MULTI-HAZARD MITIGATION STRATEGY PLAN

Strategies for Reducing Risks from Natural Hazards in South Kingstown, Rhode Island

April 2006 (approved)
November 2010 (updated)

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January 23, 2006
April 10, 2006 (as amended)
December 12, 2011 (as updated)

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Section 1.0 – INTRODUCTION

1.1 Hazard Mitigation

Hazard mitigation are actions taken to reduce and/or eliminate risk to both people and property from the effects of natural hazards. As the direct and indirect costs of disasters continue to rise, it is apparent that preparing for the onset and impacts of these events must be done in order to reduce the levels of damage and destruction. This strategy is commonly referred to as mitigation. The purpose of multi-hazard mitigation has two primary purposes: 1) to protect people, Man-made and natural structures from harm and destruction; and 2) to minimize the costs of disaster response and recovery. *Hazard mitigation planning is the process that analyzes a community's risk for natural hazards, coordinates available resources, and implements actions to reduce risks.* (Tennessee Emergency Management Agency)

1.2 Hazard Mitigation Planning Benefits

Proper mitigation actions assist in the protection and safety of the population at-risk. For, example, proper tree maintenance can prevent fallen limbs from causing downed power and telephone lines. Hazard mitigation reduces the impact of disasters, and in the long run, money invested in mitigation actions can significantly reduce the cost of post–disaster cleanup. A local hazard mitigation strategy helps to minimize the social and economic effects of any one of a number of natural hazards.

Adoption of a mitigation strategy also allows South Kingstown to become eligible for federal grants. The grants include the pre-disaster Flood Mitigation Assistance Program and the post-disaster Hazard Mitigation Grant Program; details on grant programs are found in Appendix B. These grants are administered through the Rhode Island Emergency Management Agency (RIEMA), and funding is distributed with priority given to towns that have completed local hazard mitigation strategies.

1.3 Planning Process

Planning to mitigate natural hazards is by its very purpose *strategic* planning which involves a process that delivers a set of defined initiatives to achieve a desired set of goals and objectives. This planning process comprises a definition of goals, an assessment of the resources available for meeting these goals/objectives and a definition of specific actions required. The process normally incorporates a ranking system that identifies the highest priority initiatives.

It is critical that the goals and objectives of the Local Multi-Hazard Mitigation Strategy plan not be isolated but rather be directly coordinated with the other related municipal policy documents and guidelines, as well as, within the local regulatory framework. In addition the Plan goals and objectives need to be addressed during development of the Town's five year Capital Improvement Program.

Strategic multi-hazard mitigation planning is directly addressed in the town's Comprehensive Community Plan (March 11, 1996) under the Services and Facilities Element (Section M – Emergency Management). The Plan update (March 29, 2004) also covers the topic. In both documents the Local Multi-Hazard Mitigation Strategy Plan (approved April 2006) is incorporated into the Comprehensive Community Plan by reference. The Town is presently completing its latest five year update to the Plan which will expand upon natural hazard mitigation planning as recommended by the Rhode Island Office of Statewide Planning. Again,

the updated Local Multi-Hazard Mitigation Strategy Plan will be included as part and parcel of the town's primary comprehensive long range planning document.

The Town recently updated its Harbor Management Plan (HMP) as required by the Rhode Island Coastal Resources Management Council (RICRMC) Program. The HMP update included development of a Storm Preparedness Plan per RICRMC revised guidelines. The HMP has been reviewed by RICRMC staff and has received the required Water Quality Certification from the Rhode Island Department of Environment Management. It is anticipated that the HMP will be adopted by the South Kingstown Town Council in late February 2011. The Plan will then be submitted to RICRMC for their review and action.

Implementation strategies identified as necessary to achieve specific goals to address and further mitigation from the adverse impacts caused by natural events are reviewed annually during development of the municipal five year Capital Improvement Program (CIP). The CIP represents the main local financial mechanism for funding of needed projects identified in the Local Multi-Hazard Mitigation Strategy Plan.

Participation in development of and/or revisions to the Local Multi-Hazard Mitigation Strategy Plan by the public along with local and regional governments is an integral part of the planning process. This process also involves direct involvement of the Local Hazard Mitigation Committee (LHMC) in Plan update development.

Multiple public forums have provided opportunity for citizen participation within the Plan update development process. These include public informational meetings, Town Council meetings and meetings of various municipal boards including the Conservation Commission, Economic Development Committee and Waterfront Advisory Commission.

On-going discussions with representatives of the other eight (8) Washington County towns (North Kingstown, Exeter, Narragansett, Charlestown, Hopkinton, Richmond, Westerly and New Shoreham) have taken place individually, as well as, at periodic meetings of the Washington County Regional Planning Council. This coordination is in keeping with the mission statement of the Council to: identify effective solutions to regional challenges; encourage their implementation; and, realize the shared vision of the nine Washington County municipalities. In addition, drafts of the Plan update have been provided to the adjacent communities of Narragansett, Charlestown, North Kingstown and Exeter for their review and comment.

In addition, certain aspects of the Plan update (i.e. particular implementation strategies) have been discussed at meetings with applicable State regulatory agencies. Also, Town staff has met with Congressional delegation members and their staff to discuss implementation of certain mitigation measures specifically identified in the Plan.

1.4 Community Description

South Kingstown is the second largest municipality in Rhode Island with a total land area (including land and water) of approximately 62.3 square miles. The population, according to the 2000 census, was 27,921. The Town has a population density of 448 persons/sq. mi., significantly less dense than the statewide average of 1,003. A major portion of the population resides in the central core comprised of the villages of Kingston, Wakefield and Peace Dale. The western half of Town is predominantly rural with considerably less development.

South Kingstown is a coastal community with approximately 5.5 miles of coastline along the Atlantic Ocean. The southern border of the town includes a barrier beach/coastal pond system which provides natural protection to areas located landward of the ponds. The eastern border of the town, shared with Narragansett, is defined by the Pettaquamscutt River in the north and Point Judith Pond in the south. The Town is bordered on the west by Charlestown and Richmond and on the north by Exeter and North Kingstown.

South Kingstown's coastal setting provides a major tourist attraction, and the town has grown to depend on the tourist trade as a major source of income (see Sec. 2.3.1). Unfortunately, this causes the town to be all the more vulnerable to natural hazards. During the summer, which also corresponds with the hurricane season, vacationers flock to the shore, significantly increasing the population at risk. Since the last major hurricane, Hurricane Carol in 1954, many summer cottages have been converted to permanent residences, many of which are located in flood zones. Because it has been fifty years since Hurricane Carol, most residents have never experienced a major storm event.

Plan Update

A hazard mitigation plan should be considered a living document that must grow and adapt, keeping pace with a community's growth and change. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from the Federal Emergency Management Agency (FEMA) in order to remain eligible for assistance. The evaluation, revision and update process is also a means to create an increased institutional awareness and involvement in hazard mitigation as part of daily activities.

South Kingstown's coastal location serves as a major tourist attraction, enhancing the social, scenic and economic experience of the community. The very nature of a coastal location also encompasses greater vulnerabilities to natural hazards, particularly during the summer months when the influx of vacationers significantly increases the population at risk. The South Shore area of South Kingstown has experienced significant erosion as a result of coastal storms, hurricanes and winter storms. Approximately 50 percent of the beach width has eroded since 1939 and development has surpassed the carrying capacity of the land (see Figure 1.1 Shoreline Erosion Comparison). The coastal erosion is such that the integrity of Matunuck Beach Road may be compromised with the next major storm. Matunuck Beach Road is the only access/ egress/ evacuation route for some 514 seasonal and year round dwellings south of Atlantic Avenue. The impacts of erosion have encroached upon the reaches of development south of Matunuck Beach Road. Several commercial businesses, residential dwellings, and recreational areas have begun to submit to the forces of nature.

In conjunction with the impacts of coastal erosion and as a result of storm damage, a small coastal pond east of the Town Beach and south of Matunuck Beach Road is filling in, reducing the holding capacity of the pond. Compounding the issues associated with this small coastal pond is the culvert that transports storm water from Mary Carpenter's seasonal beach complex. Approximately 200 seasonal dwelling units are threatened by the reduced holding capacity of this pond, often resulting in sand wash over onto Matunuck Beach Road (leaving Matunuck Beach Road impassable) and storm water back flow into the complex.

In January 2007 the Town of South Kingstown submitted a Pre-Disaster Mitigation grant application to the Rhode Island Emergency Management Agency (RIEMA) for funds to update the local Multi-Hazard Mitigation Strategy Plan. FEMA obligated funds to support the grant

application and the Town of South Kingstown contracted with Pare Corporation to facilitate the update. The overall purpose of this update was to advance action items identified in the existing local hazard mitigation plan and to specifically study coastal hazards in the Matunuck area (Vulnerable Areas 2A, 2B and 2C from the 2006 Plan). The study area delineated for the Matunuck area is identified in Figure 1.2.

A focus of this update was a preliminary Engineering/Planning Study (Vulnerable Area #2C / Mitigation Action #1) of the southerly segment of Matunuck Beach Road and the immediate environs (see enclosed map). An evaluation of existing conditions was followed by an assessment/selection of potential mitigation measures to ensure the integrity of Matunuck Beach Road and protect properties within the study area.

Figure 1.1 Shoreline Erosion Comparison

1939 Black and White Orthophoto, RIGIS #725.

2006 Color Orthophoto, Town of South Kingstown.

Figure 1.2 Matunuck Beach Road Study Area

1.5 Historical Damage

It's coastal location makes the Town of South Kingstown especially vulnerable to hurricanes. The earliest recorded hurricane hit New England in 1635. Since this time, several major hurricanes have struck the Rhode Island shores (See Table 1.1), most notable being the hurricanes of 1938 and 1954.

Table 1.1 Significant Rhode Island Storm Events 1635 – 2009

Date	Event	Loss of Life	Monetary Loss	Description
Aug. 15, 1635	hurricane			first recorded R.I. hurricane event – strikes at high tide
Nov. 12, 1641	nor'easter			verified by great tides in Mass.
Oct. 24, 1761	nor'easter			bridges collapsed – noted building damage in Newport
Oct. 19-20, 1770	nor'easter	unknown		recorded loss of lives and property
Aug. 10-11, 1778	hurricane			severe storm prevents naval battle between French & British; both fleets heavily damaged
Aug. 15, 1787	tornadoes			tornadoes break out in R.I., Conn., Mass. & N.H.
Sept. 23, 1815	hurricane	6 known		"Great Gale of 1815" causes severe damage to harbors & ships
March 30, 1823	winter blizzard			nor'easter hits R.I. on Easter Sunday; 24" of snow recorded
Aug. 30, 1838	tornado	none		extensive minor damage
Sept. 8, 1869	hurricane			"Great September Gale" inundates coastal areas; record waves @ Narragansett Pier
Oct. 23, 1878	hurricane			Heavy rain; wharves & docks flooded
March 11-14, 1888	winter blizzard			businesses and mail delivery stopped for 3 days, trains stranded
Aug. 26, 1924	hurricane			cottages and businesses flooded along coast ; heavy boat damage
Sept. 21, 1938	hurricane	262	$100 mil.	Highest winds ever recorded in R.I. Tidal wave inundates coastline.
Sept. 14, 1944	hurricane	none	$2 mil.	Significant property damage
Aug. 31, 1954	hurricane (Carol)	19	$200 mil.	3800 homes destroyed; 2,000 vessels sunk
Aug. 17-20, 1955	hurricane (Diane)	none	$170 mil.	Heavy rains cause Blackstone R. to crest 15' above banks
Sept. 12, 1960	hurricane (Donna)		$5 mil.	8.31" rainfall in Kingston; 170,000 electric customers lose power
Feb. 6, 1978	winter blizzard	21	$110 mil. (products & wages)	worst snow storm in R.I. recorded history; 30,000 vehicles stranded on roads; coastal damage
Sept. 27, 1985	hurricane (Gloria)	2		174,000 homes without power
August 1991	hurricane (Bob)		$817,000 (debris clean-up)	Extensive tree damage results in loss of electricity and impassable roads for up to five days
December 23, 1994	winter storm	None	$5 mil.	74 mph winds cause power loss to 40,000 customers
January 17, 1996	winter blizzard	None		17" snow in S.K.; post storm warming causes notable flooding
February 17, 2003	winter blizzard	None		19" snow accumulation in South Kingstown

A review of FEMA records from 1953 to the present identifies four hurricane events in Rhode Island that warranted Federal Disaster Declaration status. Those declarations occurred on 9/2/54 (hurricane Carol), 8/20/55 (hurricane Diane), 10/15/85 (hurricane Gloria) and 8/26/91 (hurricane Bob). In addition, federal disaster and/or emergency declarations were issued in Rhode Island for three snow storm events during the same recording period. Those winter storm related declarations occurred on 2/16/78, 1/24/96 and 3/27/03 with the most noteworthy being the Blizzard of 1978.

The 1938 Hurricane hit during a summer flood tide on September 21, 1938, and served as catalyst to the already severe conditions (Gordon 1980). South Kingstown recorded a storm surge high of 11.5 feet (Vallee 1999). The heavy surf of the storm hit the fishing village of Jerusalem, causing great damage to the fishing fleet as well as nearby homes. At the western boundary of the village, dunes as high as 25 feet were flattened (Gordon 1980). In nearby Matunuck the wind and water undermined many of the cottages (Minsinger 1988). Upper Point Judith Pond also sustained serious damages. Boats from Hanson's yard were found 200 yards inland of the pond, scattered among the roofs of toppled houses (Providence Journal 1938). On the South Kingstown side of Narrow River flooding reached the bottom of Torry Hill. In Green Hill every structure was destroyed (Gordon 1980). Unfortunately, many people invested more money into these high-risk areas as they started rebuilding along the shore as fast as they could clear the wreckage.

Just sixteen years later, in 1954, Hurricane Carol swept up the Atlantic Coast causing similar damage. Though the storm was almost equal in severity, improvements in the warning and evacuation systems greatly reduced loss of life. The storm surge was slightly higher than that of '38, reaching a maximum of 11.6 feet (Vallee 1999). In both Green Hill and Jerusalem structures were washed off the barrier beaches. The Potter Pond Bridge on Succotash Road washed out early in the storm leaving more than 100 people stranded on the East Matunuck side (Providence Journal 1954). Many of the homes in Jerusalem were located on filled marshes, only two to three feet above mean high water. These low-lying houses sustained extensive damage, in fact some were completely demolished by the storm (Gordon 1980). Only pilings were left of the docks in Snug Harbor. Abandoned by their owners, boats were ripped from their slips and moorings and strewn across the small fishing village.

In nearby East Matunuck a large portion of the cottage community was destroyed, sand from the beach was washed onto the road to Jerusalem, making it impassable, waves swept debris all the way to the shore of the Potter's Pond channel. Further west, the coastline at Matunuck Point was cut back 80 feet, and the roof was ripped right off the popular Theater-by-the-Sea (Providence Journal 1954). Continuing down the coast, in Green Hill, houses were swept from their perches on the barrier beaches and into the ocean.

1938 Hurricane:
Green Hill Beach

ABOVE: Before

BELOW: After

Hurricane Carol:
Inland & Coastal Damage

Poles were toppled, massive trees uprooted at Kingston village traffic light.

At East Matunuck the Potter Pond bridge on Succotash Road was washed out.

In 1991, Hurricane Bob caused some minor but troublesome damage to the town. The tidal surge was thought to have damaged the Potter Pond Bridge causing it to close for several days. Fourteen boats were grounded in South Kingstown waters, with area marinas reporting $100,000 worth of damage. Nine roads were closed for a period of several days following the storm because of debris and fallen trees (Minsinger 1992).

Besides hurricanes, the town experiences nor'easters, usually on an annual basis. South Kingstown has never had any serious problems with wildfires, snow, ice or earthquakes. Since 2004, there have been two significant storm events in South Kingstown. The January 22/23, 2005 winter storm (FEMA 3203-EM) brought high winds, coastal flooding and heavy snow (22 inches) to South Kingstown. The April 15/16, 2007 coastal storm brought significant coastal flooding through several high tide cycles, closing several roadways. The extent of some of the impacts from the April 2007 coastal storm is shown below.

1.6 Goals and Objectives

This mitigation strategy is adopted by the Town of South Kingstown to protect its citizens, visitors, businesses and property. The town also wishes to preserve its cultural, historical, structural (i.e. public infrastructure), and natural resources. These objectives will be accomplished through the use of hazard mitigation actions in the following categories:

- Planning/Regulation
- Structural/Maintenance
- Public Education and Incentives
- Post Disaster Opportunities
- Emergency Services & Facilities

Section 2.0 – HAZARDS: IDENTIFICATION AND RISK ASSESSMENT

2.1 Hazard Identification

Identifying potential hazards is the first step in any effort to reduce community vulnerability. The subsequent identification of the risk and vulnerability for a community are the primary factors in determining how best to allocate finite resources to address what mitigation might take place. The FEMA document titled Multi-Hazard Mitigation Planning Guidance, dated March 2004 was used in developing this strategy plan as a basic template to identify the various natural hazard types. The hazard identification and analysis involves all of those hazards that potentially threaten South Kingstown. For the purposes of the Multi-Hazard Mitigation Strategy Plan the following hazards are addressed.

- ✓ Coastal Erosion
- ✓ Coastal Storm
- ✓ Dam Failure
- ✓ Drought
- ✓ Earthquake
- ✓ Flood
- ✓ Hurricane
- ✓ Severe Winter Storm
- ✓ Wildfire

It was determined that the following natural hazard types present a risk to South Kingstown of very low probability, given the Town's location, climate, geography and/or geology: avalanche; expansive soils; extreme heat; hailstorm; land subsidence; landslide; tornado; tsunami; or, volcano.

By collecting and analyzing information for each potential hazard that may affect South Kingstown, several determinations have been made:

(1) which hazards merit special attention
(2) what actions might be taken to reduce the impact(s) of those hazards
(3) what resources are likely to be needed

2.2 Risk

In assessing the hazards to a community, both the risk and the vulnerability must be taken into account. A hazard is the actual event that poses the danger to the community, (e.g. the hurricane, tornado, earthquake, etc. that threatens the town). In the South Kingstown Hazard Mitigation Strategy, "risk" refers to the predicted impact that a hazard would have on people, services, specific facilities and structures in the community. For example, in the event of episodic or chronic coastal erosion, a road within the coastal zone might be at risk. The predicted impact of coastal erosion on that road could be, say, collapse leading to lack of access from one area of town to another. The term "vulnerability" refers to the characteristics of the society or environment affected by the event that resulted in the costs from damages (Heinz Center Report, 1999, p. 105). The vulnerability of an area refers to its susceptibility to a hazard. The areas of the town affected by extreme natural events are identified by hazard risk assessment. In determining the risk and vulnerability of the town, the likelihood, frequency and magnitude of damage from identified hazards is assessed.

In developing a mitigation strategy, South Kingstown defined the risks that the town could face and followed up with an assessment of the vulnerability of the at-risk areas, and the implications of experiencing natural disasters (e.g., loss of life, damage to the natural environment, property damage, economic losses). Risk assessment is the determination of the likelihood of adverse impacts associated with specific natural hazards, and vulnerability assessment is concerned with the qualitative or quantitative examination of the exposure of some societal component (i.e. economy, environment).

In March of 1996, officials from South Kingstown and four other South County communities attended a workshop with the Rhode Island Emergency Management Agency (RIEMA), URI/CRC and Rhode Island Sea Grant, and other state and federal agency representatives to learn about and begin their hazard mitigation planning process. At the workshop, using risk assessment and mitigation strategy matrices to facilitate the process, officials initiated the identification of risks and the formation of local hazard mitigation recommendations.

For the purposes of this 2010 update, those hazards with a high future occurrence identified as having the most probability of impacting the Matunuck Beach Road study area include:

- Coastal Erosion
- Coastal Storms
- Floods
- Winter Storms
- Hurricanes

In addition, this update expands upon the information provided in the 2006 Plan relative to risks associated with climate change and sea level rise (see Section 2.2.2 Flood).

2.2.1 Wind (hurricanes, coastal storms)

South Kingstown's proximity to the coast makes it particularly susceptible to natural disaster. A FEMA report noted that "Existing flood protection along the coast of South Kingstown is limited to the natural protection offered by the barrier beaches. . ." (FEMA 1986). Since 1635, South Kingstown has been impacted by 71 hurricanes of varying severity, an average of one hurricane every 5 or 6 years. There are detailed accounts of both the 1938 and 1954 hurricanes, and the devastation that they caused. Not only is the risk of hurricanes high, the vulnerability to hurricanes is also considerable. The purpose of hazard mitigation is to reduce the vulnerability of an area to a potential risk, by using pre-disaster strategies to safeguard the town.

A hurricane is defined as a large circulating windstorm covering hundreds of miles that forms over warm ocean water. To be officially classified as a hurricane, the wind speeds must exceed seventy-four (74) miles per hour. During a hurricane, high winds, marine over wash, storm surge and small-scale wind bursts may damage or destroy homes, businesses, public buildings and infrastructure. The wind bursts, termed "microbursts", are localized winds and may reach speeds in excess of 200 miles per hour (Vallee, 2000).

In the northern hemisphere winds circulate in a counter clockwise direction. A great dome of water as much as fifty miles in diameter (called the "storm surge") is pushed ahead of the storm by its winds. This can result in tides twenty (20) feet higher than usual. This storm surge is responsible for many hurricane related deaths.

The winds that accompany hurricanes have the potential to cause serious damage. Downed power lines leave residents without electricity, and can impede business for days. Fallen trees can damage buildings and block roadways. Unsecured building components including gutters, screened enclosures, roof coverings, shingles, car ports, porch coverings, overhangs, siding, decking, windows, walls, gables can be blown off structures and carried by the wind to cause damage in other places. Wind driven rain often causes water damage in roof and wall envelopes.

Debris generated by high winds can include wood, brick, concrete, metal, and may also contain hazardous materials such as gas, oil, and cleaning solvents from damaged households and businesses. Though dealing with debris appears to be solely a post disaster problem, it also can be mitigated through pre-disaster actions including the designation of local debris disposal sites (Salt Ponds SAMP 1999). There are no landfills located near South Kingstown. The local transfer station cannot handle the excess debris left by a storm, and no offshore site for disposal has been approved. Sites recommended in the Salt Ponds SAMP include Marina Park, Brousseau Field, the RIDEM field north of Succotash Road, and the Green Hill Beach Association parking lot.

Town staff has attended RIEMA sponsored workshops regarding development of a Local Debris Management Plan. Preliminary information has been submitted to RIEMA that provides a Town profile. Staff will continue to work with RIEMA in development of the debris management plan.

The Rhode Island State Building Code requires that all structures be built to withstand a minimum of 90-mph winds. In 1997, the Schedule D Exposure Rating was implemented, requiring that all structures within 1500 feet of a water body meet tougher design criteria for high wind areas. However, these new standards only affect recently built or renovated structures.

