

STORM PREPAREDNESS AND HAZARD MITIGATION



Prepared by the

BRISTOL HARBORMASTERS OFFICE, BRISTOL RHODE ISLAND

TOWN OF BRISTOL

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**FEMA FLOOD MAPS ARE AVAILABLE AT THE BRISTOL TOWN HALL AND
HARBORMASTER'S OFFICE.**



Maps effective as of March 5, 1996

One of the critical harbor and shoreline users is the individual boater. Because they are often the primary occupants of the harbor area, they should be given special attention. As part of this element of the Harbor Management Plan and related ordinance, each boater should complete and submit to the Harbormaster a preparedness plan. There is a growing amount of technical and educational material being developed for individual boat owners about to prepare for storm events.

The following is a summarization of key points contained in the current literature.

Boat owners will be faced with the decision of what to do with their boats in advance of a storm event.

If the storm is less than tropical strength and the decision is made so that boats can remain tied to the docks, all lines should be doubled and chaffing protection provided where dock lines pass through fairleads and chocks over the vessel's side. Dock lines should be attached to the high end of the pilings, if on a floating dock, rather than to cleats or other fastenings on the dock.

If mooring tackle has been recently inspected and serviced, leaving the boat on the mooring may be the best option. One of the drawbacks to staying on a mooring, as with staying at a dock, is the threat of storm surge. Check with expected storm-surge forecasts to determine if the scope of the mooring will provide sufficient holding power at maximum tidal flow. All individuals using their moorings during a storm must notify the Harbormasters Office that they will be weathering the storm on the mooring. Those same individuals will also be required to notify the Harbormaster again when finally leaving the vessel. The Town of Bristol requires mooring inspections to be done every other year. Inspection reports are due on September 1st.

Regardless of whether the boat remains at a dock or mooring, there are some basic steps that need to be taken before the storm strikes. The first step is to minimize the amount of surface area the wind can work against. The more surface area the wind has to push on, the greater the strain on all components of your boat and securing devices. Remove sails entirely and stow them below deck, especially roller furling jibs. Secure or remove everything in the cabin that is not fastened down, with particular attention to the galley area and chemicals stored in lockers. Secure all ports and hatches, and remove and cap all funnels. Tightly secure the tiller or wheel with strong lines from either side of the cockpit, do not leave coils of line on deck, and take out all slack from running lines on the deck or mast. In order to minimize damage caused by impact of loose boats in a crowded harbor, it is important to place fenders on both sides of the boat. Once all precautions have been taken, the boat owner should leave the boat and seek shelter.

Can the municipality tow a disabled vessel?

According to the U.S. Coast Guard, assistance cases fall into two broad categories: distress and non-distress. Distress is defined as imminent danger requiring immediate response and assistance (U.S. Coast Guard COMDTINST 16101.2B, p. 2). If the situation is life threatening, the historic law of the sea obliges the Harbormaster, or any boater, to render assistance.

In cases of distress the Coast Guard should be notified immediately of the situation and of the intent of the Harbormaster. The Harbormaster plays a key role in the hierarchy of emergency response, as he/she is often the first to arrive on-scene. If the Coast Guard deems it necessary, it may direct other private/public resources, in addition to its own, to respond. If the Coast Guard arrives and finds a stable situation with the first responders capable of assisting, it may withdraw its response equipment.

However, if the Coast Guard finds the situation unstable, and if the first responders are unable to provide the necessary assistance, it will intervene immediately. When a Harbormaster responds to a distress situation, and provides some form of emergency aid, he/she is afforded protection from liability through Title 46, Section 2303 of the US Code which states:

Any person...who gratuitously and in good faith renders assistance at the scene of a vessel collision, accident, or other casualty without objection of any person assisted, shall not be held liable for any civil damages as a result of the rendering of assistance for any act or omission in providing or arranging salvage, tonnage, medical treatment, or other assistance where the assisting person acts as an ordinary, reasonable prudent man would have acted under the same or similar circumstances.

