improvements in the low-moderate income/neighborhood revitalization areas. Finally, university/college programs may be able to donate resources to help plan, communicate risks or implement mitigation activities. Private entities, such as the Nature Conservancy and the Champlin Foundation, routinely fund acquisition of natural buffer easements. FEMA provides assistance for mitigation activities through the Hazard Mitigation Assistance Grants and Preparedness Grants can be targeted to specific improvements. Finally, the Town does not participate in FEMA's Community Rating

System (CRS). This system offers discounts to a participating community's flood policyholders if the community meets three goals: reduce flood damage to insurable property, strengthen and support the insurance aspects of the NFIP and encourage a comprehensive approach to floodplain management.

## 6.0 Technical Resources

### Town Resources

#### **Town of Warren**

Office of Planning and Community Development  
514 Main Street  
Warren, RI 02885  
[www.townofwarren-ri.gov](http://www.townofwarren-ri.gov)

### State Resources

#### **Rhode Island Department of Emergency Management**

645 New London Avenue  
Cranston, RI 02920  
(401)-946-9996  
[www.riema.ri.gov](http://www.riema.ri.gov)

#### **Rhode Island National Flood Insurance Program**

645 New London Avenue  
Cranston, RI 02920  
(401) 946-9996  
[www.riema.ri.gov](http://www.riema.ri.gov)

#### **Rhode Island Fire Marshal's Office**

118 Parade Street  
Providence, RI 02909  
[www.fire-marshal.ri.gov](http://www.fire-marshal.ri.gov)

#### **Coastal Resources Management Council**

Stedman Government Center  
4808 Tower Hill Road  
Wakefield, RI 02879  
p.: 401-783-3370  
[www.crmc.ri.gov](http://www.crmc.ri.gov)

#### **Department of Administration**

Division of Planning  
One Capitol Hill  
Providence, RI 02908  
p.: 401-222-6800  
[www.admin.ri.gov](http://www.admin.ri.gov)

#### **Rhode Island Department of Environmental Management**

235 Promenade Street  
Providence, RI 02908  
p.: 401-222-6800  
[www.dem.ri.gov](http://www.dem.ri.gov)

#### **Rhode Island Department of Transportation**

Two Capitol Hill  
Providence, RI 02903  
p.: 401-222-2378  
[www.dot.ri.gov](http://www.dot.ri.gov)

#### **State of Rhode Island Building Commissioner's Office**

One Capitol Hill  
Providence, RI 02903  
401-222-3033  
[www.ribcc.ri.gov](http://www.ribcc.ri.gov)

#### **Rhode Island Builders Association**

450 Veterans Memorial Parkway, #301  
East Providence, RI 02914  
(401)-438-7400  
[www.ribuilders.org](http://www.ribuilders.org)

#### **Public Utilities Commission**

89 Jefferson Boulevard  
Warwick, RI 02888  
(401)-941-4500

### Federal Resources

#### **Federal Emergency Management Agency**

Region 1 Office  
99 High Street, Sixth Floor  
Boston, MA 02110  
(617)-956-7506  
[www.fema.gov](http://www.fema.gov)

#### **National Weather Service Forecast Office**

445 Myles Standish Boulevard  
Taunton, MA 02780  
(508) 823-2262

#### **U.S. Army Corps of Engineers**

New England District  
696 Virginia Road  
Concord, MA 01742  
(978) 318-8111

## 7.0 Appendix A: Public Workshop Advertisement

TOWN OF WARREN, RHODE ISLAND



# Warren Natural Hazard Mitigation Plan Update





**What:** Planning Board Discussion of Hazard Mitigation Plan  
**When:** Monday, January 23, 2012, 7:00 p.m.  
**Where:** Town Council Chamber, 2<sup>nd</sup> floor Town Hall  
**Questions?** Call Caroline Wells at 245-2469 or at [cwells@townofwarren-ri.gov](mailto:cwells@townofwarren-ri.gov)

## Appendix B: Planning Board Comments, July 24, 2012

### MEMORANDUM

July 24, 2012

**To:** Warren Town Council, c/o Council President Christopher Stanley

**From:** Warren Town Planning Board Chairman Frederick Massie

**Subject:** Warren Planning Board Recommendations to Warren Town Council

At its regularly-scheduled meeting, at 7:00 pm, on Monday, July 23, 2012, the Warren Planning Board considered applications and requests for the Board's recommendations to the Warren Town Council. The applications and requests Planning Board actions regarding these applications and requests are as follows:



2. **The Warren Hazard Mitigation Plan** was presented to the Planning Board by Town Planner Caroline Wells for Board review prior to the meeting. Based on their review, the Board noted the need for several revisions to the Plan's section **5.0 Hazard Mitigation Policies and Actions** (pages 29 & 30). Specifically:

**Action 2 & 9** – Extensive street flooding occurring after significant rainfalls in the 103/114 street area adjacent to the side entrance to the American Tourister complex must be specifically addressed. As this roadway is a designated escape route in times of emergency, and, as the street flooding during a storm could prevent the use of this route, the Planning Board strongly recommends immediate corrective action, taken in concert with the Rhode Island Department of Transportation, must be a priority of the Hazard Mitigation Plan and this must be reflected in the Plan.