Since the 2006 plan (revised) was drafted, the Town has experienced 8 significant high-wind and 3 coastal storm events. Of these combined eleven events, 1 was a secondary impact of Hurricane Isabel (9/18/03 high wind/heavy surf), and another, the secondary impact of Tropical Storm Noel (11/3/07 high wind/downed power lines).

2.2.2 Flood (riverine flooding, coastal storm surge, and sea level rise)

Flooding is the accumulation of water within a water body and the overflow of excess water onto adjacent floodplain lands (FEMA, Multi Hazard Identification and Risk Assessment, 1997). The floodplain is the land adjoining the river/stream channel, ocean or other watercourse or water body that is susceptible to flooding.

Flooding results from: large-scale weather systems generating prolonged rainfall; on-shore winds; locally intense thunderstorms; dam failures; or significant snow melt. Floods are capable of undermining buildings and bridges, eroding shorelines and stream banks, uprooting trees, washing out access roads, and causing loss of life and injuries. Also, flash floods (characterized by rapid onset and high velocity waters) carry large amounts of debris that further exacerbate conditions.

Under the National Flood Insurance Program (NFIP), FEMA is required to develop flood risk data for use in both insurance rating and floodplain management. FEMA develops this data through Flood Insurance Studies (FIS). Detailed analyses are used to generate flood risk data only for developed or developing areas of communities. For undeveloped areas FEMA uses approximate analyses to generate flood risk data.

The related Flood Insurance Study for South Kingstown (Community Number- 445407) was developed by FEMA as published January 3, 1986. Since that time FEMA has made revisions to pertinent elevation data along the South Shore in response to geographic changes (i.e. coastal erosion) and has drafted a Flood Insurance Study for all of Washington County, dated October 19, 2010.

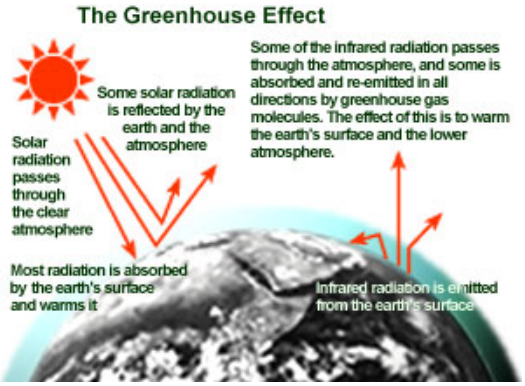
South Kingstown contains "A", "D", "X" and "V" flood zones. "A" zones comprise areas inundated by a 100-year flood, which have a one percent chance of occurring in any given year. V-zones are areas of 100-year coastal flood with velocity (wave action) where waves greater than 2.9 feet are expected during a 100-year flood or storm surge. "X" zones include some areas having a 0.2% annual chance flood or areas outside of the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined but possible are designated as "D" areas.

Flooding in South Kingstown can occur in either coastal or inland areas. There are four watersheds located at least partially within Town: the South Coastal, Narrow River, Saugatucket River and Pawcatuck River watersheds. All drainage within South Kingstown occurs within those watersheds. Within those major watersheds are seven (7) sub-basins: Green Hill Pond; Point Judith Pond; Pettaquamscutt (Narrow) River; Chickasheen River; Chipuxet River; Saugatucket River; and Pawcatuck River sub-basins.

Climate Change

The Environmental Protection Agency (EPA) indicates there is recent, strong evidence that most of the warming of the Earth's surface temperature over the past 50 years, is a direct result of human behavior.

Human activities have been contributing to natural background levels of greenhouse gases since the Industrial Revolution. The primary source of emissions is the burning of fossil fuels for energy. Although increases in the atmosphere's heat-trapping ability can be predicted, resulting impacts on climate are more uncertain. By 2100, Rhode Island could see a temperature increase by about 4 degrees F (with a range of 1-8 degrees F) in the winter and spring and by about 5 degrees F (with a range of 2-10 degrees F) in the summer and fall.



Increased temperatures and frequency of heat waves could also impact the number of heat-related illnesses and deaths in Rhode Island. The same high temperatures could also result in an increase in ground-level ozone (a major component of smog). Ground-level ozone facilitates respiratory illnesses such as asthma and respiratory inflammation, as well as reducing general lung functioning. The very same warming and climate increases could also expand the habitat and infectivity of disease-carrying insects, increasing the potential for malaria, Eastern Equine Encephalitis and Lyme Disease.

Sea Level Rise

The Intergovernmental Panel on Climate Change (IPCC) continues to better understand the science and implications of climate change and sea level rise. Rising sea levels, as a direct result of warmer temperatures and glacial ice melt, threaten low-lying coastal areas through coastal

flooding, coastal erosion, wetland inundation and saltwater intrusion. Standard management approaches to address these issues include:

- Coastal Armoring
- Rolling Easements
- Setbacks
- Re-nourishment
- Post-Storm Reconstruction Policies

The Coastal Resources Center (CRC), scientists from the University of Rhode Island and the Rhode Island Sea Grant have been working to assist the Rhode Island Coastal Resources Management Council (CRMC) on policy implications of climate change and sea level rise. Figure 2.1 shows the historic and projected shoreline within the study area as a direct result of climate change and sea level rise, beginning with 1939 up to 2100. CRMC's response to climate change and sea level rise includes the following new policy that was adopted March 2008 (*Section 145 CRMC Regulations*):

- *"The Council will integrate climate change and sea level rise scenarios into its operations to prepare Rhode Island for these new, evolving conditions and make our coastal areas more resilient."*

- *"The Council's sea level rise policies are based upon the CRMC's legislative mandate to preserve, protect, and where possible, restore the coastal resources of the state through comprehensive and coordinated long-range planning."*

- *"For planning and management purposes, it is the Council's policy to accommodate a base rate of expected 3 to 5 foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities and to insure proactive stewardship of coastal ecosystems under these changing conditions. In addition, this long-term sea level change base rate will be revisited by the Council periodically to address new scientific evidence."*

Figure 2.1 CRMC's Historic and Projected Shoreline

Inland Flooding

The most recent federal flood study found that "Flooding in South Kingstown is generally limited to the coastal lowlands along Block Island Sound, Point Judith Pond and the Pettaquamscutt River" (FEMA 2010). The study does note that there are no flood control structures affecting stream flow in the town. And of the two dams on the Saugatucket River, only the dam above Rt. 108 has any means of controlling flow over the main spillway.

It should be noted that there are a number of dams or impoundments that do regulate downstream flow from ponds in South Kingstown. In recent years a number of those structures have been rehabilitated (see Sec. 2.3.3).

Coastal Flooding / Erosion

South Kingstown's 5.5 miles of exposed shoreline make the town particularly susceptible to relative sea level rise. In Rhode Island the relative sea level rise is approximately 25 cm every 100 years (Salt Ponds SAMP 1999). Rising sea levels push beaches inland covering coastal marshes and further exposing development to coastal flooding. As waves break higher on bluffs and dunes the rate of coastal erosion increases. Rising seas will also likely increase sand over wash. Protective structures will lose their effectiveness as they are over topped by weaker and weaker storms. The nature of sea level rise prevents it from being accurately predicted, consequently "it is difficult to plan for a specific scenario, however it would be prudent to be aware of the impact of sea level rise. As the rate of sea-level rise estimates are refined, the responses needed can be more finely tuned" (Salt Pond SAMP 1999).

A storm surge can flood and erode coastal areas, salinize land and ground water, contaminate water supplies, cause agricultural loss, damage private and public facilities and infrastructure and result in injury or loss of life. The highest recorded storm surge level in South Kingstown, 11.6 feet above mean sea level, occurred during Hurricane Carol, just barely topping the previous record of 11.5 feet above mean sea level from the Hurricane of '38. Both hurricanes were considered category 3 storms, though the 1938 was the more severe of the two (David Vallee personal communication May 1999).

The geology of South Kingstown's coastline is a combination of headlands and barrier beaches. The barrier beaches lie parallel to the coast and in concert with the salt ponds mitigate wave impacts to adjacent backshore properties. These beaches are composed of sand and gravel deposited by waves and surges and enclose the salt ponds that lie behind them. The headlands are composed of glacial till or glacial river sand and gravel and are fronted by beaches (Salt Pond SAMP 1999).

There are six (6) areas along the coastal shore and Pettaquamscutt River designated under the Coastal Barrier Resources System (CBRS). The Coastal Barrier Resources Act and the Coastal Barrier Improvement Act of 1990 are federal laws enacted to minimize loss of human life, discourage development in high-risk areas, reduce wasteful federal expenditures and preserve the ecological integrity of those critical resource areas. The laws provide protection of resource areas by prohibiting federal expenditures or financial assistance, including flood insurance for residential or commercial development in those areas. The laws designate areas as either within the CBRS or Otherwise Protected Areas (OPA). For those areas specifically identified, flood insurance is not available for new construction or substantially improved structures on or after the earliest CBRS map date.

Table 2.1 Coastal Barrier Resources System in South Kingstown

Map Number	FIRM Date	CBRS/OPA Units	Earliest CBRS Map Date	General Description
4454070016E	6/16/92	RI-10	11/16/90	Pettaquamscutt Cove and contiguous lowlands
4454070018E	6/16/92	RI-10	11/16/90	Pettaquamscutt Cove and contiguous lowlands
4454070028F	9/30/95	RI-12, RI-12P	11/16/91	Potter Pond, East Matunuck Beach and Succotash Salt Marsh
4454070031F	6/16/92	DO3, DO3P	10/1/83	Northern portion of Trustom Pond including federal lands
4454070032G	9/30/95	DO3, DO3P, RI-12, RI-12P	10/1/83	Browning Beach, Card Pond, lowlands contiguous to Card Pond
4454070033G	9/30/95	D04, D03P	10/1/83	Green Hill Beach ,Green Hill Pond, Moonstone Beach, southern portion of Trustom Pond including federal lands

2.2.3 Wildfires

Risk of wildfires has the potential to be significant in the town because of the many heavily wooded areas within South Kingstown. The Town has 13,676 acres of vacant forested land, comprising 37.6% of the total town land area (RIGIS data, December 2004).

Wildfire risk to developed areas is less given the existing fire protection service and facilities. Fire protection is provided by two volunteer fire districts: the Kingston Fire District and the Union Fire District. The Kingston Fire District serves Kingston and the University of Rhode Island with one fire station and obtains its water from the Kingston Water District system. The Union Fire District serves the remainder of the Town with eight (8) fire stations and obtains water from the: South Shore municipal system; United Water system; Kingston Water system; and, University of Rhode Island water system.

Unfortunately, only 17.7% of the total land area in South Kingstown at present is serviced by one of the three available water systems (TSK GIS data, 2010). For fires that occur throughout the vast majority of town, firefighters must rely upon tanker trucks or available water from nearby ponds or streams. Needless to say, this creates a less than optimum scenario for effectively fighting fires in outlying areas of town.

The Town is a member of the Southern Rhode Island Fire League. This regional organization pools equipment and manpower resources in reciprocal support. Each participant has executed mutual aid agreements concerning that support (conversation with Jeff O'Hara, Board of Wardens, June 2000). For example, the town of Exeter has a tanker truck with a much greater capacity than the maximum 3,000-gallon truck available from West Kingston. This truck is used to assist South Kingstown in fire fighting activities where municipal water is unavailable or where unusual water quantities are required. In addition, both volunteer fire districts participate in the Southern New England Fire Emergency Assistance Plan. This group provides mutual aid on a regional basis.

2.2.4 Severe Winter Storms

Winter storms can have many of the same effects as hurricanes, bringing with them high winds, coastal erosion, and flooding. The principal hazard associated with snow is its accumulation on roofs causing failure to roof trusses and supports. According to state building regulations all structures must be designed to withstand a snow load of 30 lbs. per square foot, which minimizes structural damage resulting from winter storms. Accumulated snow and ice, along with accompanying high winds, can break power and utility lines, risking loss of heat, power, communications and water in both residential and commercial areas. Snowmelt can also cause flooding problems. Historically, the town has not had many major problems with snow and ice because of its milder maritime climate.

The most noteworthy recent exception was the Blizzard of 1978. Although South Kingstown received appreciably less total snowfall than northern areas of the state, the storm resulted in adverse impacts to residents. The 16" +/- of snowfall caused power outages and rendered many roadways impassable for a few days.

Since the 2006 plan, just under half of the significant weather events have been severe winter storms bringing heavy snow and high winds. Three storms alone caused more than $500,000 in damages across Washington County.

2.2.5 Earthquakes

An earthquake is the sudden release of strain energy in the Earth's crust, resulting in energy waves that radiate outward from the earthquake source. The point on the Earth's surface directly above the focus is called the earthquake epicenter. The severity of earthquake effects is dependent upon: magnitude of energy released; proximity to the epicenter; depth to the epicenter; duration; geologic characteristics; and, type of ground motion.

When earthquakes occur, much of the damage is a result of structures falling under the stress created by the ground movement. Another significant effect is damage to the public and private infrastructure (i.e. water service, communication lines, drainage system). Because earthquakes are highly localized it is difficult to assign regional boundaries that share the same relative degree of risk.

Earthquakes are not considered a high probability risk in this area. There have been a total of 15 earthquakes in South Kingstown since 1928, one registering a high of 4.6 on the Richter Scale (Narragansett Haz-Mit Plan). South Kingstown does enforce the state building code, adopted in 1977, which set standards for new construction and renovation. Structures must be built to withstand earthquakes registering up to 3.0 on the Richter Scale.

A new software package called HAZUS has recently been developed by FEMA. This program was designed to help assess the earthquake risk in local areas through the use of a large database. The database includes information on building materials, design levels, economic value, population, and bridges. Using the information available for the community, HAZUS models a severe earthquake in the area to help determine where the damage might occur. Currently the program uses generic information for northeast states, but Rhode Island is working on loading state specific information into the database.

2.2.6 Drought

The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. The National Climatic Data Center uses the Palmer Drought Severity Index (PDSI) to compute drought conditions. Research indicates Rhode Island has sustained eleven (11) drought periods during record keeping between January 1895 through July 2003 (NRCC, Cornell Univ. 2005). These computations indicate drought conditions present in the state for approximately 4.4% of the 1,303-month record period.

South Kingstown is in the Southern Drought Region for planning and strategy implementation purposes. State data indicates the following annual precipitation for South Kingstown: northwester corner (49" – 51"); northern sector (43" – 45"); central area (41"); and, coastal region (47" – 49").

South Kingstown is actively represented on the Rhode Island Water Resources Board. That Board drafted the Rhode Island Drought Emergency Management Plan, adopted in June 2002 as Element 724 of the State Guide Plan.

The Water Supply Management Plan serves as the primary planning tool for the sole municipal water supply. That document includes a detailed Drought Emergency Response Plan that the LHMC feels adequately provides a comprehensive strategy for addressing local drought conditions. The other two water suppliers (Kingston District and United Water District) have similar plans that coordinate with the municipal plan.

2.2.7 Dam Failure

There are a total of twenty seven (27) dams in South Kingstown including numerous smaller privately owned dams/impoundments. Most of the dams in South Kingstown were constructed decades ago. While a regular inspection program of municipally owned dams has been on-going since 1999, the lack of a regular dam inspection schedule at the State level has resulted in uncertainty regarding present privately owned dam conditions. Dam failure could pose a notable hazard and have significant environmental and social consequences depending upon location (see Section 2.3.3 for a discussion of Dams/Impoundments).

2.3 Vulnerability

Analyzing the vulnerabilities to natural hazards that can occur to the town is the next step in the process of developing a mitigation strategy. An assessment of the weak points in both developed areas (i.e. buildings, utilities, roads, and bridges), and in the natural environment (i.e. beach erosion, built upon flood plains) is the logical follow-up to the identification of the types and areas of risk. This analysis should include an estimation of the number of people exposed to the risk with special considerations for elderly populations and concentrated populations (i.e., children at school). The assessment should also include a report on shelter capabilities and the ability for businesses to recover quickly.

A vulnerability chart was developed based on the identification and profile of the natural hazards that have occurred throughout South Kingstown from 2004 - present. The following criteria adapted from the FEMA *State and Local Mitigation Planning How-to-Guide Series* were utilized for frequency and severity categorization:

Criteria for Frequency Categorization:

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

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

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

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

The criteria used for severity categorization, based on past hazard events includes:

Criteria for Severity Categorization (based on past hazard events):

Minor: Limited and scattered property damage; no damage to public infrastructure; contained geographic area; essential services not interrupted; no injuries or fatalities.

Serious: scattered major property damage; some minor infrastructure damage; wider geographic area; essential services are briefly interrupted; some injuries/fatalities.

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

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

The table below, *Table 2.2 Vulnerability Matrix 2010 Update* describes the expected frequency of occurrence, and the potential severity of the damage resulting from each individual hazard evaluated for this update. Coordination with the State Plan was also a consideration in the development of the updated Vulnerability Matrix.

Table 2.2 Vulnerability Matrix 2010 Update

Hazard	Future Occurrence	Potential Damage
Coastal Erosion	**High**	**Severe/Moderate**
Coastal Storm	**High**	**Severe/Moderate**
Dam Failure	Medium/Low	Moderate
Drought	Low	Low
Earthquake	Low	Severe
Flood	**High**	**Moderate**
Hurricane	**High**	**Severe/Moderate**
Winter Storm	**High**	**Moderate**
Wildfire	Medium/Low	Moderate/Low

2.3.1 Economic Vulnerability – Property Damage

The risk assessment matrix identifies high-risk areas in South Kingstown, and the applicable maps (1 & 2, Northern/Southern sections) show locations of these areas. Development in many of the at-risk areas has increased significantly in recent years causing an increase in the at-risk population. Areas that once contained summer cottages are now year round residential neighborhoods, causing some high risk areas to be vulnerable 365 days a year. At-risk areas that have experienced increased development include the property along Narrow River, the shore of Point Judith Pond, and much of the area along the southern coast. Most of this development predates recent regulations requiring flood proofing, leaving many vulnerable areas unprepared to face a storm of any significance.

The total value of whole insurance in force under the National Flood Insurance Program in South Kingstown was $118,131,700 at the time the original Plan was developed. The majority of the 795 NFIP insured structures in South Kingstown are single-family houses. Repetitive loss, defined as a property that has sustained at least two losses greater than $1,000 due to flood damage since 1978, had occurred at seven of these properties.

Table 2.3: Flood Insurance Data (2004)

Total Policies In Force	Whole Insurance In Force	Total Losses	Total Payments	Number of Repeat Losses	Repeat Loss Properties
795	$118,131,700	153	$ 829,918.07	17	7

(Source: FEMA, NFIP, Loss Statistics from Jan. 1, 1978 through December 2003; Policy Information by State as of December 2003).

Since the 2006 plan, at risk areas such as the Matunuck Beach Road area (half of the South Shore area) have experienced significant increases in development. Investments in coastal development directly correlate with the magnitude of damages associated with hazard-related remediation work. Approximately $1.3 million in building permit activity has been invested towards new and/or improved structures in the Matunuck Beach Road area.

Town-wide National Flood Insurance Program's total value of whole in-force insurance is $220,145,700. According to the State Floodplain Coordinator and since the 2006 plan, there have been thirty-five loss claims totaling $550,000 in payments, town-wide. Six repetitive loss properties have incurred approximately $220,000 in damages since the 2006 plan.

Table 2.4 Flood Insurance Data (Town-Wide/2010)

Total Policies in Force	Whole Insurance in Force	Total Losses	Total Payments	Number of Repeat Losses	Repeat Loss Properties
1,033	$220,145,700	219	$1,407,799.78	23	6

(Source: FEMA, NFIP, Loss Statistics from Jan. 1, 1978 through March 2010; Policy Information by State as of 3/31/2010).

Most of the NFIP insured properties are located in Green Hill, Matunuck, Snug Harbor, and in the area around Worden Pond. Several low-lying commercial and residential areas are threatened by

coastal storms, including Green Hill, Matunuck, East Matunuck, Snug Harbor, Upper Point Judith Pond, and Middlebridge.

A large portion of the southwestern corner of the town lies in the V-zone, placing Green Hill at high risk to coastal storms. Most of Green Hill is also classified by CRMC as land *Developed Beyond Carrying Capacity*. CRMC defines these areas as "developed at densities of one residential or commercial unit on parcels of less than 80,000 square feet, and frequently at higher densities of 10,000 square feet or 20,000 square feet". This dense residential development combined with the high risk of flooding makes Green Hill a particularly vulnerable area of South Kingstown.

As is apparent from historic damage, both the 1938 and 1954 hurricanes decimated the shoreline of South Kingstown. In the fifty years since the Hurricane Carol storm, development in these same areas has proceeded rapidly. Significant growth has also occurred along the shores of Narrow River, much of this development does not meet the standard regulations for construction in flood prone areas because it occurred prior to the adoption of these standards.

Tables 2.5 and 2.6 detail total land and building values within flood prone areas. All flood zone data presented is based on the FEMA flood insurance rate maps as revised through October 19, 2010. Zone A/V indicates those parcels that contain both 'A' and 'V' flood zone designations.

Table 2.5 Property Values Within Flood Zones: By Zone

Zone	Lots	Size (ac)	Land Value	Building Value	Total Value
A	1,893	13,118	$476,072,907	$321,661,200	$797,939,707
V	349	233	$89,172,730	$17,345,800	$106,518,530
A/V	169	906	$125,923,640	$29,265,200	$155,188,840
TOTAL	**2,411**	**14,256**	**$691,169,277**	**$368,272,200**	**$1,059,647,077**

(Sources: Town of South Kingstown GIS/Tax Assessor Database, December 2010; FEMA 2010)

Table 2.6 Property Values Within Flood Zones: By Land Use

Zone	Land Use	Lots	Size (ac)	Land Value	Building Value	Total Value
A	Residential	1,536	5,824	395,183,807	253,799,100	648,982,907
AV	Residential	141	234	81,453,460	23,415,200	104,868,660
V	Residential	185	100	78,878,330	16,788,900	95,667,230
	RESIDENTIAL	**1,862**	**6,158**	**555,515,597**	**294,003,200**	**849,518,797**
A	Commercial	65	377	22,934,100	32,624,500	55,558,600
AV	Commercial	9	85	6,037,500	5,294,200	11,331,700
V	Commercial	3	4	554,000	106,400	660,400
	COMMERCIAL	**77**	**466**	**29,525,600**	**38,025,100**	**67,550,700**
A	Other	292	6,917	57,955,000	35,237,600	93,398,200
AV	Other	19	587	38,432,680	555,800	38,988,480
V	Other	161	129	9,740,400	450,500	10,190,900
	OTHER	**472**	**7,633**	**106,128,080**	**36,243,900**	**142,577,580**
	TOTAL	**2,411**	**14,256**	**$691,169,277**	**$368,272,200**	**$1,059,647,077**

(Sources: Town of South Kingstown GIS/Tax Assessor Database, December 2010; FEMA 2010)

A review of Table 2.5 reveals that residential properties constitute the majority of at-risk building values. The specific at-risk building values by land use are as follows:

Land Use	**Bldg. Value**	**Pct.**
Residential	$ 294,003,200	79.8
Commercial	38,025,100	10.1
Other	36,243,900	10.1
TOTAL	**$ 368,272,200**	**100.0**

Real estate sales/transactions include an estimated $8.2 million in investments. Updated property values (SK Tax Assessor, February 2009) by land use category includes:

Seasonal/Beach (342 parcels total)

Land	*Building*	*Tangibles*
$13,507,800	$2,223,300	$9,015,700

One, Two, Multi-Family Year Round Residences (172 parcels total)

Land	*Building*
$91,505,000	$36,085,100

Commercial

Land	*Building*
$4,004,600	$3,486,600

Coordination with Town's GIS Department and Assessor's Office was used to determine calculations for update of real estate values for land, buildings and tangibles.