The key phrase here is “act as an ordinary, reasonable prudent...” which dictates that the Harbormaster must act in good faith and in a reasonable, seamanlike manner. Any variance from this standard may increase liability.

This potential liability, and the fact that alternatives exist, should dissuade the Harbormaster from towing. Other resources that may be able to offer assistance can be contacted. The Coast Guard will issue a Marine Assistance Request Broadcast (MARB) which solicits voluntary response of anyone who can assist the disabled mariner (including Coast Guard Auxiliary Units and good Samaritans) (U.S. Coast Guard COMDTINST 16101.2B, p. 2). A Harbormaster may also contact a friend or family member of the boater for assistance.

Another viable form of assistance may be sought through professional towing companies that work in the area. The Harbormaster can provide the disabled boater with information on how to contact these companies, and their current rates. In most instances these firms will contact the boater directly in response to the MARB. Once the boater decides upon a

service and a verbal agreement is made, the Harbormaster cannot interfere with that contract. Safe Sea - 401-294-2360 Sea Tow - 800-338-7327

It is clear that "good faith" actions of Harbormasters are protected, to some degree, by the "Federal Boating Safety Act of 1971," but to what extent remains uncertain. Unfortunately, there is no statutory framework from which to formulate guidelines. Issues such as this are decided by customary law, which means each case is reviewed individually by a judge and jury. Because there are so few cases involving Harbormaster liability, judges and jurors lack prior judicial decisions which set precedents. It is therefore difficult to predict the extent to which Harbormasters will be protected by the state. In order to limit the potential of being found liable, Harbormasters must realize the extent of their liability and must make rational, professional decisions which can be supported as reasonable actions before a court of law.

What is the municipalities mooring liability?

The major concern focuses on the Harbormaster's involvement with setting mooring standards, placing ground tackle and conducting inspections. In order for a Harbormaster to avoid or minimize the amount of liability he/she must exercise reasonable care. This includes:

- (1) setting mooring standards which are appropriate for the area. The Harbormaster must be able to justify the standards which have been set. The maximum load the mooring gear is expected to withstand must be identified and documented (Taylor, 1992);
- (2) providing mooring occupants with information on the stress points of moorings and offering advice on dealing with extreme weather conditions; and
- (3) ensuring that all mooring gear under town control is routinely inspected, and that proper records of these inspections are kept. The question of liability continually arises if the town conducts the inspections itself. Liability results not because the town inspects the mooring, but because it does so improperly or fails to correct a situation in which the mooring does not meet specifications. The Town of Bristol places the burden of mooring inspection on the boaters. Moorings are to be inspected every other year based on odd or even years. (*see Town Ordinances, Chapter 8, Sec. 8-57. Mooring Inspections.*)
- (4) identifying and correcting situations which may cause damage to a moored vessel. If a Harbormaster learns that two boats are hitting one another while on town managed moorings, the situation needs to be rectified quickly. The Harbormaster must first stop the vessels from hitting. This can be achieved by removing one of the vessels from its mooring. The Harbormaster then decides where to move the vessel. Bristol mooring tackle specifications are indicated in the Bristol Town Codes (Chapter 8) Information on mooring specifications and storm preparedness can be obtained through the Harbormasters Office, Town Clerks Office and through any Mooring Inspector or online in the near future.

If and when the Town of Bristol implements a commercial mooring field with town owned moorings, owning and then renting the mooring gear, it will greatly increase the

liability of the Town. The town will need to provide security patrols, annual mooring inspections and provide additional monitoring during storms and weather events.

HAZARD MITIGATION PLAN

SUMMARY FOR BRISTOL HARBOR AND SURROUNDING WATERS

- Land Use: The land use along the shores of Bristol are a mix of high density residential and minimal water dependent commercial development, such as marinas, boat yards, commercial seafood businesses and restaurants, etc. The majority of residential and commercial properties will be significantly affected in the event of severe weather combined with high tides and a substantial storm surge.
- Moorings: The town regulates mooring fields in Bristol Harbor, Narragansett Bay, Mt. Hope Bay and the Kickemuit River.