**Action 4** – The noted public education series must include a section, developed after reviewing common insurance industry requirements detailing steps residents may take to minimize their personal liability for wind damage during hurricanes and/or other high wind situations.

**Action 5** – The Town must develop a tree ordinance that will guide the Town and National Grid in tree-trimming to minimize damage to above-ground utility wires and poles during significant storm events.

**Action 13 & 18** – The Plan must reflect the current Fire Department/emergency communications infrastructure relative to a satellite/cell communications center and towers.

Based on the inclusion of the revisions noted above, the Planning Board voted unanimously to recommend the Warren Town Council accept the Warren Hazard Mitigation Plan.

## Appendix C: Zoning Regulations

### Sec. 32-98. - Purpose.

The provisions herein governing the development and use of inland and tidal land subject to flood hazards shall be minimum provisions, shall take precedence over any other conflicting laws, ordinances or codes, but shall consider any flood plain management programs in neighboring areas, and are established for the following purposes:

- A. To avoid or lessen the various hazards to persons resulting from inland and tidal flooding and the damage to property resulting from accumulation or runoff of storm and flood waters;
- B. To protect floodways from encroachment;
- C. To maintain the capability of the flood plain to retain flood waters;
- D. To provide for the development of the flood plain with uses not subject to severe damage by flooding and which are compatible with other uses permitted in the various zones;
- E. To permit only uses, improvements and practices in the flood plain that are not hazardous during flood periods;
- F. To establish areas in which the elevation and flood proofing of structures and facilities must be regulated;
- G. To avoid the creation of new flood problems; and
- H. To complement and enhance an overall conservation program.

### Sec. 32-99. - Definitions.

For the purpose of this article, and this ordinance generally, the following terms shall have these meanings:

- A. *Special flood hazard areas*: Those areas of special flood hazard identified as "A" zones (AI-30) and "V" and V1-30 zones by the Federal Emergency Management Agency (FEMA) through a report entitled "The Flood Insurance Study for the Town of Warren, R.I." dated December 1982 with accompanying Flood Insurance Rates Maps (FIRM), effective date June 1, 1983, and any subsequent revisions thereto, and in addition, any regulatory floodway lines or maps designated through the process described in [section 32-100 \(B2\)](#) herein, are adopted by reference and declared to be part of this ordinance without the need to revise this ordinance.
- B. *Base flood elevation*: The one hundred-year flood elevation or level as designated on a FIRM or a FHBM.
- C. *Flood fringe land*: The continuous land adjacent to and higher than special flood hazard areas, the elevation of which is no greater than one (1) foot above the adjacent base flood elevation, and for the purposes of the flood provisions within this zoning ordinance, shall be subject only to provisions dealing with storage of bulk materials and anchoring of customary yard features in flood fringe lands.
- D. *Development*: Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavating or drilling operations.
- E. *Regulatory floodway*: The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation of that flood more than one (1) foot at any point.
- F. *Substantial improvements*: As defined in Rhode Island State Building Code Rules and Regulations for Construction in Flood Hazard Areas, dated July 1, 1977, and any amendments thereto.
- G. *Nonconforming structure*: For the purpose of this article, a nonconforming structure shall mean:
  - 1. A residential structure with the lowest habitable floor (including basement) below the one hundred-year base flood elevation; or

2. A nonresidential structure which has not been flood proofed to that level.

H. *Recreational vehicle*: A vehicle, which is:

1. Built on a single chassis;
2. Four hundred (400) square feet when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel or seasonal use.

**Sec. 32-100. - Development standards.**

All lands determined to be within special flood hazard areas and flood fringe lands shall be subject to the procedures and requirements established in this section. Additionally, development within two hundred (200) feet of any water course shown on a FIRM or FHBM shall also be governed. However, nothing contained herein shall prohibit the application of these requirements to lands which can be demonstrated by competent engineering survey to lie within any flood fringe lands; conversely, any lands which can be demonstrated by competent engineering survey to lie beyond the flood fringe lands shall not be subject to these requirements:

- A. Nonconforming structures located with all special flood hazard areas shall not be enlarged or expanded.
- B. No proposed construction or other development shall proceed prior to the issuance of a development permit from the building inspector. Such proposals shall be reviewed to assure that:
  1. All such proposals are consistent with the need to minimize flood damage within the flood-prone area;
  2. All public utilities and facilities such as sewer, gas, electrical and water systems are located and constructed to minimize or eliminate flood damage; and
  3. Adequate drainage is provided to reduce exposure to flood hazards.
- C. All proposed new developments shall include base flood elevation data within such proposals.
- D. No water course may be altered or relocated without prior notification to the building inspector; the R. I. Statewide Planning Program; affected adjacent communities; and the Federal Emergency Management Agency (FEMA).
- E. To insure that the flood carrying capacity within an altered or relocated water course is maintained, the following provisions shall be taken:
  1. Until a regulatory floodway is designated, no new construction, substantial improvement or other development (including fill) shall be permitted unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one (1) foot at any point within this community.
  2. When a regulatory floodway is designated, based on flood data from any sources, including the developer:
    - a. The regulatory floodway shall be selected and adopted on the principal that the area chosen for the regulatory floodway must be designed to carry the waters of the base flood without increasing the water surface elevation of that flood more than one (1) foot at any point;
    - b. Encroachments shall be prohibited including fill, new construction, substantial improvements and other development within the adopted regulatory floodway that would result in any increase in flood levels within the community during the occurrences of the base flood discharge; and
    - c. The placement of any mobile homes shall be prohibited within the adopted regulatory floodway except in an existing mobile home park or mobile home subdivision.

- d. Recreational vehicles placed on sites within zones A1-30, AH and AE shall either be on the site for fewer than one hundred eighty (180) consecutive days, be fully licensed and ready for highway use, or meet all standards of Section 60.3 (b)(1) of the NFIP Regulations and the elevations and anchoring requirements for "manufactured homes" in paragraph (c)(6) of Section 60.3.
3. All buildings shall be set back from a floodway at least the average of the setbacks existing on similar improvements on plots within two hundred (200) feet, or at least thirty (30) feet if there are no such improvements on plots within two hundred (200) feet. Accessory structures may, by special use permit, extend to the floodways; authorized public and semi-public bodies may be permitted to erect structures within a floodway only when the most extenuating circumstances warrant the issuance of a special use permit.
  4. No principal building shall be located within the floodway set back lines established in accordance with subsection E.3 above. Principal buildings shall be located landward of mean high tide.

**Sec. 32-101. - Standards for coastal velocity zones.**

Within all special flood hazard areas designated as velocity zones and identified as zone VI-30 on the effective FIRRM, the following requirements shall apply:

1. New construction shall be located landward of the reach of mean high tide;
2. The alteration of sand dunes shall not be permitted; and
3. The placement of any mobile homes shall be prohibited within zones V1-30 except within an existing mobile park.

**Sec. 32-102. - Other requirements.**

- A. *Filling.* The filling of special flood hazard areas if otherwise authorized, may be permitted provided that the fill material:
  1. Obtained elsewhere is offset by the removal of an equivalent volume in the immediate vicinity of the area filled;
  2. Is obtained from the immediate vicinity of the area filled; and
  3. Shall not encroach upon, impede the flow of, or diminish the cross-sectional area of the floodway.
- B. *Preliminary site work.* No preliminary site work may begin on any land below the base flood elevation until the building inspector has certified that the proposed use shall:
  1. Not cause the base flood elevation to rise more than one (1) foot when combined with all other similar existing and proposed uses;
  2. Not make more than twenty five (25) percent of the parcel below the base flood elevation along inland fresh water streams impervious to water, including but not limited to, roofs and paved areas;
  3. Not create hazards to water supplies or sewer systems; and
  4. Meet all other code provisions relating to flood hazards.
- C. *Storage of bulk materials.* No material shall be stored in special flood hazard areas as well as in flood fringe lands which are likely to cause an obstruction, create a fire hazard, or pollute the water during flood periods. Such material includes but is not limited to substantial quantities of lumber and other floatable materials, volatile materials, acids, poisons, liquids other than water, and soluble materials.
- D. *Customary yard features, anchoring.* Reasonable provisions shall be made for anchoring down those items customarily found out of doors, which are capable of floating in water for a prolonged period of time and ordinarily not anchored. Such items shall include but not be limited to: movable structures and sheds; animal shelters, cages and feeders; fuel containers, tanks, cylinders and cans;

picnic benches; railroad ties; flower boxes and planters; barrels and refuse containers; storage boxes; pallets; tires and tubes; freezers and refrigerators; lobster and eel traps; boat hulls; docking and float materials; signs; and stored vehicles.

- E. *Other regulations to apply.* Except for the provisions of this article as they apply to the flood plain and the flood fringe land, the regulations for the zoning district in which such land is located shall continue in full force and effect.

**Sec. 32-103. - Variances in special flood hazard areas.**

The zoning board of review may vary the provisions of this article in the case of a proven hardship. Variances granted under this section shall be noted on the property deed and shall contain the following information:

- A. Flood hazard zone designation and date of flood map; and
- B. Number in feet which the lowest habitable floor will be located in relation to the one hundred-year flood level.