Economic impacts to local boat and marina owners is also significant in the event of a hurricane or other storm with excessive winds and tides. The South Kingstown Harbor Management Plan states that, "There are a total of thirteen marinas and two yacht clubs on the South Kingstown side of Point Judith Pond which offer slips for 987 boats." The Plan notes that there are no such facilities in Green Hill Pond or the Narrow River. Further research indicates a total of 421 private docks located within Green Hill Pond (129), Potter Pond (123), Point Judith Pond (114) and Narrow River (55). Also, there are 151 private moorings inventoried as of November 2004. All of the moorings are located within either Point Judith Pond or Potter Pond.

There are also sixty-six (66) residential docks located within the 'A' flood zone of inland freshwater bodies, those being: Barber's Pond (6); Hundred Acre Pond (15); Indian Lake (25); Saugatucket Pond (2); Tucker Pond (4); and, Worden Pond (14). Those structures are vulnerable in the event of local flooding and/or wind driven wave action.

Though earthquakes have not historically caused much damage to the town, there are some at-risk areas. Older masonry buildings are of the most concern because they are the most vulnerable to earthquakes. Specific buildings that are at risk from earthquakes include the town hall, the high school, Hazard School building, Peace Dale Mill, Peace Dale Congregational Church, URI

Kingston campus buildings, Peace Dale library, Neighborhood Guild and the Peace Dale Post Office Building.

As previously stated, at risk areas have experienced significant increases in development, dominated primarily by tear downs. Residential building permit activity of approximately $1.3 million has been invested in the Matunuck Beach Road area alone.

Again, investments in coastal development directly correlate with the magnitude of damage associated with hazard related remediation work. Until investors realize the time limited potential of these hazard areas, tear downs and redevelopment cycles are more than likely to continue into the future.

South County Hospital is identified as the one critical facility located within an "at risk" area. The regional medical facility is located in a U.S. Army Corps of Engineers Evacuation Area A, which is susceptible even to weak hurricanes.

The South County Hospital complex (A.P. 64-1, Lots 122 & 122-1) has assessed values of $42,520,000 (buildings) and $5,897,500 (land) for a total value of $49,707,900 (per Tax Assessor Records, December 31, 2009). And while no definitive figures are available for total equipment replacement costs it is estimated that a conservative value would be in the neighborhood of $6 million.

2.3.1 Economic Vulnerability – Impact of Business Interruption

Notwithstanding the obvious costs of commercial property damage (see Table 2.6), the impacts of potential business interruption from a natural disaster cannot be under estimated. Business closures result in a reduction of revenues to proprietors and a loss of wages to employees. In addition, State and local tax revenues can be significantly reduced.

Travel & tourism in South Kingstown is a major contributor to the local economy in terms of revenue and employment. Figures show that South County travel & tourism sales for 1997 were $21.6 million. In addition, lodging revenue taxes in South County for the same year produced $20.29 million. This was a 35% increase from just two years prior.

In 2000 the travel & tourism industry accounted for 38,931 jobs in the State (Tyrrell 2001). In 2007, average annual tourism wages had reached $31,100 (RIEDC 2008). By 2008, tourism was the forth largest industry in Rhode Island, based upon jobs. Total tourism expenditures in the State reached $6.8 billion in 2008.

In addition to the costs of commercial property damage, the impacts from potential business interruption following a disaster include reduction in revenues to proprietors, lost wages to employees, reduction in state/ local tax revenues, and significant impacts to the travel and tourism industry.

2.3.2 Social Vulnerability

The vulnerability of the built environment in South Kingstown to hazards, combined with trends in population growth and the value of insured property suggests that there is the potential for significant problems. The South Kingstown Multi-Hazard Mitigation Plan identifies the risk and vulnerability potential of pertinent components of the community. Those key components being:

public safety and welfare; development and the built environment; social institutions; and, natural ecosystems.

A critical step in assessing risk and vulnerability of South Kingstown to natural hazards is to identify the links between the potential destructive impacts to the built and natural environments and that relationship to the social structure. Such major negative impacts to the social structure include: closure of institutions; loss of vital services; and, disruption to the movement and availability of goods and services.

The vulnerability of a community obviously includes the potential for direct damage to residential, commercial and industrial property, as well as, schools, government and critical facilities. However, it also includes the potential for disruption of communication and transportation following disasters. Any disruption to the infrastructure, such as a loss of electric power or break in gas lines, can interrupt businesses and cause stress to affected families. This is especially the case where residents are forced to evacuate their homes and become subject to shortages of basic supplies.

The social assets/ potential losses continue to be key components of the community and include the closure of institutions, loss of vital services (communication and transportation systems), and disruption in the movement of goods and services, and emotional strain from financial and physical losses.

Another component of the social vulnerability includes the long-standing 'sense of place' or cultural traditions associated with the Matunuck area as a traditional New England summer colony. The Town Beach and Deep Hole Fishing Area provide both active and passive recreational opportunities and serve as regional destinations. The few remaining commercial establishments not only provide a place for residents, visitors and college students to eat and drink, but offer musical venues throughout the year, and are synonymous with Matunuck's 'sense of place'.

Evacuation

The population of South Kingstown has been steadily growing in the second half of this century. The addition of vacationers and summer residents increases the population and the vulnerability of the town during the hurricane season. As one source notes, "As the population has exploded along America's coasts, so have the fears of officials charged with evacuating people when hurricanes or major storms threaten." (Millemann 1989) Areas that need to be evacuated prior to a major hurricane include Green Hill, Matunuck, East Matunuck, Snug Harbor, the shore of Point Judith Pond, and along Narrow River. The East Matunuck and Jerusalem areas are both particularly vulnerable because the Potter Pond Bridge provides the only means of access/egress for those residents. In 1954, Hurricane Carol caused a complete collapse of the bridge, marooning residents on the vulnerable East Matunuck side. Citizens eventually had to be rescued by boat.

It has been estimated that evacuation clearance times vary from 4 hours and 15 minutes to 9 hours and 30 minutes for the West Bay region of Rhode Island. In off-peak and mid-peak traffic conditions traffic during an evacuation in South Kingstown should be free flowing. An evacuation during peak traffic conditions (rush hour) would cause congestion along State roadways, most notable being Routes 1, 108, 138. It should be noted that in 2002 the Rhode Island Emergency Management Agency (RIEMA) completed installation of signage that clearly identifies designated emergency evacuation routes in South Kingstown.

The South Kingstown Police Department along with municipal staff have developed a comprehensive evacuation strategy that includes: designation of evacuation routes; development of a uniform citizen notification protocol and procedure; and, establishment of thirteen (13) Police Hurricane Posts for use during hurricane/severe coastal storm events.

Table 2.7: South Kingstown Evacuating Population

Storm Strength	Permanent Population	Seasonal Population	Mobile Home Pop.	Population Evacuating Surge Areas	Population Evacuating Non-Surge Areas	Total Evacuating Population
Weak	29,400	6,610	460	3,850	510	4,820
Strong	same	same	same	4,970	1,260	6,690

The Matunuck Beach Road study area remains one of several areas in town that need to be evacuated prior to a major weather event. The Matunuck area is particularly vulnerable because Matunuck Beach Road provides the only means of access/ egress for some 514 seasonal and year round dwellings south of Atlantic Avenue. As previously noted, the impacts of coastal erosion have encroached upon the reaches of development south of Matunuck Beach Road such that the integrity of Matunuck Beach Road may be compromised with the next major storm.

Shelters

Shelter use in times of evacuation is not easily predicted. Each emergency situation presents a new set of circumstances, which govern shelter use. These variables include the length of the warning period, official encouragement of the evacuation, public awareness of location / availability of shelters, and the severity of the approaching hazard. Local officials do have some degree of control over the population that seeks public shelters. If evacuees are encouraged to seek safety at the homes of friends or family, hotels/motels, or shelters that are not advertised, usage would probably be lower in public shelters. Evacuations that occur late at night tend to put added stress on shelters because of the increased sense of urgency and inability to contact family and friends in order to make alternative arrangements.

A shorter period of time between the evacuation notice and the landfall of the storm usually causes greater use of the shelters because of the rapid nature of the evacuation. The number of retirement communities and trailer/mobile home parks in an area affects shelter use because both of these communities are more likely to seek public shelter.

Hurricane evacuation notices should be released eight hours before the predicted landfall of the storm. This gives most residents needed time to seek alternatives to “riding out the storm” in public shelters, minimizing the shelter demand and opening spaces for those without such alternatives.

South Kingstown High School (primary facility), Broad Rock Middle School and Curtis Corner Middle School (secondary facilities) are the Red Cross approved shelters in South Kingstown. The total shelter capacity for municipal facilities is 2500 +/- people. However, the University of Rhode Island’s Tootel / Keaney athletic complex has an additional capacity of 5000 people (USACE 1995). The Red Cross historically has designated the Tootel / Keaney complex as a mass evacuation facility that would serve the region in the event of catastrophic conditions.

Table 2.8 identifies the public shelter facilities available in South Kingstown. The American Red Cross (ARC) has agreed to extend its arrangement to operate the South Kingstown High School, Broad Rock Middle School and Curtis Corner Middle School (personal communication with Lt. Jeff Peckham, SKPD, Nov. 2005). URI is presently negotiating with ARC to operate the Tootel / Keaney Gym as a Mass Care Facility. The total shelter capacity is based on the ability to provide adequate provisions (i.e. food, water) for a three (3) day period.

Table 2.8: South Kingstown Public Shelter Facilities

Facility Name	ARC Operated	Flood Potential	Shelter Capacity
URI Tootel / Keaney Gym	Yes	None	5,000
South Kingstown High School	Yes	None	1,500
Broad Rock Middle School	Yes	None	500
Curtis Corner Middle School	Yes	None	500
		TOTAL SHELTER CAPACITY	7,500

Table 2.9 lists both shelter demand and availability. During a weak hurricane it is projected that there would be just over 6450 extra spaces in designated shelters located within South Kingstown, if you include the URI gym complex. A severe hurricane leaves 6130 extra available spaces under the same scenario. These numbers do allow for some fluctuation in projected shelter needs. Also as noted above, the Tootel / Keaney complex is intended to serve residents from surrounding towns in extreme cases.

Table 2.9: Estimated Public Shelter Demand/Capacity for South Kingstown, RI

Strength of Storm	Surge Vulnerable Residents	Non-Surge Vulnerable Residents	Mobile Home Residents	Total Shelter Demand	Total Shelter Capacity
Weak	510	80	460	1050	7500
Severe	700	210	460	1370	7500

2.3.3 Environmental Vulnerability

Hurricanes, earthquakes, nor'easters, floods or any weather related hazard event will have particular impacts on the natural and built environment. Differences in storm size, speed of movement, wind speeds, storm surge heights, timing with respect to tides and landfall location relative to vulnerable resources makes for high variability in impacts and related costs.

When the natural environment is impacted there are both direct and indirect costs. Some of the directs costs may include: erosion of recreational beaches; loss of buffering dunes and upland property; destruction of agricultural crops due to flooding; and loss of urban landscaping and community forest resources due to high winds. Indirect costs include: the widespread distribution of debris; accidental fuel spills; release of sewage, industrial waste and household chemicals onto the land or into the marine environment. (Heinz Center Study, 1999)

Impacts of severe weather events to the natural environment include both direct (loss of habitat and salinization of land/ groundwater) and indirect costs (widespread inland damage to built environment, threats to ecosystems/ species, and contamination of potable water supply).

Public Infrastructure

There are three (3) areas of the town where water and sewer lines are vulnerable to hurricanes. The first is located in Middlebridge where both water and sewer lines span Narrow River under the Middlebridge Bridge. The bridge has been lost to severe hurricanes and is subject to flooding from weaker hurricanes. Currently it carries a water line, which provides service to northern Narragansett, and sewer lines, which service the Middlebridge Road area of South Kingstown. A break in the sewer line would result in the discharge of raw sewage into Narrow River. It is noted that the sewer system does include isolation valves that would be activated to minimize sewage discharge if the sewer line is breached.

The second area is located in Snug Harbor and East Matunuck. Here the main line of the South Kingstown South Shore Water System spans the Potter Pond Bridge, which has been lost to both the 1938 and 1954 hurricanes. The water main is vulnerable not only under the bridge, but along the bridge where a storm surge channel into Potter Pond has been known to open up. A break in this main, if it goes undetected for long enough, could drain the whole water system, interrupting water service to a large area of the town and posing a potential heath problem.

The third area of 'at-risk' infrastructure concerns the 12" water main located west of the Potter Pond Bridge that services a significant portion of the South Shore Municipal Water System. The portion of the water main located between East Matunuck State Beach and Ocean Avenue is located approximately four feet below the existing barrier beach. This location makes the water line extremely vulnerable to being undermined from storm surge induced shoreline erosion.

Vulnerability to Lifeline/ Utility Systems include the 12-inch water main along Matunuck Beach Road that services a significant portion of the South Shore municipal water system. Estimated costs for the relocation of this pipeline inland along U.S. 1 are approximately $1 million (2008 dollars). Disruption to electric/ telephone services and potential replacement is estimated at $40,000 per utility pole (2008 dollars).

There are four (4) public boat-launching facilities in the Town: Pond Street Boat Ramp, Gooseberry Road Boat Ramp and Marina Park Boat Ramps (2). The Marina Park facility includes a 150 space parking area along with a five acre public recreation area. Each of these facilities is obviously vulnerable, given their marine locations.

Contamination from on-site wastewater treatment systems (OWTS) in flood prone areas can also cause potential pollution (i.e. release of fecal coliform, pathogens) and related health problems.

Roadways

Impacts to transportation systems include loss of access/ egress to significant residential areas along and east of Matunuck Beach Road (also serves as the primary evacuation route).

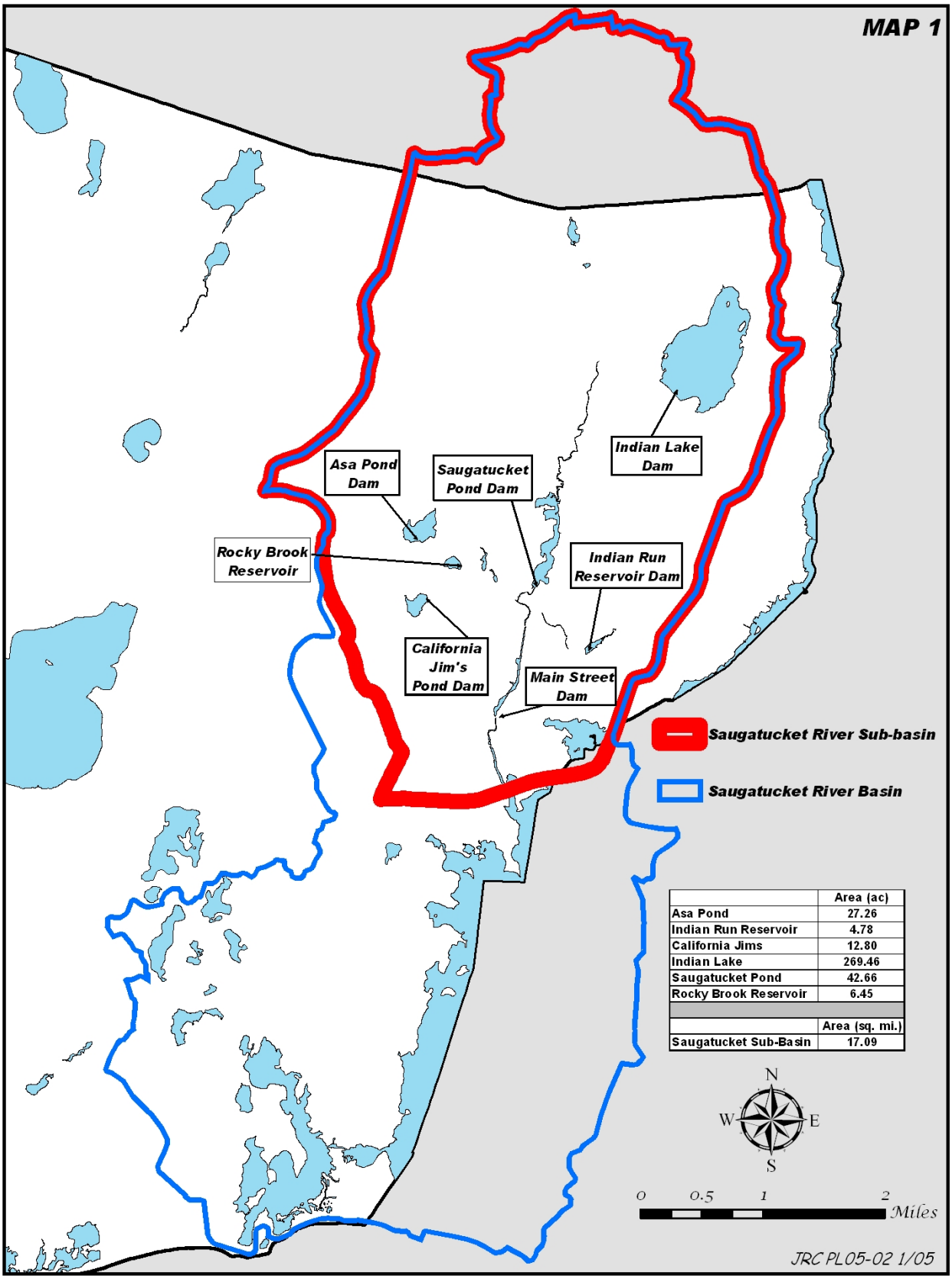
A review of FEMA, CRMC and Army Corps data reveals that some roadways that provide access/egress to significant residential areas have sections that would be flooded in a 100 year storm event (see Appendix J). Most noteworthy of those roads are:

Road	Flood Prone Section
Broad Rock Rd.	500' section beginning 500' south of Moorsefield Rd.
Card's Pond Rd.	beginning at Moonstone Beach Rd., thence easterly for 4500 l.f.
Curtis Corner Rd.	between Rockwood Lane and Kogoli Way
Green Hill Beach Rd. **	from Maple Dr. south to terminus
Matunuck Beach Rd. **	from Card's Pond south to terminus
Matunuck School House Rd.	Aspen Rd. to Green Hill Beach Rd.
Middlebridge Rd.	contiguous properties along eastern side of road are within 100 year flood plain
Ministerial Rd.	three segments along roadway within Zone 'A'
Moonstone Beach Rd.	from Matunuck School House Rd. to terminus
Moorsefield Rd.	various segments between Broad Rock Rd. and Rt. 1
Saugatucket Rd.	various segments between Rose Hill Rd. and Rt. 1
Succotash Rd. **	from Stedman Rd. southerly to terminus
Winchester Dr.	from Quagnut Dr. southerly to terminus
Worden's Pond Rd.	¾ mile section proximal to Worden Pond

(** roadways designated by RIEMA and Town of South Kingstown as hurricane evacuation routes)

Dams/Impoundments

There are five (5) major riverine systems in South Kingstown: Queens River; Chipuxet River; Chickasheen River; Saugatucket River; and, Pettaquamscutt River. The Saugatucket River Basin is perhaps the most troublesome from a natural disaster mitigation perspective due to its land use composition. Located within the Basin are the Peace Dale / Wakefield residential core along with the Dale Carlia, Peace Dale Village and Downtown Main Street commercial areas. The other basins contain predominantly agricultural land with more sparsely populated residential areas than Peace Dale / Wakefield.



	Area (ac)
Asa Pond	27.26
Indian Run Reservoir	4.78
California Jims	12.80
Indian Lake	269.46
Saugatucket Pond	42.66
Rocky Brook Reservoir	6.45
	Area (sq. mi.)
Saugatucket Sub-Basin	17.09

Within the 17.1 sq. mi. northern sub-basin of the Saugatucket River Basin (see Map 1) are seven lakes/ponds of note. Five (5) of those water bodies are impounded by dams (Indian Lake, Saugatucket Pond, Asa Pond, California Jim's Pond, Rocky Brook Reservoir and Indian Run Reservoir). In addition to the abovementioned dams there is a structure located at Main Street that forms a dam across the Saugatucket River.

California Jim's Dam breached in 1998, resulting in a total draining of the 12.8-acre pond. Significant down stream flooding occurred in the Peace Dale Flats commercial area. A concrete spillway was constructed in 1999 to replace the former structure. In the same year the owner's of Indian Lake Dam had that earthen structure rehabilitated.

The collapse of California Jim's Dam heightened awareness of the need to assess and correct deficiencies in the structural integrity of dams in South Kingstown. Over the past seven years the Town has had Asa Pond Dam rehabilitated and Indian Run Reservoir Dam reconstructed. In the latter case a concrete spillway replaced the existing earthen/wooden spillway.

In accordance with R.I.G.L. Chapter 46-18 and 46-19 a dam owner is responsible for safe operation of his/her dam and is liable for the consequences of accidents or failures to the dam. In general a dam owner is required to use "reasonable care" in the operation and maintenance of a dam. This includes the proper operation, maintenance, repair and rehabilitation of a dam, which are essential elements in preventing a dam failure.

R.I.G.L. Chapter 46-19 establishes the governing criteria for administration and enforcement of the Rhode Island Dam Safety Program. The Department of Environmental Management has responsibility to: (a) cause dams to be inspected to determine their condition; (b) to review and approve plans for construction or substantial alteration of a dam; and (c) order the owner to make repairs or take other necessary action to make a dam safe.

Two amendments to Chapter 46-19 were enacted in 2006. Section 9 was amended to require a city or town where a high or significant hazard dam in located to complete an Emergency Action Plan (EAP) for the dam. The Rhode Island Emergency Management Agency (RIEMA) is responsible for coordinating development of the EAPs and must give final approval for an EAP to be considered complete. It is the responsibility of the city or town to develop this plan in accordance with the EAP template to satisfy the requirements of the applicable RIGL.