100. Authority:

The primary authority for carrying out the responsibilities detailed in this plan is vested with the Harbormaster, who will work in cooperation with the harbor commission. However to successfully complete the activities outlined in this plan, the Harbormaster is required to work with other town departments including the: planning board, police and fire departments, town planners, building code official, department of public works and the emergency management officer. The Harbormaster shall be a member of the Emergency Management Committee.

200. Goals of the Harbor Hazard Mitigation Plan

To prevent the loss of life and property by:

- properly preparing for storm events
- having a completed and enforceable response and recovery plan
- working in cooperation with harbor and shorelines users to ensure that a coordinated approach is applied to hazard mitigation
- integrating harbor hazard mitigation activities with other, ongoing, local hazard mitigation programs.
- identifying and completing long term actions to redirect, interact with or avoid the hazard.

300. Risk Assessment

310. General Harbor Characteristics:

The bottom consistency is mixed. Bristol Harbor, from the northern most point of the harbor is soft bottom. The northeast corner tends to be harder. The average depth in the Bristol Harbor is approximately 17 feet.

The Kickemuit River is mainly soft sand and mud. The average depth in the Kickemuit River is approximately 6 feet.

The surrounding harbor uses can be divided into three general uses:

1. Open space – approximately 20% of Bristol 's waterfront is open space.

2. Residential - this use totals approximately 80% of the land use. Generally, the single family dwellings are built upon lots that range from 10,000 square feet to 1 acre.
3. Commercial - commercial waterfront uses such as marinas, vessel repair businesses and restaurants are located in the harbor. There are four marinas located in the Bristol. With another proposed and one to be expanded. Fuel is not available to boaters.

320. High Hazard Areas:

Historically, flooding has always been significant during storm events for Bristol.

330. Risk Assessment Table

Threat	Marine interest	Effect	Result -1	Result -2
Flood/surge	Boaters on moorings and docks	decreased scope	Dragging	
		Lower	threaten shoreline homes	
		Middle	threaten shoreline business	
		Upper	Severe threat to auto bridge	
	Marina facility	flooded facility	floating debris	
		spills of hazardous material	threaten surrounding	
		Docks topping piles	freed docks and boats	
	Private residences		flooded property	
		Docks topping piles	freed docks and boats	
Wind	Boaters on moorings	windage	Dragging or pennant	
	Marina facility	windborne debris	structural damage	

400. Strategies for Preparedness, Response and Recovery

410. Town of Bristol - The Harbormaster will coordinate all harbor activities related to preparation, response and recovery. This will be done in coordination with the emergency management officer and other department heads.
- 410.1 Preparedness - The Town of Bristol , through its Harbormaster, will activate the following preparedness, response and recovery plan 72 hours prior to a severe storm event or as necessary for unpredictable events.

THE SAFFIR-SIMPSON HURRICANE SCALE

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region. Note that all winds are using the U.S. 1-minute average.

Category One Hurricane:

Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage. Hurricanes [Allison](#) of 1995 and [Danny](#) of 1997 were Category One hurricanes at peak intensity.

Category Two Hurricane:

Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings. [Hurricane Bonnie](#) of 1998 was a Category Two hurricane when it hit the North Carolina coast, while [Hurricane Georges](#) of 1998 was a Category Two Hurricane when it hit the Florida Keys and the Mississippi Gulf Coast.

Category Three Hurricane:

Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required. Hurricanes [Roxanne](#) of 1995 and [Fran](#) of 1996 were Category Three hurricanes at landfall on the Yucatan Peninsula of Mexico and in North Carolina, respectively.

Category Four Hurricane:

Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof

structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km). [Hurricane Luis](#) of 1995 was a Category Four hurricane while moving over the Leeward Islands. Hurricanes [Felix](#) and [Opal](#) of 1995 also reached Category Four status at peak intensity.