In 2010, the Town completed an Emergency Action Plan (EAP) for each of the six dams in Town designated as either 'high hazard' or 'significant hazard' structures. Those dams being: Asa Pond Dam (RI #549); Hefler Farm Pond Dam (RI #525); Peace Dale Pond Dam (RI #426); Indian Run Reservoir Dam (RI #573); Wakefield Mill Dam (RI #425); and Rock Brook Reservoir Dam (RI #579). All of these dams are Town owned with the exception of the privately owned Hefler Farm Pond Dam. Indian Run Reservoir Dam and Rocky Brook Reservoir Dam have a 'significant hazard' designation. The other four structures are designated as 'high hazard' dams.

Shoreline Impacts

In Matunuck the town beach and accompanying pavilion are both susceptible to the severe erosion that the area has experienced in recent history. After the winter storms of 1998, two outboard sections of the boardwalk were severely undermined by erosion and had to be removed. An existing stone rip-rap groin and drainage pipe outfall were removed from off the beach. Town

officials felt these man-made structures were exacerbating beach erosion and storm damage. CRMC concurred with that assessment and issued the necessary emergency assents.

Also, the beach was not in an acceptable condition to serve as a viable summer recreation facility, given the extensive beach erosion and scouring that had occurred. Fortunately, the Town was able to undertake an extensive beach nourishment program funded by $40,000 received from the Governor's office. The program was implemented by the town in concert with technical assistance provided by RICRMC staff. A total of 4,584.5 tons of sand were dumped and spread onto the beach (See Appendix F).

Erosion and deposition are natural processes and tend to occur in cycles. The south shore beaches have been eroding steadily for a long period of time, leaving most beaches in need of sand with narrow, low profiles. Beaches in this state are particularly vulnerable to storm surges and over wash, giving them little ability to protect the backshore. A major function of barrier beaches is to provide protection. They are meant to move back and forth with wave action and storms. Most New England hurricanes hit the coast on a northward re-curving track. Since South Kingstown's shoreline projects west to east it is exposed directly to the full force of storm winds and waves, leaving the entire coast at high risk to erosion.

The dynamic nature of a barrier beach results in periods of sand erosion or sand deposition depending on the forces it is exposed to. The South Shore barriers are presently migrating landward in response to storms and sea level rise. Sand eroded from the ocean beach is transported by storm surge over wash to the back barrier and coastal lagoon. When developed the barriers become even more vulnerable to erosion due to the loss of deposition capability. Any structures built on the barrier are at high risk for storm damage. These structures may also interfere with fore dune growth. The most vulnerable areas of the shore are those that have high erosion rates and significant development. Historically high erosion rates in the area occur along the shore south of Green Hill Pond and along the shore south of Potter and Point Judith Ponds. Matching these areas with CRMC areas designated Developed Beyond Carrying Capacity, shows that the very western edge of town, just south of the western portion of Green Hill Pond, is the most vulnerable to erosion. The headland between East Matunuck and Cards Pond is composed of the same material as the barriers. This headland is also susceptible to erosion and storm surge over wash. At present this section of beach is 'sediment starved', making it particularly vulnerable to erosion.

The South Kingstown Town Beach provides both active and passive recreational experiences as well as natural habitat and protection. Recent coastal storms have resulted in significant beach erosion and scouring, additional damage to the remaining sections of the boardwalk, and inundation of waters inland to the extent that the septic system was inundated. The town undertook the removal of the undermined sections of the boardwalk, cordoned off the dune system to facilitate the re-establishment of vegetation, relocated an innovative/ alternative ISDS system further inland, and implemented an extensive beach nourishment program.

Continued storm surge and sand over wash has resulted in the filling in of a small coastal pond, northeast of the Town Beach. Storm waters repeatedly exceed the capacity of an existing culvert under Matunuck Beach Road between the coastal pond and Mary Carpenter's development. This reduced carrying capacity of both the pond and culvert, coupled with increased frequency of storm surge and sand over wash, has resulted in this portion of Matunuck Beach Road (also the primary evacuation route for over 500 dwelling units) to be come impassable at times.

Multiple residential and commercial structures seaward of Matunuck Beach Road have also experienced the impacts of erosion and sea level rise. Since the 2006 plan, several private residences have been condemned unsafe due to structural and septic system damage, with one residence having been demolished in 2007. Several commercial establishments have had to install holding tanks to mitigate failing septic systems, while the repair of an existing stone revetment has ensured the immediate future of some.

The South Shore's geographic location, the northward recurving track of most New England hurricanes, and direct exposure to the full force of high winds and storm surge throughout the year continues to erode the South Shore coastline at alarming rates. The narrow, low profiles of the barrier beaches that remain provide little protection to the backshore. The increased frequency and severity of storm events, rising sea levels, and compromised natural protection features, the barrier beached continue to migrate landward. This migration landward further subjects the built environment, primarily structures, utilities and Matunuck Beach Road to potential significant damage.

2.4 Development of the Local Hazard Mitigation Strategy

In order to initiate the local hazard mitigation strategy development process, a Local Hazard Mitigation Committee (LHMC) was formed in 1998. The LHMC includes representatives from the following town departments: Police, EMS, Planning, Parks & Recreation, and Public Services. The LHMC also has representatives from the local fire districts and a liaison from Coastal Resources Management Council.

A series of meetings of the Local Hazard Mitigation Committee members have been held throughout the strategy development process (see Appendix I). All meetings were open to public participation. In addition, the Strategy Plan review and approval process included a public hearing before the Town Council (see Appendix A).

The LHMC developed a draft Risk Assessment Matrix that was subsequently reviewed by Committee members and RIEMA staff. A final matrix was developed (see Table 3.2) based on comments received and further analysis by the LHMC. The matrix includes a prioritized list of the at-risk areas located with in the town. Actions needed to correct problems are summarized in Section 3.0 – Mitigation Actions. The actions listed in Section 3.0 include a variety of both structural and non-structural methods, which, once implemented will help to minimize the vulnerability of the town to the impacts of natural hazards.

In 2007, the Town of South Kingstown was awarded a Pre-Disaster Mitigation grant to update the local Multi-Hazard Mitigation Strategy Plan. The overall purpose of the Update being to advance action items identified in the existing local Multi-Hazard Mitigation Strategy Plan by specifically studying coastal hazards in the Matunuck area (Vulnerable Areas 2A, 2B and 2C of the 2004 Plan). The following mitigation actions from the 2006 Multi-Hazard Mitigation Plan Strategy pertinent to the vulnerable areas identified were considered:

Vulnerable Area #2A: Town Beach and Pavilion/Boardwalk Facility

- Mitigating Action #1 – Setback Pavilion and Boardwalk
- Mitigating Action #2 – Beach and Dune Nourishment Project

Vulnerable Area #2B: South Shore Bordering Atlantic Ocean

- Mitigating Action #1 – Develop Shoreline Management Plan
- Mitigating Action #2 – Over Wash Sand Removal

- Mitigating Action #3 – Develop Setback, Retrofit, and Elevation Program
- Mitigating Action #4 – Create an Educational Display
- Mitigating Action #5 – Beach Closings

Vulnerable Area #2C: Matunuck Beach Road

- Mitigating Action #1 – Perform Engineering study of Matunuck Beach Road to Identify Possible Long-Term Solutions
- Mitigating Action #2 – Tourist Evacuation and Shelter

Pare Corporation worked with South Kingstown municipal staff (Planning, GIS, Assessor, Building/Zoning, Public Works), Rhode Island Emergency Management Agency (RIEMA) planners, the State Floodplain Coordinator, representatives from CRMC, and the Local Hazard Mitigation Committee (LHMC) in the completion of this 2010 Update. The Federal Emergency Management Agency's (FEMA) *Crosswalk* guidance document and State and Local *Mitigation Planning How-to-Guide Series* were utilized in the creation of the project scope, schedule, and implementation of the Update.

A series of meetings of the LHMC were held throughout the Update process (see Appendix I). In addition, a public informational hearing was conducted in August 2008 to present alternative mitigation measures identified, falling under three categories: No Action alternative; Alternatives Considered But Not Carried Forward due to cost and/or feasibility; and Proposed Action alternatives. The purpose of the meeting was to engage the public and receive their input. The public presentation and periodic project updates were posted on the Town's website for public review and comment. The LHMC selected a variety of structural and non-structural alternative mitigation measures to incorporate into the plan's Update for the vulnerable areas studied. In addition, the Multi-Hazard Mitigation Strategy Plan Update review and approval process included a public hearing before the Town Council (see Appendix A).

2.5 Maps

The University of Rhode Island, in conjunction with RIEMA, has developed GIS maps to be included in this strategy plan. The first map (Map 2 Northern & Southern sections) show specific areas at risk in South Kingstown and the second map (Map 3 Northern & Southern sections) identify critical facilities located in town.

Risks In South Kingstown

Map 1 (Northern Section)

Public Infrastructure
- Dams
- Bridges
- Major Roads
- Other Roads
- Railway
- Trailer Parks

Social/Economic Risks
- Extended Care Facilities
- Day Care Center
- 1 Dot = 1 Building Location

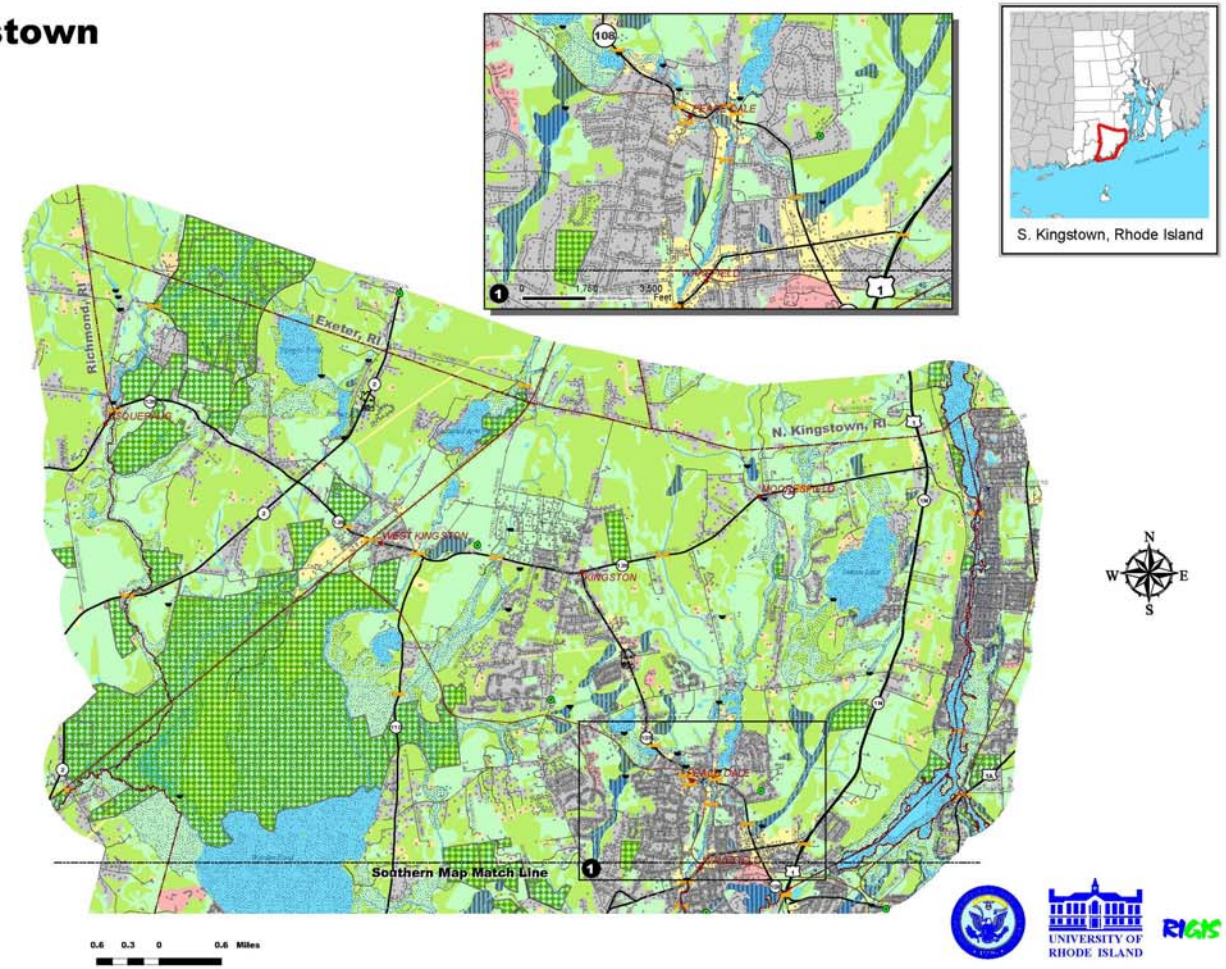
Flood Zones
- A - Zone (100 Year)
- V - Zone (100 Year)
- X - Zone (500 Year)
- Rivers and Streams
- Open Water

Barrier Beaches
- Developed
- Undeveloped

Land Use / Land Cover
- Commercial/Industrial
- Forest
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Other
- Open Space

- Municipal Boundary

Note: Map information has been extended 1 kilometer around the South Kingstown border. This extension is intended to aid administrators in hazard mitigation. This map confers no legal status to anything hereon.



Risks In South Kingstown

Map 1 (Southern Section)

Public Infrastructure
- Dams
- Bridges
- Major Roads
- Other Roads
- Railway
- Trailer Parks

Social/Economic Risks
- Extended Care Facilities
- Day Care Center
- 1 Dot = 1 Building Location

Flood Zones
- A - Zone (100 Year)
- V - Zone (100 Year)
- X - Zone (500 Year)
- Rivers and Streams
- Open Water

Barrier Beaches
- Developed
- Undeveloped

Land Use / Land Cover
- Commercial/Industrial
- Forest
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Other
- Open Space

- Municipal Boundary

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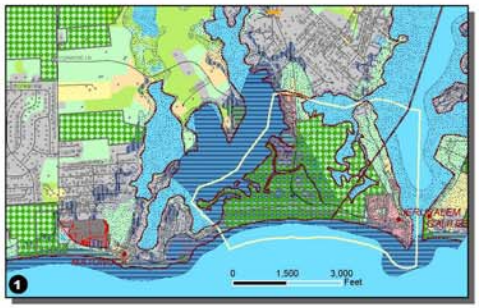
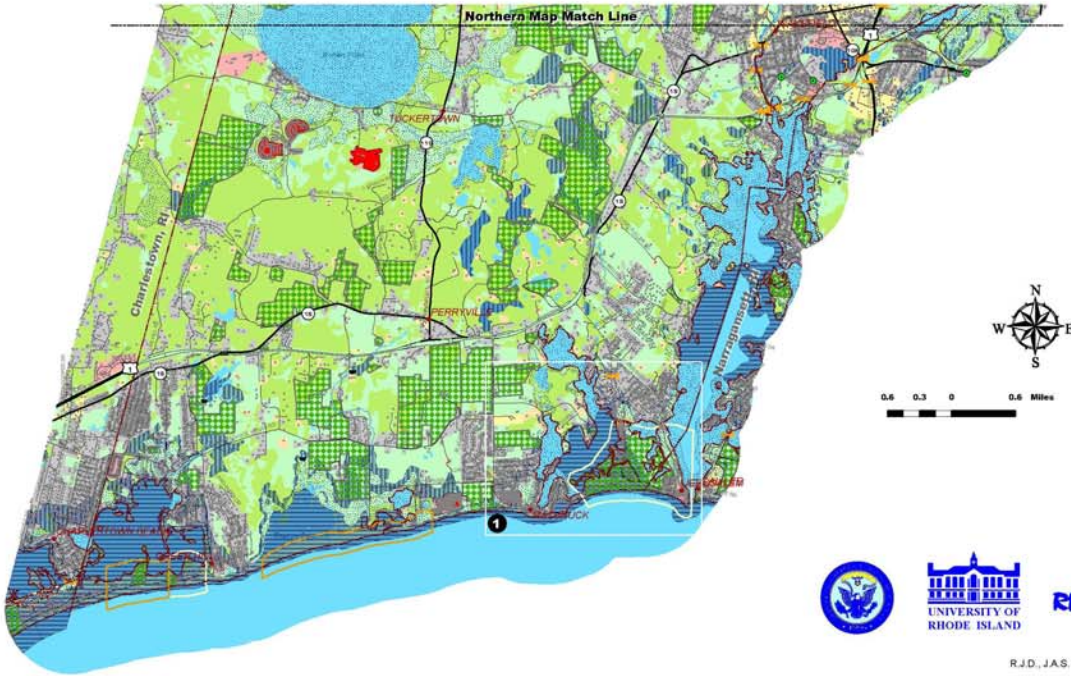




UNIVERSITY OF RHODE ISLAND

RIGIS

R.J.D., J.A.S. - 1/13/2005

Critical Facilities In South Kingstown

Map 2 (Northern Section)

Public Infrastructure
- Town Hall
- Fire Stations
- Police Stations
- URI Police Station
- Hospitals
- Schools
- Library
- Major Roads
- Other Roads
- Bridges
- Railway

Utilities
- Sewer Pump stations

Preparedness

Red Cross Approved Shelters
- Broad Rock School
- Curtis Corner Middle School
- South Kingstown Senior High

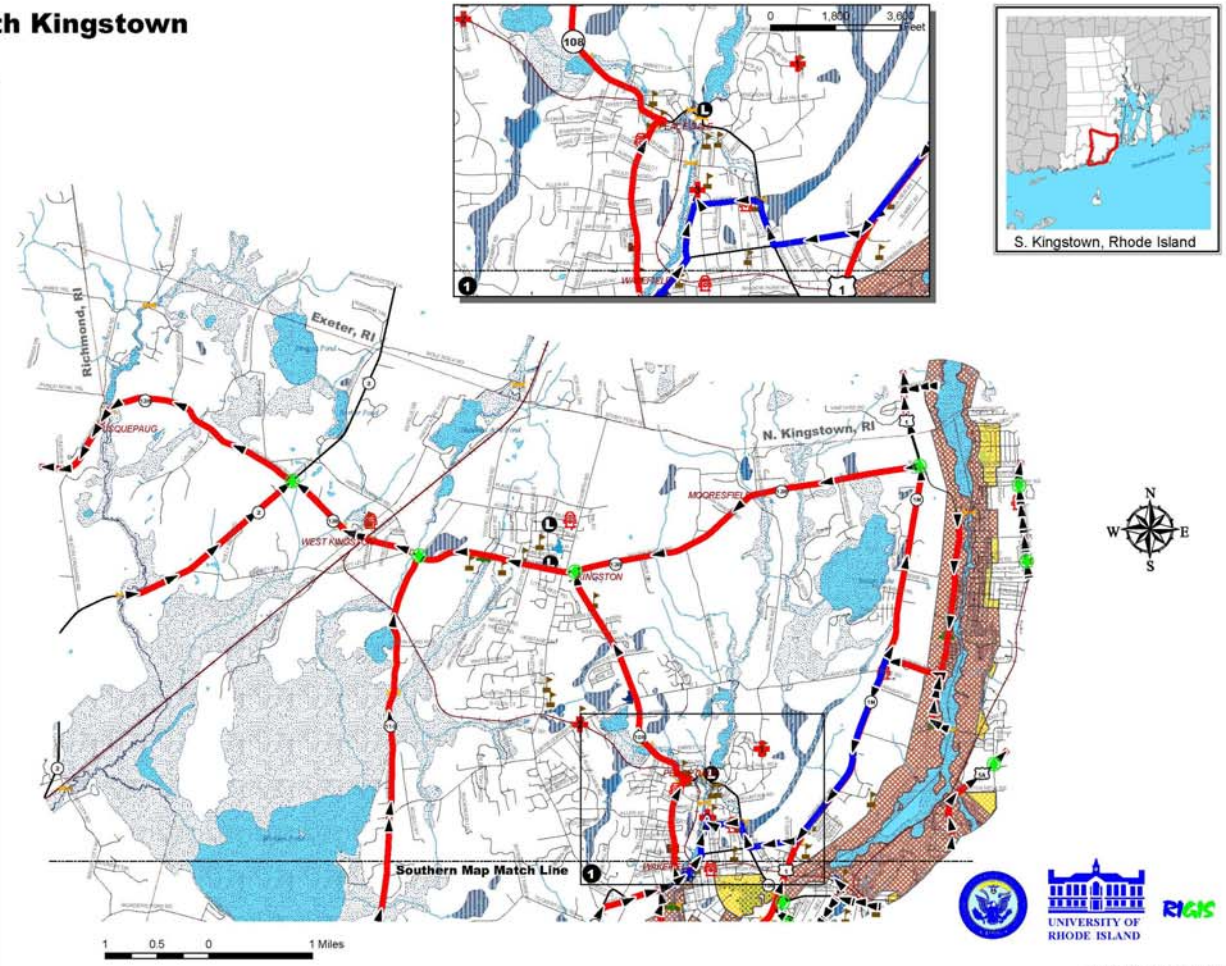
- Evacuation Route
- Shelter Route
- Traffic Control Point

Slosh (Hurricane) Evacuation Areas:
- A (Category 1 & 2 hurricane with forward wind speeds up to 40 mph and category 3 hurricane with forward wind speeds up to 20 mph)
- B (all other categories and forward wind speeds)

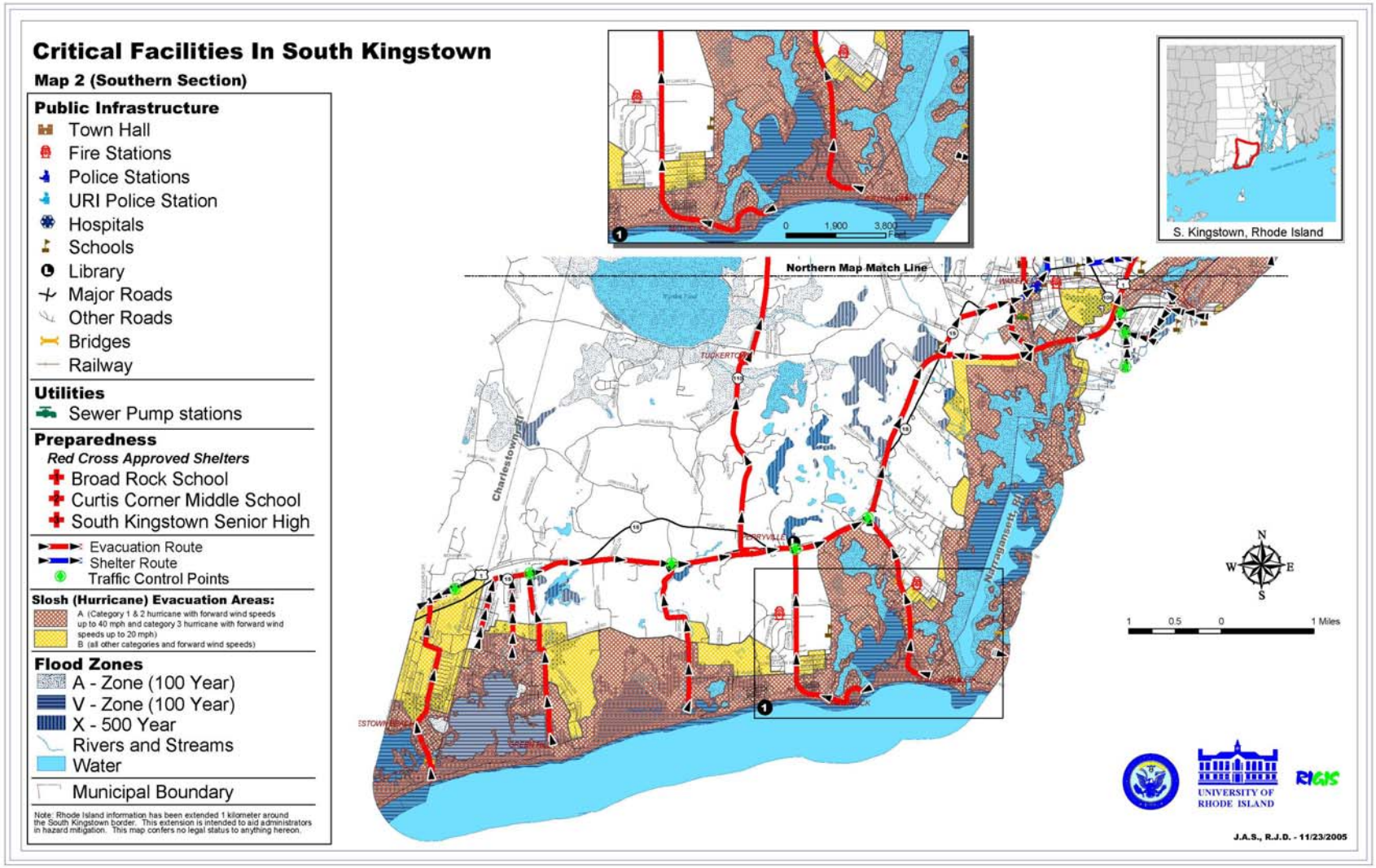
Flood Zones
- A - Zone (100 Year)
- V - Zone (100 Year)
- X - 500 Year
- Rivers and Streams
- Water

- Municipal Boundary

Note: Rhode Island information has been extended 1 kilometer around the South Kingstown border. This extension is intended to aid administrators in hazard mitigation. This map confers no legal status to anything hereon.



J.A.S., R.J.D. - 11/23/2005


Critical Facilities In South Kingstown
Map 2 (Southern Section)
Public Infrastructure
Town Hall
Fire Stations
Police Stations
URI Police Station
Hospitals
Schools
Library
Major Roads
Other Roads
Bridges
Railway
Utilities
Sewer Pump stations
Preparedness
Red Cross Approved Shelters
Broad Rock School
Curtis Corner Middle School
South Kingstown Senior High
Evacuation Route
Shelter Route
Traffic Control Points
Slosh (Hurricane) Evacuation Areas:
A (Category 1 & 2 hurricane with forward wind speeds up to 40 mph and category 3 hurricane with forward wind speeds up to 20 mph)
B (all other categories and forward wind speeds)
Flood Zones
A - Zone (100 Year)
V - Zone (100 Year)
X - 500 Year
Rivers and Streams
Water
Municipal Boundary
Note: Rhode Island information has been extended 1 kilometer around the South Kingstown border. This extension is intended to aid administrators in hazard mitigation. This map confers no legal status to anything hereon.
0 1,900 3,800 Feet
S. Kingstown, Rhode Island
Northern Map Match Line
Charlestown, RI
Narragansett, RI
N
W
E
S
1 0.5 0 1 Miles
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J.A.S., R.J.D. - 11/23/2005

2.6 Capability Assessment

South Kingstown implements and enforces the State Building Code, and participates in the National Flood Insurance Program (NFIP) along with all Rhode Island communities. In 1984 the South Kingstown Town Council adopted the Defense Civil Preparedness and Hurricane Plan, which established The South Kingstown Defense Civil Preparedness Agency. This agency was created to "properly minimize risk of natural or manmade catastrophe through effective preparedness; to clarify and strengthen the roles of municipal agencies and officials in the event of disaster; to provide prompt rescue for persons threatened by disaster; and to assist with restoration, recovery and rehabilitation of persons and property affected by disaster" (SK Comp Plan). The hurricane plan contains a Police Department Hurricane Evacuation Plan, a Public Services Department Hurricane Preparedness Plan, a Marina Operation and Available Emergency Equipment section, a Public Works Department Hurricane Planning section, and a Hurricane Action Checklist (see Appendix H). The South Kingstown Emergency Operations Plan (EOP) also designates emergency response procedures for natural disasters. The state has worked with communities to develop an Annex K - Municipal Administration Plan for Hazard Mitigation to be included with the EOP. This Plan is updated on an annual basis.

Under the NFIP, new homes built in South Kingstown must meet structural guidelines; e.g. the first floor of any residential structure must be above the 100-year flood boundary. The NFIP also prohibits the alteration of sand dunes and the establishment of new mobile home sites in the flood plain (Gordon 1980).

In several cases South Kingstown ordinances are more stringent than those of the state. The town requires an average setback of 100 feet from the mean high water mark (Gordon 1980). This requirement is in many cases above and beyond the CRMC requirement that residential structures be setback 30 times the erosion rate and commercial structures be set back 60 times this rate. The town also requires that all septic systems be located at least 150 feet from a wetland (i.e. swamp, marsh, pond). The RIDEM minimum setback requirement is fifty feet. The original purpose of this requirement was to prevent nitrates and pathogens from leaching into the salt ponds. However, it also serves to prevent septic systems from some flooding which reduces possible sources of pollution during a storm. In one study of the hurricane risk in Rhode Island, it is stated that "South Kingstown has been the most progressive and strictest of the communities studied in regards to zoning requirements" (Gordon 1980).

In 1972 South Kingstown designated areas of the town to be in a High Flood District (HFD). These areas are based on the Federal Emergency Management Agencies A and V flood zones. The HFD stretches from the ocean to the back of the coastal ponds and includes all of the town's barrier beaches. Development is limited in the HFD and construction in this zone requires a Special Use Permit from the Zoning Board of Review per the Zoning Ordinance (Sec. 601).

The Special Use Permit application requires a comprehensive assessment of the effects of the proposed project. Applicants must show that "the proposed structure will not result in any conditions which will be detrimental to public health, safety or welfare" (SK Zoning Ordinance). The applicant must also provide an Environmental Impact Statement and detailed construction plans that comply with both strict design and materials criteria.

The University of Rhode Island's Geology Department has been studying the beach profiles of South Kingstown's shoreline for many years (Boothroyd et al, 1998). The data from these studies has provided the basis for the stringent setback requirements of both the state and the town. In the winter of 1998, a series of storms caused severe erosion along the coast. This erosion was

most serious along the town beach and the area just to the east where gale force winds removed sand dunes. Several homes and the town beach boardwalk were left dangerously close to the ocean; 38 property owners in the area are in danger of losing their rear yards, if not their homes (Providence Journal 1998). On the beach, the escarpment sloped sharply seaward, and patches of parent material showed in areas where beach sand erosion had occurred.

The Town of South Kingstown has worked with both the Army Corps of Engineers and the Coastal Resources Management Council (CRMC) in the past to study the erosion problem at the town beach and the surrounding areas. A $40,000 beach nourishment project was then implemented as a short-term solution, while a long term dredging and nourishment project is being investigated. The CRMC report of this study lists immediate, intermediate, and long-term solutions to the problem of erosion. These solutions could be useful in mitigating future erosion problems.

To combat erosion along the shores of Point Judith Pond, local residents have used a combination of bulkheads and stone rip-rap. Further construction of this type of erosion and flood protection is prohibited in most locations under the present CRMC program. These hard construction measures may work well in the immediate area that they are intended to protect, however, they have been shown to cause more significant problems including increased erosion, loss of critical habitats etc. in the surrounding areas. They should be considered only in those cases where all practical alternatives have proven unsuccessful. Also, there may be cases where the man made shoreline protection measures are the only feasible mitigation to protect life, property, roadways and infrastructure (i.e. utilities).

The South Kingstown Harbor Management Plan has identified 221 substandard waterfront lots and numerous areas that are zoned for less than the recommended two acres. Theses areas are non-compliant with the CRMC Narrow River and Salt Pond Region Special Area Management Plans. A comprehensive proposal for managing Upper Point Judith Salt Pond was done in 1989 by the URI Department of Marine Affairs. The CRMC Salt Ponds Special Area Management Plan also provides an in depth assessment of the salt ponds in the area. Together these plans offer a wide range of recommendations to assist South Kingstown in the development of effective harbor management strategies.

Tree damage can often be problematic long after a storm has passed through. Downed trees can cause power outages, block roads, and create debris problems. South Kingstown does employ a part time tree warden responsible for removal of downed trees, large branches and shrubs resulting from storms. In 1998, South Kingstown expended $23,000 to undertake a tree inventory. This project identified trees throughout the area by species, location, condition and maintenance needs. According to these criteria, trees requiring immediate removal or pruning were identified and prioritized. The annual Tree Program budget is expended to address these immediate needs. The town maintains a tree management inventory software program that is updated as each removal/maintenance project is completed.

Land acquisition in high-risk areas seems to be one of the best options for decreasing the vulnerability in the area. The Town of South Kingstown has a proactive Open Space Protection Program that, in concert with private organizations such as the South Kingstown Land Trust, The Nature Conservancy and Narrow River Preservation Association have made important land acquisitions. Much of this land is located in the areas around the salt ponds. During the prior Administration President Clinton commended South Kingstown for its open-space initiatives. The Town of South Kingstown was singled out for preserving undeveloped land while accommodating growth.

From 1999 to 2009 the Town contributed $7,484,351 towards the $14,718,988 needed to protect 1,434.7 acres of open space. Those acquisitions including approximately 300 acres of riverine wetlands that provide vital flood storage during storm events.

Town figures as of July 2009 show that 10,994.4 acres of land has been preserved as open space. This represents 30.2% of the total Town land area. Additional open space acquisitions are anticipated in the future through the Town's collaborative efforts with the South Kingstown Land Trust, DEM, USF&WS and other interested organizations. The extent of open space purchases will be contingent upon availability of funding.

There has been a large increase in development since the hurricanes of '38 and '54, especially in the South Shore District. Since these hurricanes, development has turned from summer to year round residences, leaving the town at even greater risk to hurricanes. In an effort to help the town check growth, several reports on managing development have been written including two by the URI Coastal Resources Center; *A Plan to Check Residential Sprawl in the South Shore District of the Town of South Kingstown*, and *Priority Open Space Areas in the Salt Ponds Region of Narragansett, South Kingstown, and Charlestown*. These studies provide land use recommendations, and include both the economic and environmental benefits of controlling growth.

Comprehensive Plan

The South Kingstown Comprehensive Plan has several goals and policies already in place that can support and facilitate mitigation activities within the Matunuck Beach Road study area:

Land Use Element

Goal 3 To promote and require high standards of development to preserve and enhance the quality of life, to encourage a sense of community, and to protect the natural resources of the Town.

Policy 3.6 The Town will work with the Coastal Resources Management Council and RI Department of Environmental Management to ensure that, to the extent permitted under the RI General Laws and regulations governing those agencies, assents and permits will be consistent with the community comprehensive plan and local zoning requirements.

- To preserve the quality of natural resources, the Town reserves the right, as permitted by applicable State law, to require more stringent standards than the minimum standards applied by the Coastal Resources Management Council and RI Department of Environmental Management in their assent and permitting processes.

Natural and Cultural Resources Element

Goal 1 To protect and to preserve the quality and quantity of the Town's potable water supply.

Policy 1.4 The Town recognizes that a watershed management approach to resource protection and utilization is necessary. It is therefore necessary to plan on both a Town-wide and regional basis based upon watershed boundaries

to coordinate resource management issues. It also means that such programs as erosion and sediment control, stormwater management, aquifer use and protection, and open space acquisition need to be planned on both a Town-wide and inter-town (regional) basis.

Goal 2 To protect and to preserve both freshwater and coastal wetland resources.

Policy 2.1 The Town will work toward protecting the integrity of the varied wetlands, which serve many important ecological and economic functions. Protection efforts will be directed toward swamps, marshes, bogs, floodplains, wet meadows, aquatic beds, beaches, and all other wetlands as defined by RIDEM Freshwater Wetlands Act, April 1998, as amended, and CRMC's Freshwater Wetlands in the Vicinity of the Coast Program, and Section 210.3 of the RICRMP. The Town will pursue both regulatory and non-regulatory options for ensuring the protection of these resources.

Policy 2.2 The Town recognizes that the irreplaceable coastal resources need comprehensive protection. The Town will take a regional watershed approach, critical to preserving these fragile resources, to address land use, stormwater runoff, and all point and non-point source pollution. The Town will pursue management strategies consistent with the Coastal Resources Management Council's Special Area Management Plan for the Salt Ponds (1999) and the Special Area Management Plan for the Narrow River (1999).

Services and Facilities Element

Goal 15 To maintain an effective emergency management response program that recognizes the importance of providing protection to citizens and property through public education, municipal preparedness plans and adequate training of key personnel.

Policy 15.1 The Town supports an expanded public awareness of potential emergency situations and appropriate citizen response.
- The Police Department maintains an ongoing emergency management response program with RIEMA and FEMA. As issues relating to Homeland Security arise, the Town shall respond in accordance with Federal and State protocols.

Policy 15.4 Encourage development of programs and policies that foster preventative measures that mitigate potential natural disaster damage.
- The Town will examine its present guidelines and regulations to see where possible measures can be instituted and encouraged that reduce storm damage potential.

Open Space and Recreation Element

Goal 3 To assure public access to publicly –owned and controlled open space and to all important public natural and cultural resources for all citizens and will protect all current and historic rights-of-way which assure this access.

Policy 3.1 The Town shall protect all protect all current and historic rights of way to natural and cultural resources.

-The Town shall work with the Coastal Resources Management Council to identify and protect rights of way to coastal areas.

Goal 4 To protect all beach areas for pedestrian-based recreation, to preserve the open-space character of the shorefront, and to protect the fragile ecology of the dunes.

Policy 4.1 The Town shall continue to manage beaches under its jurisdiction for the benefit of the community.

As noted in previous sections of this update, the Town of South Kingstown continues to be proactive in mitigating projects to minimize the vulnerability of the town to impacts of natural hazards. At the Town Beach, the Town undertook the removal of the undermined sections of the boardwalk, cordoned off the dune system to facilitate the re-establishment of vegetation, relocated an innovative/ alternative ISDS system further inland, and implemented an extensive beach nourishment program. In 2006, repairs to a riprap revetment (pre-existing regulations) were completed as a public-private partnership with the Town, Matunuck Beach Trailer Association, and two private owners.

Since the 2006 plan, several private residences have been condemned unsafe due to structural and septic system damage, with one residence having been demolished in 2007. Several commercial establishments have had to install holding tanks to mitigate failing septic systems, while the repair of an existing stone revetment has ensured the immediate future of some.

CRMC permit activity for hazard-related remediation projects (as well as costs associated with these projects) continues to increase in accordance with increased development within at-risk areas such as Matunuck. A number of CRMC hazard-related remediation project applications have been submitted since the 2006 plan, including: Beach Nourishment (4 applications); Erosion Control (4 applications); and Structural/ISDS (5 application).

CRMC, Coastal Resources Center (CRC), scientists from the University of Rhode Island, Rhode Island Sea Grant, and the State Building Code Commission have been working to prepare communities to adequately plan for the implications of climate change and sea level rise. Although it is universal that global sea levels are on the rise, future sea level rise is not expected to be uniform or linear. A general rule of thumb is that sea level estimates are increasing as the science of modeling becomes more advanced.

2.7 Coordinating with Neighboring Municipalities

Due to the similar risks and vulnerabilities that both towns face South Kingstown and Narragansett have worked closely in the development of their respective hazard mitigation strategies. Several of the mitigation actions listed in this plan are also included in the Narragansett Plan, and the towns have planned to work together to implement these actions. For instance, the towns share several bridges that are considered vulnerable. Also, a mutual aid agreement is in the works. This agreement would allow the towns to share a tub grinder to assist with debris removal following a storm.

Section 3.0 – MITIGATION

Risk management is the process by which the results of an assessment are integrated with political, economic and engineering information to establish programs, projects and policies for reducing future losses and dealing with the damage after it occurs (Heinz Center, 1999). Managing risks involves selecting various approaches that, when applied to the risk area, will reduce vulnerability.

Following identification of possible mitigation actions the next basic step is evaluating these actions using pertinent criteria. The most important criteria obviously is whether or not the proposed action will in fact mitigate the particular hazards or potential loss. The criteria used by the LHMC for prioritizing actions did take into account social, technical, administrative, political, legal, economic and environmental factors.

Based on historical damages, public safety concerns, property value, tourism concerns, environmental factors, the LHMC drew up the risk assessment matrix, prioritizing twenty (20) vulnerable areas. The specific order of priority was based on the LHMC review of hazards in light of potential risk. Based on likelihood of occurrence and extent of potential damage the risk assessment matrix was developed. The following LHMC decision making rationale is summarized in *Table 3.1 Identification of Vulnerable Areas*, and further detailed in *Table 3.2 Risk Assessment and Identification of Priority Problems in the Town of South Kingstown, RI.*

Table 3.1: Identification of Vulnerable Areas (2006 Plan)

Hazard	Future Occurrence	Potential Damage	Vulnerable Area
Coastal Erosion	High	Severe / Moderate	2A,2B,2C,3A,4A,4B,11
Coastal Storm	High	Severe / Moderate	2A,2B,2C,3A,4A,4B,5C,6, 7,8,11,12
Dam Failure	Med./Low	Moderate	1,5B
Drought	Low	Low	
Earthquake	Low	Severe	1,10
Flood	High	Moderate	1,2A,2B,2C,3A,4A,4B,5A 5B,7,11
Hurricane	High	Severe/Moderate	2A – 2C,3A,4A,4B,5A,6, 7,8,11,12
Winter Storm	High	Moderate	4A,6
Wildfire	Med./Low	Mod./Low	9

Table 3.2
RISK ASSESSMENT AND IDENTIFICATION OF PRIORITY PROBLEMS IN THE TOWN O F SOUTH KINGSTOWN, RI

#	RISKS/TYPES OF VULNERABILITIES	LOCATION OF RISK (Identify on map)	OWNERSHIP Town/State etc	NATURAL HAZARD	PRIMARY EFFECT OF HAZARD	FREQUENCY OF DAMAGE	BENEFIT FROM MITIGATION PROJECT	RANKED PRIORITY 1=HIGH, 10=LOW
1	Dams, earthen & stone masonry types	Usquepaugh River (3) Saugatucket River (2) Rocky, Indian Run, Smelt & Factory Brooks numerous small dams	Town/Pvt/State some w/multiple jurisdictions	Flash Flooding with severe erosion	Risk of flood, property damage, loss of life due to failure of old earthen/stone masonry dams in varying states of disrepair Engineer inspection and timely repairs/maintenance required	HISTORICAL Cal Jim Dam 2/18/98 Severe weather (freq) POTENTIAL Earthquake (Infreq)		1
2A	Town Beach and Pavilion/Boardwalk Facility	Matunuck Beach Road at Cards Pond Road	Town	Flooding, Erosion Storm Surge	Loss of valuable recreational facility, tourism and related local commerce Wave borne structural debris exacerbates damage along	HISTORICAL subject to storm patterns	preservation of existing recreational facility and natural beachfront	1.3
2B	All South Shore on Atlantic Ocean	Ocean beach & bluff Pt Judith Pond west to Charlestown	Town, State Feds & Pvt	Flooding, Erosion Storm Surge	Loss of property, structures, public utilities Possible loss of life, damage/loss of natural resources	HISTORICAL ie: winter of '97-98 Hurricanes '38, '54 etc	Protect existing infrastructure & preserve natural ocean beach	1.4
2C	Matunuck Beach Road	From Town Beach to Ocean Avenue	Town	Flooding, Erosion Storm Surge	Routinely floods during large ocean storms esp. at high tide with overwash of sand/debris from beachfront	HISTORICAL Severity subject to tides	Maintain overland access to residential/commercial properties	1.5
3A	South Shore Water System Main	Barrier beach between Matunuck /Snug Harbor	Town Easement across State land	Storm surge/Erosion (Could expose water main	Loss of sole supply potable water & fire protection for Snug Harbor, East Matunuck, Jerusalem & SoCo Hills	POTENTIAL Subject to seasonal	Protect lives & property, Heath & Safety	2
4A	Barrier beaches coastal ponds	Pt Judith Pond and barrier beach ponds	SK/Narra/C'town State/Fed/Pvt	Erosion/flooding/storm surge	Public beaches, wildlife refuges, Pvt property subject to damage & loss; possible loss of life in uncontrolled breach of a coastal pond; protect water quality due to exposed and/or failed septic systems; loss of wildlife habitat	HISTORICAL Hurricanes/Nor'easters combined with normal seasonal storm patterns	Protect wildlife habitat/dunes Decrease structural damage and post disaster cleanup Protect pond water quality and thereby public health & safety	3
4B	Pettaquamscutt River Middlebridge Area	Pettaquamscutt Lake, River & Cove	SK/Narra/NK Fed/State/Pvt	Flooding/erosion/storm surge	Govt/Pvt property flooding/erosion; damage to buildings & homes; inundation of floodwaters into sanitary sewers & ISDS systems; loss of life; damage to river ecosystem	HISTORICAL Heavy rains combined w/ high tides and storms with easterly winds	Protect property, lives, natural resources & public health & safety	3.5
5A	Middlebridge Bridge	Middlebridge Road at SK/Narragansett town line	South Kingstown & Narragansett	Flooding	Interruption of transportation & E911 response Water & sanitary sewer force main subject to failure in event of catastrophic structure failure; septic pollution in a fragile riverine estuary	HISTORICAL especially during high tides and s'easterly storms	Maintain transportation and utility functions while protecting fragile estuarine ecosystem	4
5B	Saugatucket Road	Saugatucket Road at Saugatucket River	Town	Flooding/erosion	Interuption of transportation/E9-1-1 response (short term) Structural failure/water main break	HISTORICAL POTENTIAL	Maintain trans/E9-1-1 functions Preserve all functions & prevent damage to river ecosystem	4.1
5c	Potter Pond Channel Bridge	Succotash Road	RI DOT with influence on SK & Narra.	Flooding/erosion	Risk of washout/flooding cuts off sole overland access to State beach/Jerusalem area; risk of loss of life; property, commerce & tourism	HISTORICAL with increased risk during high tides & ocean storms	Safe evacuation route reduce risk to E911/fire/rescue staff, ie cost savings to Towns Potential minus, bigger bridge = bigger boats in upper ponds	4.5

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6	Utility/Tree damages	Townwide	SK/State ROW's utility providers	Wind/icing	Excessive tree damage causes power/communication loss Blocked roadways, E911 delays, utility interruptions risk of electrocution,loss of water/sewer pumps, freezers etc Property damage and disposal of debris	HISTORICAL problems magnified by high winds and/or icing, lack of trim/maintenance	Improved reliability of power and communications during and after major storm events Lower cost/less recovery time Improved safety	4.5
7	Boat ramps Repair/ Rehabilitate	Townwide	Town/State	Storm surge/flooding	"Crush" at boat ramps as small craft owners haul boats loss of time/tempers due to bottleneck at old ramps loss of property, environmental (fuels/lubricants) due to sinking	HISTORICAL mostly May to October for any major storm event	Reduce property loss, post storm cleanup, environmental impact improve timeliness of evacuation	5
8	"Evacuation Route" & "Storm Surge Elevation" signs	Townwide as required by field conditions	Town & others	Flooding/wind/storm surge	Clarify risk associated with flooding/storm surge & wind events; provide clear directions to Evac Centers for persons unfamiliar with local resources (ie summer vacationers & URI students/renters along the coastline & other low areas)	HISTORICAL Routine occurrences subject to weather patterns	Provide reliable evacuation info with advance warning to reduce risk of loss of life; improve TSK standing in NFIP CRS ratings	5.5
9	Fire Protection	Townwide rural areas Usquepaugh, Perryville etc	Town/UFD RIDEM (Great Swamp)	Fire/wind	Reliable supply of water for firefighting in rural portions of Town w/o municipal water, loss of property, lives, wildlife habitat & time and resources transporting water from existing hydrants or ponds	HISTORICAL subject to drought, arson, & lightning	Improve public safety & welfare Reduce risk of property & loss of life risk, protect forested areas	5.5
10	Underground Fuel Tanks	Townwide	Town/Pvt	Flooding	Existing underground storage tanks in/out of service leaking and/or improperly decommissioned & removed Risk of empty tank floating up during a flood event	POTENTIAL subject to detection and proper action	Groundwater protection, fire prevention	6
11	Ocean Avenue pedestrian ramp	Ocean Avenue/State Beach	Town	Erosion	Pedestrian access to beach reduced at high tide to climbing over large boulders; limits access of older persons unable to navigate a boulder strewn path	HISTORICAL current condition subject to storm patterns/types	Restore/improve access to beach and related area without trespass onto private property	7
12	Lights/Poles at Town facilities	Townwide	Town	Wind/Ice	Loss of facility use Loss of lighting that could be used for "artificial daylight" for a temporary encampment for National Guard troops	HISTORICAL Hurricane Bob	Improved facilities that could serve as site for emergency as well as routine recreational purposes	8

As stated in the introduction, '*A hazard mitigation plan should be considered a living document that must grow and adapt, keeping pace with a community's growth and change'*. In order to remain eligible for assistance, DMA 2000 requires communities to seek and receive re-approval from the Federal Emergency Management Agency (FEMA). The update process also provides a means to create an increased institutional awareness and involvement in hazard mitigation as part of daily activities.