Category Five Hurricane:

Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required. [Hurricane Mitch](#) of 1998 was a Category Five hurricane at peak intensity over the western Caribbean. [Hurricane Gilbert](#) of 1988 was a Category Five hurricane at peak intensity and is one of the strongest Atlantic tropical cyclones of record.

LEVEL 3 - 72 HOURS

1. If hurricane, begin tracking and monitoring hourly weather reports
2. Contact any services under contract for after event to assess their readiness
3. Manage harbor traffic as it increases during marina/boater preparation activities
4. Ensure fuel tanks are full and reserve batteries are charged
5. Inventory and update first aid equipment and other onboard emergency tools
6. Contact local marinas and boat moving companies for statuses to relay to mariners.
7. Maintain radio watch
8. Alert local port community, encouraging boat owners to seek safe refuge, remove boats from water, or take action to minimize damaging effects
9. Alert local marinas, marine interests, holders of mooring permits, and occupants of special anchorage areas to impending emergency.
10. Keep Marine Safety Office (MSO) Providence apprised of hazardous conditions in harbor
11. Monitor Kickemuit River with vessels taking refuge.

12. Document waterfront using photographs or video
13. Start tracking time and resource allocations for possible state and federal reimbursement.
14. Post notice to have all vessels removed from Town docks.

LEVEL 2 - 48 HOURS

1. Continue to perform activities in level 3
2. Contact mooring permit holders who are not complying with preparedness plan.
3. Assist marinas/waterfront business with special requests
4. Continue to manage harbor traffic as it increases
5. Finalize emergency work schedule with assistant Harbormasters
6. Confirm arrangements to have Harbormaster vessel hauled and stored
7. Preparation of town properties with department of public works, that includes:
 - removing all town equipment from flood plain
 - securing all items such as trash bins, benches, etc..
 - complete necessary precautions for Harbormaster office
8. Establish liaison with police, fire and public works departments
9. Alert maritime community to unsafe conditions in the harbor as needed
10. Curtail regular business activities
11. Begin regular patrols of the harbor to ensure necessary individual precautions are begin taken
12. Advise MSO Providence as to the status of emergency preparedness in progress
13. Alert local harbor community to any impending closure of anchorages or waterways.
14. Encourage local marinas to suspend fueling operations and to secure fueling piers sufficiently to minimize pollution threat.
15. Inventory of individuals who plan on staying on their moored vessels during the storm event.

LEVEL 1 - 24 HOURS

1. Final patrol of the harbor
 - inventory number of vessels and precautions taken by harbor and shoreline users
 - clear public pier of vessels and equipment
2. Log information on transient boats (see section 425.2)
3. Fuel Harbormaster vessel
4. Haul and store Harbor Patrol vessel with assistance of the Department of Public Works
5. Complete shoreline survey and final harbor check from shore
6. Alert harbor community and MSO to any unsafe conditions in harbor
7. Continue to perform pertinent level 2 activities.
7. All vessels must be removed from town docks at this time. Transient moorings **will not** be allowed to be used during any storm event.
8. Raise hurricane signal twelve hours prior to storm's arrival

410.2 Response - The Town of Bristol's policy is that no emergency watercraft will be dispatched for emergency response during a storm event. All requests for assistance will be forwarded to the nearest Coast Guard Station. This policy will remain in effect unless revoked by the Fire Chief or Town Administrator. The Harbormaster will remain on-call to address any harbor related issues. This will also allow the Harbormaster vessel to begin operation immediately at the conclusion of storm. The Harbormaster shall monitor police, fire and marine frequencies throughout the event.

410.3 Recovery - Immediately after the event has terminated, the town has three recovery priorities.

Priority 1:

Reestablish the Harbormaster's Office as an operational unit in order to facilitate the second and third priority

Priority 2:

Take the necessary immediate action to minimize additional risk to life and property.

Priority 3:

Reopen the harbor for recovery activity.