The updated Risk Assessment Matrix, *Table 3.3 Risk Assessment and Identification of Priority Problems in the Town of South Kingstown, RI (2010 Update)* acknowledges and reflects completed remediation projects in Town and considers any new vulnerable areas and/or action items that should be included relative to hazard mitigation. The specific order of priority was based on the LHMC's review of hazards in light of potential risks.

3.1 Mitigation Action Plan

Using the hazard risk assessment, and the risk assessment matrix, the LHMC has developed an action plan. This plan recommends mitigation measures that will help to reduce South Kingstown's vulnerability to natural hazards. Priority status for FEMA project grant money, distributed through RIEMA, will be given to those projects with a well developed process for mitigating the problem. Financing options are explained in more detail in Appendix D.

Mitigation Categories

The mitigation actions included in this plan are objectives for the town. Actions will be implemented according to priority, funding, and time frame. Each recommended action includes a description, and has been classified according to the following categories:

- Planning and Regulations
- Property Protection, Structural Projects and Maintenance
- Public Information, Outreach, and Incentive Programs
- Emergency Services
- Post-Disaster Opportunities

Time Frame

Time frame objectives are identified for each mitigation action, and indicate the initiation of each project. The time frames are as follows:

Short term = 0 – 6 months
Medium term = 6 –18 months
Long term = 18 months to 5 years

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Evaluation/Selection of Mitigation Actions

After reviewing the Town's identified risks and vulnerabilities to natural hazards, the input/feedback from the public meeting and recommendations from the Town, the local Capability Assessment, and review of the alternative mitigation measures developed for the Matunuck Beach Road study area, the Local Hazard Mitigation Committee (LHMC) selected mitigation actions to incorporate into the 2010 Update. The range of mitigation activities identified included mitigation actions to achieve specific hazard concerns within Vulnerable Area #2A *Town Beach and Pavilion/Boardwalk Facility*, Vulnerable Area #2B *South Shore Bordering Atlantic Ocean*, and Vulnerable Area #2C *Matunuck Beach Road*.

Prioritization of Actions

Due to budgetary constraints and other limitations, it is often impossible to implement all mitigation actions. The LHMC needed to select the most cost-effective actions for implementation first to use resources efficiently and develop a realistic approach toward mitigation risks. The Disaster Mitigation Act 2000 (DMA) supports this principle of cost-effectiveness by requiring action plans to follow a prioritization process that emphasizes benefits over costs. DMA 2000 states:

> *"The mitigation strategy section shall include an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs."*

Part 1: Review Benefits and Costs

As part of the planning process, the LHMC utilized Review Tools 1, 2, and 3 associated with each action identified (Exhibits 1, 2, and 3 included in Appendix I).

Part 2 Prioritize Actions – Qualitative Method, Relative Score

The LHMC utilized Method B: Prioritization using STAPLEE and Relative Scores (Exhibit 7 included in Appendix I).
STAPLEE Criteria

1. **Social**: Is the action compatible with present and future local community needs and values?
2. **T**echnical: Is the action feasible with available local resources (or as supplement by outside resources as necessary)?
3. **A**dministrative: Does the community have the administrative capacity to implement the action?
4. **P**olitical: Is there strong public support to implement and maintain the action?
5. **L**egal: Does the community have the legal authority to implement the action?
6. **E**conomic: Is the action cost-effective?
7. **E**nvironmental: Does the action impact environmental resources, and is the impact positive, negative, or neutral?

Part 3 Documentation of the Process

The Review Tools/Exhibit Worksheets will be included in the plan update, as an appendix, to emphasize that a Benefit-Cost Review was employed when prioritizing actions.

Based on the updated hazard risk assessment, risk assessment matrix, and mitigation remediation projects completed to date, the LHMC developed a revised/updated Mitigation Action Plan 2010.Furthermore, specific mitigation and planning actions have been identified, analyzed and prioritized that promote and support the Town's continued participation within the National Flood Insurance Program.

This updated Mitigation Action Plan replaces the one identified in the 2006 plan. Similar to the 2006 Plan, each mitigation action will incorporate a brief description of the intended action, responsible parties, proposed time frame for completion, approximate costs, and potential funding sources. The specific order of priority was based on the LHMC's review of hazards in light of potential risks.

Planning / Mitigation Actions

{NOTE: The following actions are differentiated as either 'planning' or 'mitigation' based on recommendations from FEMA staff noted in their preliminary Plan review of July 2010. 'Mitigation' actions are those that specifically reduce or eliminate damage from future events and adhere to criteria set forth in the HMGP. 'Planning' actions are delineated into the categories of: Preparedness (P); Maintenance (M); and, Response (R) as addressed in the aforementioned FEMA review. For the purpose of clarity 'planning' and 'mitigation' are each sequentially numbered, however there is no separate numbering distinction for 'planning' actions, regardless of category.}

Vulnerable Area #1: South Shore Water System Main

Mitigating Action #1 - Close Water Main during storms

The East Matunuck / Matunuck area water service line, located on the barrier beach, should be shut down during a storm if it is determined that the structural integrity of the line may be in jeopardy. Homeowners will be notified of precautionary actions such as use of bottled water.

{**NOTE:** This strategy represents a short term (interim) mitigation action in response to the effects of hurricanes and coastal storms. The long term action needed to address the additional hazards of climate change and sea level rise is addressed in Mitigation Action #2.}

Lead: Public Services Dept.
Other Responsible Parties: Police Dept., local EMA Director
Financing Options: town budget, grants
Timeframe: short term/interim/storm dependent
Cost: Staff time

Mitigating Action #2 - Relocation of water main

A water main between Matunuck and East Matunuck, north of Potter Pond, needs to be constructed, thereby reducing the vulnerability of the water main located along the East Matunuck barrier beach. The proposed corridor would extend from the intersection of U.S. Route 1 and Matunuck Beach Road and extend easterly along U.S. Route 1 to the intersection of Kettle Pond Drive and Old Post Road. Another point of connection would be the intersection of Succotash Road and Victoria Lane.

This action (i.e. infrastructure retrofit and relocation) will mitigate the impacts of hurricanes, coastal storms, sea level rise and climate change.

Lead: Public Services Dept.
Other Responsible Parties: RICRMC
Financing Options: town budget, grants
Timeframe: long term
Cost: $1,200,000

Vulnerable Area #2A: Matunuck Beach Road

Mitigating Action #3 – Work with CRMC to evaluate the most appropriate hard-armor shoreline protection structure, and seek funding to design, permit and install, to mitigate the long- term coastal erosion/damage to Matunuck Beach Road.

The close proximity of Matunuck Beach Road to the ocean continues to increase, given recent trends of shoreline/coastal bluff erosion. An Engineering/Planning Study was completed in 2009 to update and advance action items identified in the existing local hazard mitigation plan (2006) by specifically studying coastal hazards in the Matunuck area. The major focus of this update was an Engineering/Planning Study (Vulnerable Area #2C/ Mitigation Action #1 from the 2006 Plan) of the southerly segment of Matunuck Beach Road and the immediate environs.

An evaluation of existing and historic shoreline conditions, followed by a review of best management practices elsewhere, resulted in the development of a range of alternative shoreline mitigation measures (both soft and hard-armor solutions). A matrix of the alternative mitigation measures was created and presented to the LHMC, CRMC, and the general public at a public hearing in August 2008 for consideration. The matrix includes advantages and disadvantages, a description of the role in shoreline protection/design life, and estimated costs for each individual measure investigated (included in Appendix E).

Following the public comment period and a follow up meeting with CRMC, the LHMC determined that the soft-armor alternatives identified would not adequately protect the integrity of Matunuck Beach Road over the long-term, based on the high-energy wave environment. Four hard-armor alternatives appropriate for the site were selected for consideration and include:

> *Concrete Gravity Seawall* – Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. Gravity seawalls rely on the weight of the materials they are constructed of to provide the required stability against wave action. They require strong foundation soils to adequately support their weight.
>
> *Concrete Gravity Seawall on Steel Sheet Pile Foundation* – Steel sheet pile foundation seawalls consist of thin, interlocking sheet piles driven deeply into the ground. Drainage openings are also utilized to provide drainage from the backshore area.
>
> *Riprap Revetment* – Riprap revetments are placed on a sloping bank, depend on the stability of the underlying soil for support and require a large physical area (footprint) for construction and installation. Fill material beneath a revetment must be adequately compacted prior to installing the riprap. A riprap revetment, like other revetments, consists of two or more layers (filter and armor).
>
> *Offshore Breakwater* – Offshore breakwaters, also called bulkheads, reduce the intensity of wave action in inshore waters and thereby reduce coastal erosion. They are constructed some distance away from the coast or can be built with one end linked to the coast. The breakwaters may be small structures, placed one to three feet offshore in relatively shallow water, designed to protect a gently sloping beach and can be either fixed or floating.

Estimated costs for each of the four hard-armor alternatives selected for consideration, as well as individual cut sheets are presented below:

Structure	Cost
Concrete Gravity Seawall	$15M - $17M
Concrete Seawall on Steel Sheet Pile Foundation	$17M - $19M
Riprap Revetment	$8M - $11M
Offshore Breakwater (Reef/Rubblemound)	
Reef	$12M - $15M
Rubblemound	$25M +

Under the State of Rhode Island's <u>*Coastal Resources Management Program*</u> (a.k.a. the "Red Book") - *Table 1. Review Categories and Prohibited Activities in Tidal Waters and on Adjacent Shoreline Features (Water Type Matrices),* structural shoreline protection in Type 4 Tidal Waters is prohibited. A hard-armor structural alternative would therefore fall under *Section 130. Special Exceptions* of CRMC's regulations:

> *A. Special exceptions may be granted to prohibited activities to permit alterations and activities that do not conform with a Council goal for the areas affected or which would otherwise be prohibited by the requirements of this document only if and when the applicant has demonstrated that:*
>
> > *1) The proposed activity serves a compelling public purpose, which provides benefits to the public as a whole as opposed to individual or private interests. The activity must be one or more of the following:*
> >
> > > *(a) an activity associated with public infrastructure such as utility, energy, communications, transportation facilities, however, this exception shall not apply to activities proposed on all classes of barriers, barrier islands or spits;*
> > > *(b) a water-dependent activity that generates substantial economic gain to the state; and/or (c) an activity that provides access to the shore for broad segments of the public.*
> >
> > *2) All reasonable steps shall be taken to minimize environmental impacts and/or use conflict.*
> >
> > *3) There is no reasonable alternative means of, or location for, serving the compelling public purpose cited.*

CONCRETE GRAVITY SEAWALL

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. Gravity seawalls rely on the weight of the materials they are constructed of to provide the required stability against wave action. They require strong foundation soils to adequately support their weight.

ADVANTAGES:

- Mitigates shoreline erosion and impacts of sea level rise over long-term
- Compact design, small footprint, constructed higher up on beach
- Minimal adverse water quality impacts during construction

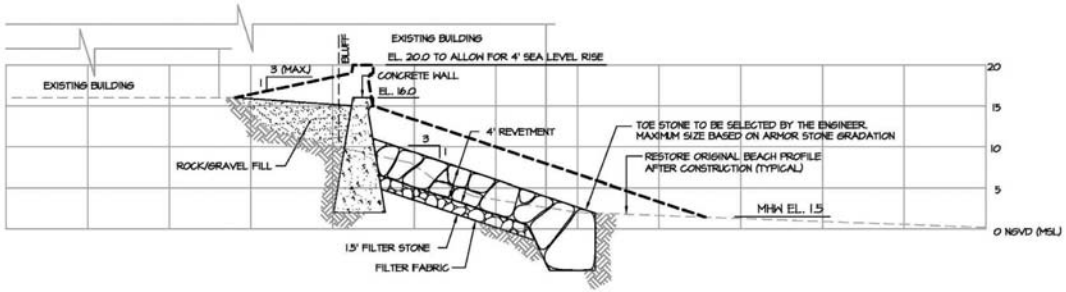
DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Medium to high initial costs
- Decreases ecological value
- Potential for end scour
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (40 - 60+ years)

APPROXIMATE COSTS:

Total project cost range $15 to 17 million

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

CONCRETE SEAWALL ON STEEL SHEET PILE FOUNDATION

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. Steel sheet pile foundation seawalls consist of thin, interlocking sheet piles driven deeply into the ground. Drainage openings are also utilized to provide drainage from the backshore area.

ADVANTAGES:

- Mitigates shoreline erosion and impacts of sea level rise over long-term
- Compact design, small footprint, constructed higher up on beach (less backland disturbance)
- Minimal adverse water quality impacts during construction

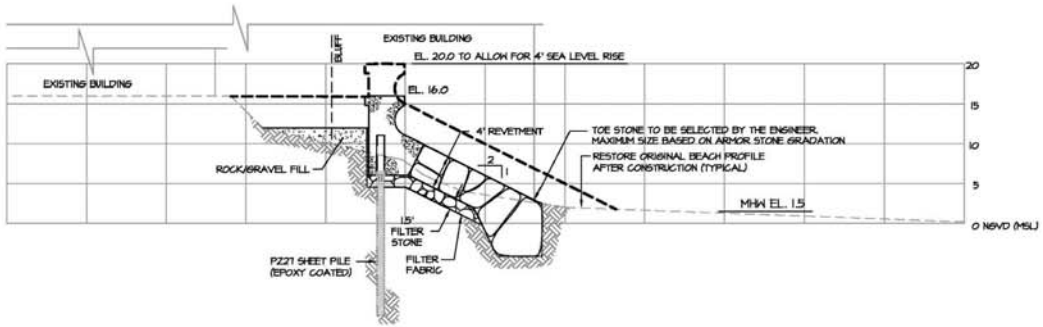
APPROXIMATE COSTS:

Total project cost range $17 to 19 million

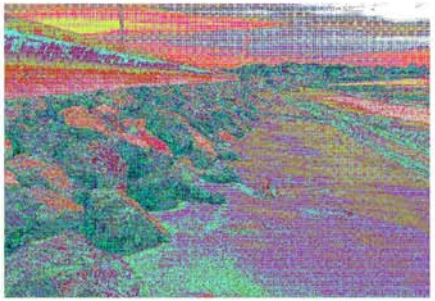
DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Medium to high initial costs
- Decreases ecological value
- Potential for end scour
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (40 - 60+ years)

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:



RIPRAP REVETMENT

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Riprap revetments are placed on a sloping bank and depend on the stability of the underlying soil for support. Fill material beneath a revetment must be adequately compacted prior to installing the riprap. Riprap revetment, like other revetments, consists of two or more layers (filter and armor).

ADVANTAGES:

- Mitigates shoreline erosion and sea level rise over long-term
- Potential for creation of additional botoom habitat
- Minimal adverse water quality impacts during construction

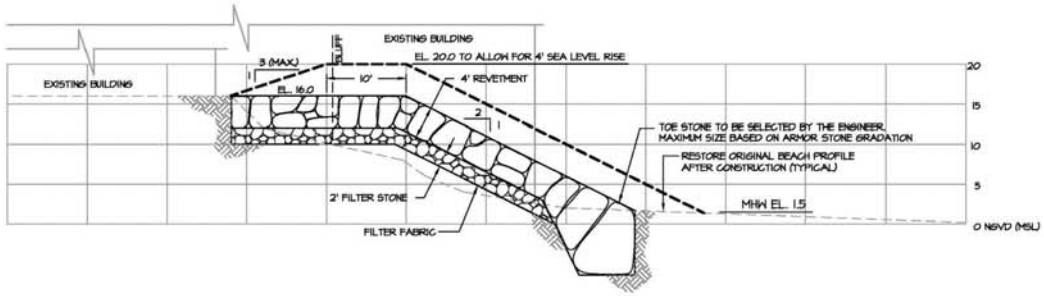
DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Large physical area (footprint) required for construction and installation
- Require periodic maintenance after major events
- Altered hydraulic conditions causes impacts to bottom habitat
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (25 - 40 years) without significant events

APPROXIMATE COSTS:

Total project cost range $8 to 11 million

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Improved stone revetment, Matunuck Beach Trailer Association.

OFFSHORE BREAKWATER

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Offshore breakwaters, also called bulkheads, reduce the intensity of wave action in inshore waters and thereby reduce coastal erosion. They are constructed some distance away from the coast or can be built with one end linked to the coast. The breakwaters may be small structures, placed one to three hundred feet offshore in relatively shallow water, designed to protect a gently sloping beach and can be either fixed or floating: the choice depends on normal water depth and tidal range.

ADVANTAGES:

- Mitigates shoreline erosion over long-term
- Potential for creation of additional habitat
- Potential for beach widening due to accretion

DISADVANTAGES:

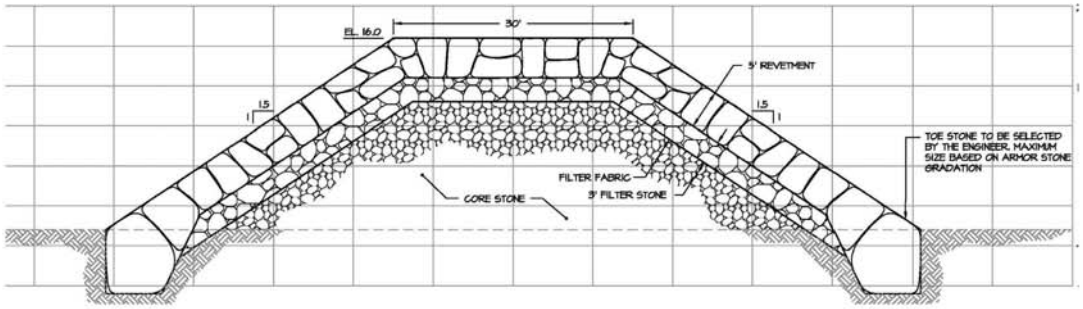
- Reduced recreational opportunities due to incrased wave action
- High initial costs
- Potential for altering adjacent coastal profile
- Altered hydraulic conditions causes impacts to bottom habitat
- Long design life expectancy (25 - 40 years) without significant events

APPROXIMATE COSTS:

Total project cost range reef: $12 - 15 million

Breakwater: 25 million +

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Shilshole breakwater, Pugent Sound, Seattle.
Photo courtesy of www.seaotter.com

B. Special exceptions may be granted only after proper notice in accordance with the Rhode Island Administrative Procedures Act, a public hearing has been held, and the record of that hearing has been considered by the full Council. The Council shall make public the findings and conclusions upon which a decision to issue a Special Exception are based.

C. In granting a Special Exception, the Council shall apply conditions as necessary to promote the objectives of the Program. Such conditions may include, but are not limited to, provisions for:

1) Minimizing adverse impacts of the alteration upon other areas and activities by stipulating the type, intensity, and performance of activities, and the hours of use and operation;
2) Controlling the sequence of development, including when it must be commenced and completed;
3) Controlling the duration of use or development and the time within which any temporary structure must be removed;
4) Assuring satisfactory installation and maintenance of required public improvements;
5) Designating the exact location and nature of development; and
6) Establishing detailed records by submission of drawings, maps, plots, or specifications.

Based on the findings of the Engineering/Planning Study, actions on behalf of the LHMC, and guidance from CRMC, it is recommended that the Town continue discussions with CRMC as to the most appropriate hard-armor shoreline protection alternative to advance. It is further recommended the Town submit conceptual engineering drawings to CRMC for 'Conceptual Review' and identify a realistic process/timeframe to secure the required permits prior to submitting an application for any FEMA-funded project assistance.

Lead: LHMC
Other Responsible Parties: Town Officials, RI CRMC, and RIEMA
Financing Options: FEMA's Pre-Disaster Mitigation Program, private business/ homeowners
Timeframe: On-going
Cost: Estimated range of $10 to $19 million, dependent on selected hard-armor solution and determined length of the structure needed to achieve the overall project goals

Planning (P) Action #1 – Tourist Evacuation and Shelter

Thousands of summer tourists visit the South Shore during hurricane season, often increasing the resident population by over 25%. Many out-of-state tourists that rent housing during the summer may not be familiar with local authorities, evacuation routes, locations of designated shelters, or know what to expect if police-enforced evacuation becomes necessary. The Police Department will distribute information on town evacuation routes and emergency shelters to hotels, bed and breakfasts, real estate agencies dealing with seasonal rentals, and other facilities and events hosting tourists and out of town visitors in the event of a natural hazard or other emergency.