To achieve these priorities, the following sequential actions will be taken:

IMMEDIATE 24 HOURS

1. Assess readiness of the Harbormaster's Office, correct deficiencies
 - reestablish radio communications.
2. Complete rapid appraisal of damage
3. Provide damage assessment information to town officials and to MSO Providence.
4. Initiate pre-established contracts services companies (towing, salvage) if required
5. Institute security watches as necessary
6. Alert maritime community to unsafe conditions in the harbor
7. Provide damage assessment information to town officials and to MSO Providence
8. Track time and resource allocation of Harbormaster's Office for possible state and federal reimbursement.

MID-TERM 1 TO 14 DAYS

1. Complete comprehensive inventory of damage using photographs and video if possible

2. Notify appropriate parties regarding damage (i.e., mooring holders)
3. Provide list of unidentified boats to MSO Providence and DEM Enforcement
4. Contact local harbor and shoreline users to assess their situation
5. Provide MSO Providence with a daily harbor status.
6. Begin to remove large pieces of floating debris from the harbor
7. Assist town and state agencies with damage assessments and emergency permitting process.

LONG-TERM 14 TO 90 DAYS

1. Analyze effects of storm on the harbor. Complete summary report within 30 days of storm event for Town Council and Town Administrator.
2. Review mitigation list and selection actions that could be implemented during the recovery phase
3. Conduct an evaluation meeting for harbor and shoreline users to identify problems not properly addressed by this plan
4. Complete a survey of boat damage
5. Update hazard mitigation plan and identify new mitigation opportunities
7. Assist emergency situations as appropriate
8. Track time and resource allocations for possible state and federal reimbursement.

420. Harbor and Shoreline Users

421. Marina facilities - As part of the Town of Bristol 's harbor hazard mitigation plan, all marina facilities as defined by CRMC, will submit a hazard mitigation plan to the Harbormaster within 90 days of this document being approved. The facility's plan will be updated annually and any changes will be reported to the Harbormaster by January 1 of each year.

Facility plans will include:

- Primary contact person primary and secondary phone numbers.
- VHF channel that is monitored
- List of facility staff who are expected to assist in preparation, response and recovery phases.
- List of hazardous material stored on site (i.e. waste oil, fuel tanks, solvents). This information can be extracted from the facilities Environmental Operations and Maintenance Plan.

- Inventory of potential recovery equipment (heavy equipment, generators), including outside contracts for special equipment for recovery phases
- Debris disposal plan
- Special assistance requested from town
- List of preparation, response and recovery activities and timing

422. Boaters - Boats moored on possible town managed moorings will be required to submit a preparedness plan. This will be accomplished by adding a preparedness plan questionnaire as part of the annual mooring renewal forms. For a mooring permit to be approved, the questionnaire must be completed and returned with the mooring application. Boaters will be expected to comply, to the best of their ability, with the plan they have prepared. The boat owner should advise the Harbormaster of any significant changes to the plan made during the boating season.

Mooring standards have been developed to maximize safety during normal weather conditions. To safeguard a moored boat during a severe storm event, additional precautions will be necessary. This actions will include:

- Improving the connection between the vessel and the mooring chain by using chafing gear and extra lines.
- Reducing windage
- Whenever possible, increase scope.

Boaters should also consider:

- Bypassing the mooring swivel and attach the chain directly to the pennant.
- Hauling their boat and storing it upland
- Leave anchor lights and auto bilge pumps on.
- Ensure that self-bailing cockpit drains are clear of debris
- Add an emergency catenary weight at the vessel end of the chain to absorb shock

Boat owners are encouraged **NOT** to stay aboard during major storm events. The town's standard procedure is not to respond to on-the-water requests for assistance during a major storm event. Such requests for assistance will be forward to the nearest U.S. Coast Guard Station.

423. Waterfront business (excluding marinas) - All waterfront business are expected to take the necessary precautions to protect their property.

424. Shorefront home owners- All shorefront homeowners are expected to take the necessary precautions to protect their property.