Lead: Local EMA Director
Other Responsible Parties: Planning Department, South County Tourism Council, DEM Division of Parks & Recreation, LHMC, South Kingstown Chamber of Commerce
Financing Options: Town Budget
Timeframe: Short term
Cost: Staff time and material printing costs

Vunerable Area #2B: Town Beach and Pavilion/Boardwalk Facility

Mitigating Action #4 – Beach and Dune Nourishment Project

Use dredge material to enhance beaches, otherwise, identify nearest/multiple source locations for future replenishment projects. It may be possible to coordinate this project with the US Army Corps of Engineers (ACOE) dredging projects to reduce costs. Best results are obtained when wide beaches are nourished and the project includes continued maintenance. Therefore long term stable funding must be established for a project of this type. Investigate continuous funding mechanisms for beach preservation, restoration, and renourishment. *The Rhode Island South Shore Regional Sediment Management Study - Westerly to Narragansett, Draft Study Scope of Work* was released in April 2009 by the New England District U.S. Army Corps of Engineers/RICRMC and warrants future coordination on behalf of the Town.

This project mitigates the effects of hurricanes and coastal storms.

Lead: Parks & Recreation Department
Other Responsible Parties: Planning Department, Public Services Department,
ACOE, RI CRMC
Financing Options: US Army Corps of Engineers
Timeframe: US Army Corps of Engineers dredging schedule
Cost: $8 to $10 million

Mitigating Action #5 – Pavilion Facility Relocation

The Town Beach Pavilion Facility is presently located in an AO (Depth 2') Zone and adjacent to a Zone AE (El. 11). Coastal storms have induced significant erosion to the existing Matunuck headland resulting in dismantling of a pedestrian boardwalk and two outboard extensions. The only remaining segment of the original structure is the Town Beach Pavilion. The project involves relocation of the existing Town Beach Pavilion Facility 200' +/- feet further inland so as to be within an 'X' zone at Elevation 17.

In conjunction with this project will be relocation of the existing On-Site Wastewater Treatment System (OWTS). Presently the OWTS is located within a Zone 'AO' (Depth 2') and is periodically inundated by coastal flooding. A new OWTS, incorporated advanced treatment technology, will be constructed adjacent to the relocated Pavilion. As such the OWTS will be relocated into an 'X' zone, thereby mitigating coastal flood damage potential.

Lead: Planning Department
Other Responsible Parties: Parks & Recreation Dept., Public Services Dept., RI CRMC
Financing Options: Grants; Town budget
Timeframe: Short term
Cost: $400,000

Mitigating Action #6 – Create an Educational Display

Create an exhibit documenting historical flood damage in the town. The display could be located at multiple sites in town, with each site's display specific to the history of natural hazards damage that have occurred over time, remediation projects and associated costs to create awareness.

This flood education effort provides an informational outreach to the citizenry and mitigates flood impacts to the community.

Lead: LHMC
Other Responsible Parties: Planning Department, Parks & Recreation Department
Financing Options: Town Budget, grants
Timeframe: Short to medium term
Cost: Staff Time or $15,000 consultant fees

Vulnerable Area #2C: South Shore Bordering Atlantic Ocean

Planning (P) Action #2 – Develop Shoreline Management Plan

Develop a management plan for the South Shore that includes the following objectives:

- Improves understanding of coastal processes;
- Predicts the likely future evolution of the coast;
- Identifies all the assets within the area covered by the plan likely to be affected by coastal change;
- Identifies the need for regional or site specific research and investigations; and
- Identifies the various policies/procedures for hazard mitigation remediation projects.

Management plan should be considered a living document, as new information comes to light, the plan should be updated.

Town shall investigate plausibility of development of a regional shoreline management plan, possibly facilitated by the Washington County Regional Planning Council, and utilizing local expertise of various state agencies (CRMC, RIDEM) and academic institutions (URI).

Lead: Planning Department
Other Responsible Parties: RI CRMC, RIDEM, CRC, Washington County Regional Planning Council
Financing Options: Town Budget, grants, URI Internship Program, private beach/homeowners association contributions
Timeframe: Medium term

Cost: Staff Time or $50,000 for consultant fees

Mitigating Action #7 – Develop Retrofit (Dry/Wet Floodproof, Elevation) Program

Promote and support enforcement of the latest CRMC policy revisions relative to climate change and sea level rise within Rhode Island, based on coordinated efforts with the Rhode Island State Building Commission, Coastal Resources Center (CRC), and RI Sea Grant. Section 145 CRMC Regulations adopted March 4, 2008 include: *'Accommodate a base rate of expected 3 to 5 foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities'*.

Structures in the floodplain should be elevated to the 100-year base flood elevation, as well as incorporating an additional 3 to 5 foot freeboard, to accommodate projected sea level rise impacts. The Program would initially focus on coastal areas and those adjacent inland areas, subject to 100 year flood events, noted as follows. Subsequent phases would address the Middlebridge Rd. neighborhood adjacent to Narrow River.

Area	FIRM Map	Flood Zone(s)	Locus
Ocean Ridge	44009C0188H	AE (El. 11 – 13) VE (El. 13 – 14	South of Matunuck School House Rd. from town line to Green Hill Beach Rd.
Green Hill	44009C0301H	AE (El. 11 – 13) VE (El. 13 – 18)	Town line east to 1700' east of Green Hill Beach Rd.
W. Matunuck	44009C0189H	AE (El. 11 -13) VE (El. 14)	South of Matunuck School House Rd. from 5300' west of Moonstone Beach Rd. to 2600' east of Moonstone Beach Rd.
E. Matunuck	44009C0193H	AE (El. 11 – 17) VE (El. 17 – 18)	South of Rt. 1 from 2600' east of Moonstone Beach Rd. to 4980' east of Matunuck Beach Rd.
Matunuck (south)	44009C0306H	AE (El. 11 – 12) VE (El. 17 – 18)	South of Matunuck School House Rd. from 1200' west of Roy Carpenter Beach Rd. to 2100' east of Ocean Ave.

The Town will make available the following FEMA manuals that reference coastal construction practices for homeowners and contractors: *Home Builders Guide to Coastal Construction* (Publication #499); and, *Coastal Construction Manual* (Publication # 55CD Third Edition).

Consider developing public/private partnership incentives to implement mitigation measures in coordination with local, state, and federal funding opportunities. Incentives could include tax incentives, cost sharing, and regulatory streamlining or acceleration of the permit process for those who implement mitigation activities.

Lead: Building Official
Other Responsible Parties: RI CRMC, Planning Department
Financing Options: Private homeowners, grants, NFIP
Timeframe: Medium to long term
Cost: Dependent upon type/number of structures

Planning (P) Action #3 - Low-Impact Development

Integrate broad principles of Sustainable/Low-Impact Development (LID) techniques in local subdivision regulations and site/neighborhood development plans.

Lead: Planning Department
Other Responsible Parties: RI CRMC, RIDEM, Building Department
Financing Options: N/A
Timeframe: Short to medium term
Cost: Staff time

Mitigating Action #8 - Open Space Acquisitions

Over the last ten years, the Town of South Kingstown has worked closely with The Nature Conservancy, U.S. Fish & Wildlife Service, South Kingstown Land Trust and Narrow River Land Trusts in coordinating an aggressive open space acquisition program. Maintaining and securing land as open space in flood zones is one way to keep the number of people and homes vulnerable to severe storms and flooding from expanding. Special consideration should be given to erosion-prone areas or floodplains where the acquisition of several adjacent properties will serve a higher purpose in reducing the risk of displacement, loss of life and damage to personal property.

The Planning Dept., in coordination with the LHMC will develop a list of priority lots to consider for acquisition in flood-prone areas that would provide public access or that have experienced recurring flood damage.

Acquisition of properties located within floodplains will mitigate the impacts of flooding generated by a variety of natural hazards.

Lead: Planning Department
Other Responsible Parties: LHMC, South Kingstown Land Trust, Narrow River Land Trusts RIEMA/FEMA, The Nature Conservancy, U.S. Fish & Wildlife Service
Financing Options: FEMA grants, Land acquisition bonds (state and municipal), RIDEM grants, USDA/NRCS funds
Timeframe: Long-term
Cost: Variable, site-specific

Planning (P) Action #4 - Business Continuation

The Town will work with the Chamber of Commerce to develop strategies that help local businesses in flood prone areas recover from the effects of a natural disaster. These strategies will include organizing business owners for collective clean-up of their properties after a disaster and the creation of a list of businesses and the people connected with those businesses that are authorized to enter the business in the period of time immediately following a disaster. This list would be used by the Police Department in their role of guarding properties after a disaster. The Police Department will develop criteria for determining when safety considerations outweigh the rights of a given business owner to access their property.

Lead: South Kingstown Chamber of Commerce and Planning Dept.
Other Responsible Parties: SKPD, EMA, Fire Districts
Financing Options: N/A
Timeframe: Incident based
Cost: Staff time

Mitigating Action #9 - Community Rating System

Strongly encourage participation in the NFIP's Community Rating System (CRS) program to enhance floodplain management, reduce flood risks and losses, and educate the public.

Lead: Planning Department
Other Responsible Parties: State Floodplain Coordinator
Financing Options: N/A
Timeframe: Medium to long term
Cost: Staff time or $15,000 consultant fees

Planning (P) Action #5 - Volunteer Disaster Assistance Program

Volunteers working at the community level, or even at the neighborhood level, can be a tremendous asset to hazard mitigation efforts before, during, and after a natural hazard event. A community member acting as a Volunteer Disaster Assistance Officer could coordinate community mitigation activities, act as a local hazard information resource, and offer assistance to residents not able to help themselves. In preparation for an impending disaster, volunteers can help residents prepare their homes and facilitate evacuations if necessary. After a disaster, qualified volunteers could provide an initial damage report to town agencies and aid resident clean-up efforts. These volunteers could be associated with homeowner associations, neighborhood watch groups, or neighborhood preservation groups.

The Town will consider providing the framework under which these organizations would be created, limited funding, and a weekend long training session consistent with the existing emergency management operations within the town. The training session should include discussion of liability issues, hazard mitigation techniques that homeowners can perform, a description of how the town would operate during and after an emergency, and other information deemed necessary

Lead: SK Police/EMA/Fire
Other Responsible Parties: Planning Department, RIEMA, FEMA, WCRPC
Financing Options: Town Budget, grants
Timeframe: Short to medium term
Cost: Staff time or dependent upon training provided

Planning (M) Action #6 – Over Wash Sand Removal

Remove only that over wash that is necessary to allow for entrance and use of houses, and other structures. Wherever possible, over wash 'should be left on non-paved roads, driveways, and parking lots in order to allow the natural barrier rollover to continue and to maintain the higher

elevation' (RICRMC Salt Pond SAMP). Sand that has been deemed necessary to remove should be stored in a protected place for debris removal, evaluation and later deposition.

Lead: Public Services Department
Other Responsible Parties: RI CRMC, RIDEM, RIDOT, local EMA
Financing Options: Town Budgets, grants
Timeframe: Short term
Cost: Highway Dept. man-hours per event

Planning (R) Action #7 - Recovery and Reconstruction Ordinance

The Town should utilize the opportunity of a disaster to improve it's disaster resilience. Once critical life and safety issues and vital public services have been addressed and re-established, emphasis should be placed on the long-term recovery of the community, balancing the need to rebuild rapidly and return to normal against the objective of building back better and stronger.

A Regional Recovery and Reconstruction Ordinance could identify/facilitate resource and cost-sharing opportunities, as well as higher utilization of municipal services to those areas within the region most in need.

Lead: Planning Department
Other Responsible Parties: RI CRMC, RIDEM, WCRPC, Building Official
Financing Options: Town budget, grants
Timeframe: Short to medium term
Cost: Staff time or $15,000 consultant fees

Planning (P) Action #8 – Beach Closings

During major storm events the Police Department will follow local preparedness plans to restrict access to the public away from flood prone areas especially local beaches and low-lying areas such as Matunuck Beach Road.

Lead: Police Department
Other Responsible Parties: local EMA
Financing Options: N/A
Timeframe: Incident based
Cost: Staff time, additional/overtime expenses for SKPD personnel

Plannning (P) Action #9 – Public Information, Outreach and Incentive Program

South Kingstown will provide information to contractors and homeowners on risks of building in hazard-prone areas and inform builders and homeowners of the benefits of building and renovating structures to current standards. The Town will use FEMA's *Home Builders Guide to Coastal Construction* (Publication #499), FEMA's *Coastal Construction Manual* (Publication # 55CD Third Edition), *No Adverse Impact (NAI) Coastal Land Management Guidelines* developed by the Association of State Floodplain Managers, and other FEMA publications.

The use of informational signs at areas of historic flooding/surge elevations and inland areas that are susceptible to flooding can be a useful tool to integrate hazard mitigation into daily routines.

Lead: Planning Department
Other Responsible Parties: RI CRMC, RIDEM, Building Department, Washington County Regional Planning Council
Financing Options: N/A
Timeframe: Short to medium term
Cost: Staff time

Vulnerable Area #3: Dams - earthen, stone and masonry types: most noteworthy being those designated as 'high' or 'significant' hazard dams. In addition the numerous small dams located throughout town.

Planning (R) Action #10 - Detailed Dam Inspections with Necessary Repairs

A detailed inspection of major privately owned dams in town is needed to assess their present structural integrity. Based on results of the dam inspections a list of priorities for repair would be developed. The Town should monitor dam owner compliance with DEM's Rules and Regulations for Dam Safety, December 2007, as amended.

Lead: Private Dam Owners
Other Responsible Parties: RIDEM, Public Services Dept.
Financing Options: Homeowners Associations contributions, town budget, grants
Timeframe: short term; medium term (dependent on urgency of particular situation as it concerns structural integrity of each dam)
Cost: Cost of inspections dependent upon size and design complexity of dam; cost of dam repairs dependent upon need as recommended by detailed inspection

Planning (P) Action #11 - Provide Dam Safety Information

The Town should work with RIDEM to provide dam safety information to those individuals and associations having responsibility for the maintenance and rehabilitation of dams under their ownership.

This action promotes education through community engagement.

Lead: LHMC
Other Responsible Parties: Public Services Dept.; RIDEM
Financing Options: town budget, grants
Timeframe: medium term
Cost: $1600 (40 staff man hours @ $40/hr.)

Planning (P) Action #12 – Emergency Action Plan (EAP) Compliance

Staff should update required Emergency Action Plan (EAP), as warranted, for 'significant' and 'high' hazard dams as required per applicable R.I.G.L.

Lead: LHMC
Other Responsible Parties: Public Services Dept.
Financing Options: town budget, grants
Timeframe: medium term
Cost: 120 +/- man-hours

Vulnerable Area #4A: Barrier Beaches and Coastal Ponds
(See vulnerable area 2C)

Planning (P) Action #13 - OWTS switches

Installation of switches on OWTS pumps allowing them to be turned off and providing protection from brown outs and power surges. Provide public info pamphlet educating homeowners of this option.

Lead: Planning Dept.
Other Responsible Parties: Building Official's Office
Financing Options: town budget, grants
Timeframe: medium
Cost: Dependent upon number of units needed (TBD)

Vulnerable Area #4B: Pettaquamscutt River - Middlebridge Area

Planning (P) Action #14 - Engineering/Planning Study to Identify Issues & Mitigation Strategies

A study should be performed to identify the various problems associated with Pettaquamscutt River flooding of the Middlebridge area. This study should include development of information on evacuation procedures/routes and assessment of existing flood prone areas with development of possible storm mitigation strategies.

Lead: Planning Dept.
Other Responsible Parties: Public Services Dept., Police Dept., RICRMC
Financing Options: budget, grants
Timeframe: short to middle term
Cost: Staff time or $20,000 (consultant fees)

Vulnerable Area #5A: Middlebridge Bridge

Planning (M) Action #15 - Bridge Monitoring

RIDOT completed the Middlebridge Bridge reconstruction project within the past decade. The Town should continue to work closely with the Town of Narragansett to ensure all significant local issues are addressed (i.e. infrastructure).

Lead: Public Services Dept., Town of Narragansett
Other Responsible Parties: Police Dept., Planning Dept., RICRMC
Financing Options: N/A
Timeframe: medium

Cost: Staff time

Vulnerable Area #5B: Saugatucket Road

Planning (P) Action #16 - Area Study to Identify Issues & Develop Strategies

A study should be performed to identify the various flooding problems in and around the Saugatucket Road area. The study would include identification of possible strategies to alleviate flooding and mitigate potential hazards to residents and structures.

Lead: Public Services Dept.
Other Responsible Parties: Planning Dept.
Financing Options: N/A
Timeframe: short to medium term
Cost: Staff time or $20,000 (consultant fees)

Vulnerable Area #5C: Potter Pond Channel Bridge

Planning (M) Action #17 - Bridge Inspection

RIDOT has completed the Potter Pond Bridge design and construction. The Town should work closely with RIDOT regarding present and future infrastructure connections to the bridge. In addition, periodic inspections should be undertaken to ensure the structural integrity of the bridge (which provides the only means of access and egress for Jerusalem residences and businesses.

Lead: RIDOT
Other Responsible Parties: Public Services Dept., RICRMC, Police Dept.
Financing Options: Federal/State funds
Timeframe: short term (bridge reconstruction), medium term (other issues)
Cost: Staff time

Vulnerable Area #6: Utility and Tree Damage

Planning (M) Action #18 – Tree Maintenance

Excessive tree damage causes power/communication loss, blocked roadways, E911 response delays, and related inconveniences. The Town should continue to follow its Master Tree Plan concerning proper maintenance/removal of trees with an emphasis on heavily treed urban residential neighborhoods.

Lead: Public Services Dept. - Tree Warden
Other Responsible Parties: Utility companies, Conservation Commission
Financing Options: town budget, RIDEM grants, federal grants
Timeframe: short term (tree maintenance) to long term (improved utility system)
Cost: $35,000 annually

Vulnerable Area #7: Boat Ramps

Planning (P) Action #19 – Boat Ramp Demand Needs Assessment

Presently there is the anticipated heavy demand on boat ramps in response to a projected hurricane or other severe storm. The Town should assess the present demand on each of the boat ramps in town (both private and municipal) to ensure adequacy of facilities. Consideration should be given to undertake a feasibility study to identify other potential boat ramp locations if the preliminary assessment indicates a need for such facilities.

Lead: Harbormaster
Other Responsible Parties: Public Services Dept.; RICRMC
Financing Options: budget, grants
Timeframe: short to medium term
Cost: Staff time or $25,000 (consultant fees for feasibility study)

Vulnerable Area #8 : "Evacuation Route" and "Storm Surge Elevation" signs

Planning (P) Action #20 – Signage

Evacuation route signs have been installed and storm surge elevation signs should be installed to assist residents. Evacuation route signs will direct residents to shelter facilities and indicate routes out of the areas subject to flooding and storm surge. The storm surge elevation signs would provide an educational benefit to inform residents of past storm elevations. Printed information, detailing evacuation and storm surge information, should be made available to the public.

Lead: Police Dept.
Other Responsible Parties: Public Services Dept., RICRMC, RIEMA
Financing Options: budget, grants
Timeframe: short term
Cost: $5,000

Vulnerable Area #9: Fire Protection

Planning (P) Action #21 – Fire Response Assessment

An assessment should be performed to determine the adequacy of present fire protection capabilities, equipment and facilities with an emphasis on more remote rural areas located in areas that depend on wells for water supplies.

Lead: Fire Districts
Other Responsible Parties: Public Services Dept., Planning Dept.
Financing Options: Fire District tax revenues, grants
Timeframe: short term to long term
Cost: $15,000 (consultant fees)

Vulnerable Area #10: Underground Fuel Tanks

Planning (P) Action #22 – Underground Fuel Storage Tank Risk Assessment

The Town should meet with RIDEM to review the present underground fuel tank storage inventory in South Kingstown to identify potential risks. Strategies to mitigate possible risks should be formulated.

Lead: RIDEM
Other Responsible Parties: Public Services Dept.
Financing Options: State grants, budget
Timeframe: short term to long term
Cost: Staff time

Vulnerable Area #11: Ocean Avenue Pedestrian Ramp

Planning (M) Action #23 – Pedestrian Ramp Maintenance

The Ocean Avenue pedestrian ramp was reconstructed in 2007. The ramp should be inspected on a regular basis to assess structural integrity and determine the need for and feasibility of rehabilitation where required.

Lead: Public Services Dept.
Other Responsible Parties: RIDEM, RICRMC
Financing Options: grants, budget
Timeframe: short term
Cost: Staff time

Vulnerable Area #12: Lights/Poles at Town Facilities

Mitigation Action #10 – Solar Powered Lighting

Recreational fields (i.e. Old Mountain Field, Broad Rock Middle School Playfields) would most likely serve as temporary staging area for disaster and post disaster periods including use of these fields for temporary debris storage and encampment areas for the National Guard. Loss of power to these facilities would hamper nighttime activities.

An investigation into methods to better ensure power to these fields should be undertaken and system upgrades incorporated on an 'as needed' basis. In addition, solar powered lighting and associated support structures should be installed to ensure the debris staging and/or emergency personnel encampment areas are functional twenty four hours a day.

Lead: Parks & Recreation Dept.
Other Responsible Parties: Public Services Dept.
Financing Options: budget, grants
Timeframe: medium term
Cost: $15,000 for feasibility study
$ 250,000 for purchase and installation of solar lighting

4.0 – IMPLEMENTATION SCHEDULE

The assignment of a time frame to each mitigation action listed in the plan allows these actions to be coordinated with other government functions, e.g. budget hearings. Setting time frames also allows for the progress of each action to be followed more closely.

4.1 Strategy Adoption

The Town of South Kingstown Multi-Hazard Mitigation Strategy Plan was initially reviewed and approved by the Town Council on March 27, 2006. The South Kingstown Town Council approved the revised Plan on April 10, 2006 that incorporated final FEMA suggested amendments. FEMA subsequently approved the final Plan on April 16, 2006.

The final draft of the Plan update will be presented to the Town Council on XXXXX. Once the Town has received RIEMA and FEMA approval, the Update (pending any necessary revisions) will be presented to the Town Council for approval by resolution and incorporated into the South Kingstown Comprehensive Community Plan.

4.2 Implementation, Evaluation, and Revision

Implementation

A revised/updated Mitigation Action Plan (2010), has been developed by the LHMC based on the updated hazard risk assessment, risk assessment matrix (Table 3.3), and mitigation remediation projects completed to date. Many of the actions listed are, in actuality, on-going programs, other actions may require regular maintenance.

The Local Hazard Mitigation Team will work with the Town's administrative staff and officials to integrate the updated hazard mitigation and planning goals and actions into the general operations of its government and partner organizations. The South Kingstown Civil Defense Preparedness and Hurricane Plan, Harbor Management Plan, and Emergency Operations Plan (Municipal Administration Plan for Hazard Mitigation) will incorporate the updated goals and actions by reference.