425. Special Hazards

1. Town Docks- all vessels shall be cleared of the town commercial dock 72 hours prior to expected storm event.
2. Transients- vessels not usually moored in the harbor, but seeking safe refuge will be allowed to moor in the specified anchorage areas. Transit yachts will not be allowed to tie to a mooring if not authorized by both the mooring owner and

the Harbormaster. Transient vessels seeking shelter will provide the Harbormaster with:

- name of owner and captain if different.
- home port
- registration/documentation numbers
- length, draft and type (power/sail)
- number of persons aboard
- address and phone were owner can be contacted

3. Passenger vessels and ferries- As deemed necessary by the Harbormaster, local passenger vessels and ferries will submit individual plans to the Harbormasters. These plans will include information about planned preparedness, response and recovery actions.

500. Inventory of longer term mitigation projects

1. Maintaining the existing seawalls. Although it does not provide complete protection, there is a measure of safety gained by having the seawall properly maintained.
2. Methods to increase scope within the harbor without losing surface area maximization should be explored. Actions may included a targeted approach to removing vessels from moorings and increasing the scope with storm pennants for those that remain. In the existing mooring configuration, increasing mooring scope is difficult. Therefore, the town should explore alternative methods for gridding the mooring field that will allow space maximization and increased scope.
3. Implement an annual education and training program conducted by the Harbormaster for the public. This program should focus on storm preparedness for the boater. Other workshops should be conducted with the help of the building inspector and planning board to discuss shoreline construction standards and storm proofing homes and business.
4. The Harbormaster should compile a list educational material that can be shared with harbor and shorefront users.
5. Maintain an accurate lists of principle marine interests including marinas, waterfront business, neighboring Harbormasters, Coast Guard, Towing and Salvage Companies, Environmental Response teams, Key vessel operators (charter boats and ferries) fishing cooperatives, etc.
6. Starting at the beginning of each hurricane season (June 1) the Harbormaster shall:
 - review local harbor hazard mitigation plan and update as necessary
 - distribute and post revised plan
 - inspect all storage sheds, outbuildings, and portable office trailers for proper tie-down.
 - inspect all emergency power sources and lighting systems to ensure they are operational

- prepare and distribute a storm checklist for to boaters
7. Conduct a Disaster Mitigation workshop for Business and Industry in cooperation with RI Emergency Management Agency. Propose activities that can be implemented to mitigate damage. Suggested actions for local coastal business may include:
 1. Place more essential equipment and functions on higher levels of the structure, above the anticipated flood level;
 2. Construct berms around the facility;
 3. Install or have dewatering pumps;
 4. Provide emergency generators and potable water storage;
 5. Install blowout plugs in floor slabs whose elevation is below anticipated flood elevation.
 6. Install master shutoff valve controls for sewer, gas, and water above anticipated flood elevation;
 7. Reinforce walls to carry hydrostatic and hydrodynamic loads;
 8. Install flood proof electrical systems and utility cores in areas subject to flooding; and
 9. Install safety glass in windows.
 8. Assess the feasibility of developing a volunteer corp who can assist the Harbormaster secure vessels during the phase or maintain security patrols after an event.

600. Coordination

Memorandum of Agreement shall be entered into with the Department of Public Works to establish the working relationship between it and the Harbormaster for completing the following activities: preparing pubic waterfront property and hauling and storing the Harbormaster vessel

The harbor commission shall work with the planning board and planning department to establish redevelopment policies for shoreline areas. These policies will be consistent with CRMC and DEM regulations.

In order to discourage redevelopment of critical shoreline areas and to reduce vulnerability of life and property to coastal hazards the town should:

1. encourage and participate in the maintenance, restoration and enhancement of beaches and dunes.
2. limit development and redevelopment in hazardous coastal areas to protect lives and property from coastal storms and hazards. Post storm development shall avoid extensive rebuilding and intensification of land uses in critical areas and encourage reductions in the amount and intensity of development in order to reduce exposure of lives and property to coastal hazards.

3. attempt to minimize public expenditures and reduce risk to public infrastructure and facilities through redevelopment
4. encourage relocation of structures landward of critical areas. This can be done by influencing State policies, expenditures, and programs to reduce the amount and intensity of development and redevelopment
5. require shorefront areas replacement of non-conforming uses and eliminate unsafe conditions and inappropriate uses as opportunities arise
6. identify shorefront areas that shall be subject to post-storm regulations and acquisition in order to reduce loss of life and damage to property.

In order to further coordinate local policies contained in the comprehensive land use plan for resource protection, coastal management, the town should consider the following policies.

1. The town should work with appropriate state agencies to ensure that Post-storm shoreline management options for shoreline areas shall be consistent, to the extent possible, with use, density and other land uses policies and standards contained in the comprehensive land use plan.
2. Create local priorities for acquiring coastal properties to promote hazard mitigation, public recreation, and resource management objectives contained in the comprehensive plan.
3. Post-storm redevelopment options should consider impacts to evacuation routes, as determined by emergency management officials.
4. maintain and or adopt minimum parcel size and configuration requirements on the subdivision of critical shoreline features.
5. discourage platting of shoreline properties and encourage replatting to accommodate post-storm relocation of structures landward.

PAST STORM INFORMATION

THE GREAT NEW ENGLAND HURRICANE of 1938 (CAT 3 - September 21)

The Great New England Hurricane of 1938 was one of the most destructive and powerful storms ever to strike southern New England. This system developed in the far eastern Atlantic, near the Cape Verde Islands on September 4. It made a twelve day journey across the Atlantic and up the eastern seaboard before crashing ashore on September 21 at Suffolk County, Long Island, then into Milford, Connecticut. The eye of the hurricane was observed in New Haven, Connecticut, 10 miles east of Milford. The center made landfall at the time of astronomical high tide, moving north at 60 mph. Unlike most storms, the hurricane did not weaken on its way toward southern New England, due to its rapid forward speed and its track. This kept the center of the storm over the warm waters of the Gulf Stream.

Sustained hurricane force winds occurred throughout most of southern New England. The strongest winds ever recorded in the region occurred at the Blue Hill Observatory with sustained winds of 121 mph and a peak gust of 186~mph. Sustained winds of 91 mph with a gust to 121 mph was reported on Block Island. Providence, Rhode Island recorded sustained winds of 100 mph with a gust to 125 mph. Extensive damage occurred to roofs, trees and crops. Widespread power outages occurred, which in some areas lasted several weeks. In Connecticut, downed power lines resulted in catastrophic fires to sections of New London and Mystic. The lowest pressure at the time of landfall occurred on the south side of Long Island, at Bellport, where a reading of 27.94 inches was recorded. Other low pressures included 28.00 inches in Middletown, Connecticut and 28.04 inches in Hartford, Connecticut.

The hurricane produced storm tides of 14 to 18 feet across most of the Connecticut coast, with 18 to 25 foot tides from New London east to Cape Cod. The destructive power of the storm surge was felt throughout the coastal community. Narragansett Bay took the worst hit, where a storm surge of 12 to 15 feet destroyed most coastal homes, marinas and yacht clubs. Downtown Providence, Rhode Island was submerged under a storm tide of nearly 20 feet. Sections of Falmouth and New Bedford, Massachusetts were submerged under as much as 8 feet of water. All three locations had very rapid tides increased within 1.5 hours of the highest water mark.

Rainfall from this hurricane resulted in severe river flooding across sections of Massachusetts and Connecticut. Three to six inches fell across much of western Massachusetts and all but extreme eastern Connecticut. Considerably less rain occurred to the east across Rhode Island and the remainder of Massachusetts. The rainfall from the hurricane added to the amounts that had occurred with a frontal system several days before the hurricane struck. The combined effects from the frontal system and the hurricane produced rainfall of 10 to 17 inches across most of the Connecticut River Valley. This resulted in some of the worst flooding ever recorded in this area. Roadways were washed away along with sections of the New York, New Haven, and Hartford Railroad lines. The Connecticut River, in Hartford reached a level of 35.4 feet, which was 19.4 feet above flood stage. Further upstream, in the vicinity of Springfield,

Massachusetts, the river rose to 6 to 10 feet above flood stage, causing significant damage. A total of 8900 homes, cottages and buildings were destroyed, and over 15000 were damaged by the hurricane. The marine community was devastated. Over 2,600 boats were destroyed, and over 3,300 damaged. Entire fleets were lost in marines and yacht clubs along Narragansett Bay. The hurricane was responsible for 564 deaths and at least 1700 injuries in southern New England. Damage to the fishing fleets in southern New England was catastrophic. A total of 2,605 vessels were destroyed, with 3,369 damaged.

HURRICANE

CAROL

(CAT 3 - August 31, 1954)

On the morning of August 31, Hurricane Carol, the most destructive hurricane to strike southern New England since the Great New England Hurricane of 1938, came crashing ashore near Old Saybrook, Connecticut, leaving 65 people dead in her wake. Carol had developed in the Bahamas several days earlier, making only slow progress northward . Carol began her rapid acceleration during the evening of August 30, while passing just east of Cape Hatteras, North Carolina. Carol made landfall on eastern Long Island and southeastern Connecticut about 12 hours later, moving at over 35 mph.

Sustained winds of 80 to 100 mph roared through the eastern half of Connecticut, all of Rhode Island, and most of eastern Massachusetts. Scores of trees and miles of power lines were blown down. Strong winds also devastated crops in the region. Nearly 40 percent of apple, corn, peach, and tomato crops were ruined from eastern Connecticut to Cape Cod. Several homes along the Rhode Island shore had roofs blown completely off due to winds which gusted to over 125 mph. The strongest wind ever recorded on Block Island, Rhode Island occurred during Carol when winds gusted to 135 mph. The National Weather Service in Warwick, Rhode Island recorded sustained winds of 90 mph, with a peak gust of 105 mph. Lowest recorded pressure was at Suffolk County Airport on the south shore of Long Island with a reading of 28.36. Block Island reported 28.51 while Quonset Airport in North Kingstown, Rhode Island reported 28.72.

Hurricane Carol arrived shortly after high tide, causing widespread tidal flooding. Storm surge levels ranged from 5 to 8 feet across the west shore of Connecticut, and from 10 to 15 feet from the New London area eastward. Storm tide profiles show, as in 1938, how dramatically the tides increased just before landfall across Narragansett Bay, the Somerset, Massachusetts area and in New Bedford, Massachusetts harbor. Narragansett Bay and New Bedford harbor received the largest surge values of over 14 feet in the upper reaches of both water ways. On Narragansett Bay, just north of the South Street Station site, the surge was recorded at 14.4 feet, surpassing that of the 1938 hurricane. However, since Hurricane Carol arrived after high tide, the resulting storm tide was lower.

Coastal communities from central Connecticut eastward were devastated. Entire coastal communities were nearly wiped out in New London, Groton, and Mystic, Connecticut, as well as from Westerly to Narragansett, Rhode Island. Once again, as in the 1938 hurricane, downtown Providence, Rhode Island was flooded under 12 feet of water.

Rainfall amounts ranged from 2 to 5 inches across most of the area. The heaviest amounts, up to 6 inches, occurred in the New London, Connecticut area in the vicinity of landfall, and across extreme north central Massachusetts.

Hurricane Carol destroyed nearly 4000 homes, along with 3500 automobiles and over 3000 boats. All of Rhode Island, much of eastern Connecticut and much of eastern Massachusetts lost electrical power. In addition, as much as ninety-five percent of all phone power was interrupted in these locations.

This information was taken from *SOUTHERN NEW ENGLAND TROPICAL STORMS AND HURRICANES, A Ninety-eight Year Summary 1909-1997*, by David R. Vallee and Michael R. Dion, National Weather Service, Taunton, MA.