Due to the nature of updated goals and actions, implementation should be a part of staff work plans. Departmental/organizational work plans, policies and procedures will be updated to include hazard mitigation concepts and actions, as well as, revisions to job descriptions to further institutionalize hazard mitigation. In addition, the LHMC will request that department heads provide progress reports on the hazard mitigation initiatives each department is responsible for carrying out. This will facilitate the LHMC quarterly evaluation of the strategy plan. Involvement of volunteer groups should be coordinated with local officials in order that actions are accomplished efficiently.

The LHMC will be expanded to include representation from: South County Hospital; The Chamber of Commerce; Town of South Kingstown Communications Department; and, South Kingstown School Department. This expanded LHMC membership will ensure direct involvement from all major private and public sector stakeholders in the community.

Evaluation

Quarterly meetings of the LHMC will be scheduled during the calendar year to ensure that mitigation actions are being carried out according to assigned time frames and to assess the effectiveness of completed actions. The strategy plan will be reviewed at each LHMC meeting and updated on a semi-annual basis, at a minimum and as actions are completed and other vulnerabilities are found. The town also needs to be aware of funding cycles and grant application deadlines when discussing priorities to ensure that potential financial assistance is applied for and procured. Use of funding will be periodically reviewed as regards the degree of efficiency.

All LHMC meetings will be duly advertised and open to the public per provisions of the Rhode Island open meetings laws and Town of South Kingstown rules and regulations. Notice of LHMC meetings will also be mailed to those civic/neighborhood associations located within areas most prone to natural disaster (i.e. residential areas along the coastal zone). Educational materials will be made available periodically to the citizenry. In addition, the Town will work with local newspapers to have articles printed that inform the public regarding potential natural hazards and local disaster mitigation initiatives.

Revision / Update

This strategy should be updated on a semi-annual or 'as needed' basis, whichever occurs earliest. Upon local approval of the revisions, any changes should be submitted to RIEMA to ensure consistency with statewide goals and objectives. In addition to semi-annual evaluation, the strategy should also be updated following any natural disaster, and the effectiveness of each completed action should be assessed. Natural disasters provide the opportunity to assess implemented mitigation strategies. This assessment would result in a modification of those less than effective measures.

Once incorporated into the Comprehensive Community Plan, the Multi-Hazard Mitigation Strategy Plan Update will be updated every five (5) years. The required five-year update is mandated under Rhode Island General Law, Chapter 45-22.2.

Coordination With Town Statutes

All proposed strategy revisions will be reviewed to ensure coordination and conformance with Town of South Kingstown goals, policies and regulations as found in applicable Town documents including, but not limited to:

Town Code	Comprehensive Community Plan
Zoning Ordinance	Subdivision and Land Development Regulations
Wellhead Protection Plan	Capitol Improvement Program
Harbor Management Plan	On-Site Wastewater Management Ordinance
Tree Ordinance	Water Supply Management Plan
Hurricane Plan	Civil Defense Preparedness Plan

Similarly any proposed amendments to the policies and regulations of the above noted Town documents will be reviewed to ensure conformance with this Multi-Hazard Mitigation Strategy Plan.

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APPENDIX A

TOWN COUNCIL APPROVAL RESOLUTION

Town of South Kingstown, R.I.

TOWN CLERK'S OFFICE

CLERK OF THE TOWN COUNCIL AND PROBATE COURT

Town Hall, 180 High Street
Wakefield, Rhode Island 02879

Dale S. Holberton
Town Clerk & Probate Clerk
401-789-9331

At a REGULAR SESSION of the Town Council of the Town of South Kingstown, County of Washington, in the State of Rhode Island, held at the Town Hall, in and for said Town on the 23rd day of January A.D., 2006 at 7:30 PM.

PRESENT: Mary S. Eddy, President
Kathleen A. Fogarty, Vice President
Cynthia B. Gleason
James W. O'Neill
Paul Tasich

UNANIMOUSLY VOTED: to approve the Multi-Hazard Mitigation Strategy Plan – Strategies for Reducing Risks from Natural Hazards in South Kingstown, Rhode Island, November 2005 and to forward the Plan to the Rhode Island Emergency Management Agency and Federal Emergency Management Agency for their review and action. Further, to give consideration to incorporating the Plan into the South Kingstown Comprehensive Community Plan at a future date.

A TRUE COPY

ATTEST: Dale S. Holberton
Dale S. Holberton, Town Clerk

Town of South Kingstown, R.I.

TOWN CLERK'S OFFICE

CLERK OF THE TOWN COUNCIL AND PROBATE COURT

Town Hall, 180 High Street
Wakefield, Rhode Island 02879

Dale S. Holberton
Town Clerk & Probate Clerk
401-789-9331

At a REGULAR SESSION of the Town Council of the Town of South Kingstown, County of Washington, in the State of Rhode Island, held at the Town Hall, in and for said Town on the 10th day of April A.D., 2006 at 7:30 PM.

PRESENT: Mary S. Eddy, President
Kathleen A. Fogarty, Vice President
Cynthia B. Gleason
James W. O'Neill
Paul Tasich

UNANIMOUSLY VOTED: to approve proposed amendments dated March 2006 to the *Multi-Hazard Mitigation Strategy Plan – Strategies for Reducing Risks from Natural Hazards in South Kingstown, Rhode Island,* November 2005 as presented in a memorandum from Principal Planner Nickerson to the Town Manager dated March 31, 2006 and entitled: "Multi-Hazard Plan Amendments"; and to forward the Plan as amended March 2006 to the Rhode Island Emergency Management Agency and Federal Emergency Management Agency for their review and final approval.

A TRUE COPY

ATTEST: Dale S. Holberton
Dale S. Holberton, Town Clerk

APPENDIX B

TECHNICAL AND FINANCIAL ASSISTANCE FOR MITIGATION

APPENDIX B: TECHNICAL AND FINANCIAL ASSISTANCE FOR MITIGATION

(Taken from Massachusetts Department of Environmental Management Flood Hazard Management Program, Flood Hazard Mitigation Planning: A Community Guide, June 1997)

STATE RESOURCES

Rhode Island Emergency Management Agency
645 New London Avenue
Cranston, RI 02920
Tel: (401) 946-9996

Coastal Resources Center
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882
Tel: (401) 874-6224

Coastal Resources Management Council
Stedman Government Center
4808 Tower Hill Road
Wakefield, RI 02879
Tel: (401) 277-2476

Rhode Island Geological Survey
8 Ranger Road, Suite 2
University of Rhode Island
Kingstown, RI 02881
Tel: (401) 874-2265

Department of Administration, Division of Planning
One Capitol Hill
Providence, RI 02908
Tel: (401) 277-6478

State of Rhode Island Building Committee Office
Building Commissioner's Office
One Capitol Hill
Providence, RI 02903
Tel: (401) 277-3529

Rhode Island Builders' Association
The Terry Lane Corporation
Terry Lane
Gloucester, RI 02814
Tel: (401) 568-8006

Department of Transportation–Design Section/Bridges
2 Capitol Hill, Room 231D
Providence, RI 02903
Tel: (401) 277-2053

Rhode Island Department of Business Regulations
233 Richmond Street
Providence, RI 02903
Tel: (401) 277-2246

State Fire Marshal's Office
24 Conway Avenue
Quonset/Davisville Park
North Kingstown, RI 02852
Tel: (401) 294-0861

Associate Director, Rhode Island Banking Commission
233 Richmond Street
Providence, RI 02903
Tel: (401) 277-2405

Public Utilities Commission
100 Orange Street
Providence, RI 02903
Tel: (401) 277-3500 Ext. 153

Department of Environmental Management, Division of Parks and Recreation
2321 Hartford Avenue
Johnston, RI 02919
Tel: (401) 277-2635

FEDERAL RESOURCES

Federal Emergency Management Agency
Mitigation Division
Region I Office
J.W. McCormack POCH, Room 462
Boston, MA 02109
Tel: (617) 223-9561

U.S. Army Corps of Engineers
New England District
424 Trapelo Road
Waltham, MA 02254
Tel: (617) 647-8505

Department of Agriculture, Natural Resources Conservation Service
(formerly Soil Conservation Service)
451 West Street
Amherst, MA 01002
Tel: (413) 253-4362

Department of Commerce, National Weather Service
Forecast Office
445 Myles Standish Boulevard
Taunton, MA 02780
Tel: (508) 823-2262

Economic Development Administration
143 North Main Street, Suite 209
Concord, NH 03301
Tel: (603) 225-1624

Department of the Interior, National Park Service
Rivers and Trails Conservation Program
Regional Office
15 State Street
Boston, MA 02109
Tel: (617) 223-5203

U.S. Fish and Wildlife Service
New England Field Office
22 Bridge Street, Unit #1
Concord, NH 03301-4986

Department of Housing and Urban Development
Community Development Block Grants
Region I - O'Neill Federal Building
10 Causeway Street
Boston, MA 02222
Tel: (617) 565-5354

Small Business Administration
360 Rainbow Boulevard South, 3rd Floor
Niagara Falls, NY 14303
Tel: (716) 282-4612 or (800) 659-2955

Environmental Protection Agency
Region I - JFK Federal Building
Government Center
Boston, MA 02203
Tel: (617) 565 3400

NATIONAL/REGIONAL RESOURCES

Institute for Business and Home Safety (IBHS)
(formerly Insurance Institute for Property Loss Reduction)
An insurance industry-sponsored, nonprofit organization dedicated to reducing losses—deaths, injuries, and property damage—resulting from natural hazards. IBHS efforts are directed at five specific hazards: flood, windstorm, hail, earthquake, and wildfire. Through its public education efforts and information center, IBHS communicates the results of its research and statistical gathering, as well as mitigation information, to a broad audience. http://www.ibhs.org

New England States Emergency Consortium (NESEC)
NESEC conducts public awareness and education programs on natural disaster and emergency management activities throughout New England. Brochures and videotapes are available on such topics as earthquake preparedness, mitigation and hurricane safety tips. http://www.serve.com/NESEC

The New England Floodplain and Stormwater Managers Association (NEFSMA)
Professional organization for New England floodplain and stormwater managers. Provides workshops, conferences, and a newsletter to membership and interested individuals and companies. Contact: Nicholas Winter, chairman, at (617) 727-0488. http://www.seacoast.com/~nefsma

APPENDIX C

EXISTING PROTECTION SYSTEMS – FEDERAL AND STATE

APPENDIX C: EXISTING PROTECTION SYSTEMS – FEDERAL AND STATE

(Taken from Massachusetts Department of Environmental Management Flood Hazard Management Program, Flood Hazard Mitigation Planning: A Community Guide, June 1997)

Coastal Barrier Resource Act

Administered by the U.S. Fish and Wildlife Service, this program has mapped public and private land identified as undeveloped coastal barrier areas. These areas may be denoted as "Otherwise Protected Areas" if they are owned by public entities. In the coastal barrier areas shown on FEMA's Flood Insurance Rate Maps, structures newly built or substantially improved after the date shown on the maps are ineligible for federal flood insurance. This serves to restrict new development in these areas because the purchase of flood insurance is required to obtain federally backed mortgages and improvement loans for structures located in special flood hazard areas.

State Barrier Beaches

RI CRMC has defined barrier beaches and enforces regulations applying to these areas. These regulations restrict alteration of the beach and/or dunes and the construction of coastal engineering structures. New or substantially reconstructed buildings generally must be elevated to a minimum of 1 foot above base flood elevation. No new commercial development is allowed on barrier beaches. If a structure is damaged more than 50 percent it cannot be rebuilt.

Warning Systems and Emergency Operations Plans

Rhode Island communities may have flood warning systems in place, and should have plans for response to flooding. In addition, RIEMA has offices throughout the state that maintain area-wide plans for flood events.

Evacuation Plans and Systems

Each community's emergency operations center should have evacuation plans in place. For communities near a nuclear power plant, evacuation plans are required, and may also be used for flood evacuation. RIEMA may have additional evacuation plan information.

Land Use Restrictions

There are several federal and state regulations that restrict land use in certain areas to help reduce flood hazard vulnerability. For example, community has open land owned by the state or federal government, examine what restrictions are placed on its development. In addition, the state Wetlands Protection Act regulates the development of all lands identified as significant to the protection of resources identified in the act.

Septic Systems

If there are areas in the community not served by a public sewer system, state septic system regulations influence development and may be a consideration for mitigation alternatives that include rebuilding and elevation of structures. Specific design requirements must be met for any construction in coastal velocity zones or river floodways. Generally, an inspection of a septic system is required if there is a change in use of the structure, an increase in flow, or a failed system. Limited inspections are required if the footprint of the structure is being changed. Upgrades are required by the state if an inspection reveals a failed system. However, local regulations may be more restrictive than state requirements, requiring inspections or upgrades in other cases.

APPENDIX D

FINANCING OPTIONS

APPENDIX D: FINANCING OPTIONS

FEDERAL EMERGENCY MANAGEMENT AGENCY

National Flood Insurance Program (NFIP)

All of Rhode Island's 39 municipalities participate in the NFIP. Flood insurance is made available to residents in exchange for municipal compliance with the minimum floodplain management regulations. Communities participating in the NFIP must:

- Adopt the Flood Insurance Rate Maps as an overlay regulatory district
- Require that all new construction or substantial improvement to existing structures in the flood hazard area be elevated or floodproofed to the identified flood level on the maps
- Require design techniques to minimize flood damage for structures being built in areas subject to riverine flood or coastal high hazard areas

Since homeowners' insurance does not cover flooding, a community's participation in the NFIP is vital to protecting property in the floodplain as well as ensuring that federally backed mortgages and loans can be used to finance floodprone property.

If a community participating in NFIP's Community Rating System (CRS) program performs activities that include maintaining records for floodplain development, publicizing the flood hazard, improving flood data and planning, for floodplain management then the flood insurance premiums paid by policy holders in the community will be reduced by 5 to 45 percent. Developing a flood mitigation plan or a multi-hazard mitigation plan will help communities gain additional credit under the CRS.

For further information contact the state of Rhode Island floodplain manager. Tel: (401) 946-9996 or FEMA Region I. Tel: (617) 223-9561.

Flood Mitigation Assistance Program

Two programs that have been authorized under the National Flood Insurance Reform Act of 1994 include the Flood Mitigation Assistance (FMA) program and a provision for increased cost of compliance (ICC) coverage. FMA makes grants available on a pre-disaster basis for flood mitigation planning and activities, including acquisition, relocation and retrofitting of structures. FMA grants for mitigation projects will be available only to those communities with approved hazard mitigation plans. ICC coverage has recently been implemented for all new NFIP policies and renewals and is intended to be "mitigation insurance." This will allow homeowners whose structures have been repeatedly or substantially damaged to cover the cost of elevation and design requirements for rebuilding with their flood insurance claim up to a maximum of

$15,000. Each state has the discretion to award funds to communities or to state government agencies. The program may fund up to 75 percent of the total cost of the proposed project, with a minimum of 25 percent of the cost coming from the community. A minimum of half the community share must be cash or "hard match." There are limits on the frequency of grants and the amount of funding that can be allocated to a state or community in any 5-year period.

The RIEMA receives about $110,000 to award as grants from the FEMA every April plus $12,000 for planning and $12,600 for technical assistance. In order to be eligible for these grants, communities must have a flood mitigation plan or a multi-hazard mitigation strategy. Communities that are suspended or on probation from NFIP are not eligible. In 1998, Charlestown, RI received over $108,000 to help implement the recommended mitigation activities that are to be amended into the local comprehensive plan. In 1999, Pawtucket, RI received $100,000 to floodproof city hall, which is located along the Blackstone River (the lowest elevation in the city).

For further information contact the State of Rhode Hazard Mitigation Officer. Tel: (401) 946-9996 or FEMA Region I. Tel: (617) 223-9540.

Hazard Mitigation Grant Program (HMGP):

Also known as the 404 Program, HMGP is available only after a federally declared disaster occurs, so the amount available varies with each disaster. It represents an additional 15 percent of all the infrastructure and individual assistance funds that are provided to states to repair damages and recover from losses, and is administered by the state in partnership with FEMA. Having a plan or completed mitigation action matrix prior to a disaster event is extremely helpful in meeting the state's deadlines for applications and ensuring the project is eligible and technically feasible. HMGP provides 75/25 matching grants on a competitive basis to state, local and tribal governments, as well as certain nonprofit organizations that can be matched by either cash or in-kind services. The grants are specifically directed toward reducing future hazard losses and can be used for projects protecting property and resources against the damaging effects of floods, earthquakes, wind and other hazards. Specific activities encouraged under the HMGP include acquiring damaged structures and turning the land over to the community for open space or recreational use, relocating damaged or damage-prone structures out of the hazard area, and retrofitting properties to resist the damaging effects of disasters. Retrofitting can include wet- or dry-floodproofing, elevation of the structure above flood level, elevation of utilities or proper anchoring of the structure.

For further information contact the State of Rhode Island Hazard Mitigation Officer. Tel: (401) 946-9996 or FEMA Region I. (617) 223-9540.

Project Impact

This FEMA initiative is designed to help create "disaster resistant" communities. RIEMA and the State Hazard Mitigation Committee select and nominate municipalities that are either high-risk or have demonstrated pro-active efforts to help safeguard their community. The city of Warwick was nominated as Rhode Island's first Project Impact city and it serves model to other municipalities. In 1999, Warwick received $300,000 for implementation of mitigation measures. FEMA expects Congress to approve this funding each year.

For further information contact the RIEMA Project Impact Program Coordinator. Tel: (401) 874-6224 or FEMA Region I. Tel: (617) 223-4175. http://www.fema.gov/

NATIONAL WEATHER SERVICE (NWS)

The Taunton, Massachusetts NWS office has developed a partnership with RIEMA. NWS donates staff time and tide gauges to help gain more lead time for evacuation.

For further information contact NWS. Tel: (508) 823-2262. http://www.nws.noaa.gov/

AMERICAN RED CROSS

The American Red Cross chapter of Rhode Island has supplied public education materials and volunteered to conduct training programs and hold seminars for the Rhode Island Hazard Mitigation Project.

For further information contact the Rhode Island Chapter of the American Red Cross. Tel: (401) 831-7700. http://www.redcross.org

U.S. ARMY CORPS OF ENGINEERS

Beneficial Uses of Dredged Material - Section 204, Water Resources Development Act of 1992, as amended, authorizes projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging an authorized federal navigation project. Non-federal sponsors are responsible for 25 percent of the project cost and 100 percent of the cost of operation, maintenance, replacement and rehabilitation. There is an annual appropriations limit of $15 million. For projects with an estimated federal cost of less than $5 million, divisions have approval authority.

1948 Flood Control Act, as amended – Section 205 (Small Flood Damage Reduction Projects) aids in the development and construction of small flood damage reduction projects for eligible non-federal sponsors. The *1960 Flood Control Act, as amended* provides 100 percent funding for technical and planning guidance to state and local

governments and federally recognized Native American tribes to help develop and interpret flood and floodplain data, such as flood hazard mapping, and for assessment for structural and non-structural flood damage reduction measures.

Under *Flood Control Act of 1946 – Section 14, as amended* projects are eligible for construction only after an analysis demonstrates the engineering and environmental feasibility and economic justification of the improvement. The local sponsor must be a municipality or public agency. Funding may also be available for flood damage reduction measures if the community writes a request letter to the U.S. Army Corps of Engineers. The non-federal cost share is 35 percent of the analysis and implementation, and the initial $40,000 of the analysis is 100 percent federally funded.

The 1974 Water Resources Development Act, as amended – Section 22 (Planning Assistance to States Program) provides technical assistance for such flood projects as erosion and control. This program uses cost-shared studies with a non-federal sponsor. The non-federal share of the cost is 50 percent and in-kind services are not authorized. Federal limits for each state is $500,000 annually.

For further information, contact the U.S. Army Corps of Engineers. Tel: (978) 318-8087 or (978) 318-8647. http://www.usace.army.mil.

STATE OF RHODE ISLAND

The state capital budget is approved on a 5-year basis and is proposed by the governor. If there is any surplus available in the emergency fund, this could be a possible source of financing for mitigation projects.

Rhode Island Department of Environmental Management (RI DEM)

In the 1980s, four major open space bond issues were approved that resulted in an investment of more than $100 million for recreational and open space land acquisition. Each application is reviewed by a committee to assure consistency with local plans and habitat values. The state participates in funding either through a matching grant or a revolving loan. Funds may be available through the RI DEM Parks and Recreation Division for tree trimming, dune restoration and bulkhead repair. In addition, the state has several funding programs (amount varies for each program) for the acquisition of land or purchase of development rights to protect open spaces. For instance, two Rhode Island municipalities use a real estate transfer tax for land preservation. Rhode Island has several incorporated land trusts that work to preserve land and natural resources. Land owners can participate in the Farm, Forest and Open Space Program. Under this program, land may qualify for a reduced property tax assessment if it meets specific criteria as farmland, forest land or open space.

For current funding availability contact the Open Space and Recreational Bond Fund Land Acquisition Program or RI DEM. Tel: (401) 222-2776.

RI Department of Transportation

The State Planning Council designates which Transportation Improvements Plan enhancement projects the state will pursue. Applications for the Federal Wooden Bridge Replacement Program can be made through RI DOT. In addition, RI DOT has a debris management program that goes into effect during a storm event. The new federal transportation bill, TEA-21 (Transportation Equity Act for the 21st Century), is a successor to the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA). There are a few categories within this bill that may have available funding for natural hazard mitigation projects. These include transportation enhancement (categories include: storm water remediation, storm water runoff protection, and environmental mitigation) and bridge replacement. The municipality must apply for project funds through RI DOT. The annual funding averages for Rhode Island are $156,781,000. There is an average of $26,749 available under the Bridge Rehabilitation and Replacement category.[1]

For further information contact RI DOT. Tel: (401) 277-2481.

North East States Emergency Consortium (NESEC)

Since 1998, RIEMA has been given funds for preventive measures and maintenance. Providence and Woonsocket both received $5,000 grants from NESEC for mitigation activities that were addressed in their local hazard mitigation strategies.

For further information contact NESEC. Tel: (781) 224-9876.

MUNICIPAL

Several utility companies have prevention and clean-up programs that require cooperation from municipalities. For instance, companies are usually willing to co-sponsor planting low-growing trees as part of a tree replacement program. Utility companies will provide the bucket truck area lift if the town/city helps dispose of tree trunks.

The Clean Water Finance Agency has financing programs for local government units and water suppliers. The clean water state revolving fund uses monies from the Federal Clean Water Act to support sewer work such as sewer extensions and septic system repair, and to give homeowners of all incomes low-interest loans for septic system repairs. The community-wide onsite wastewater management plan is a Clean Water Finance Agency program for failing or sub-standard septic systems, and it identifies areas in municipalities where system failures could cause degradation to water quality. Municipal loans for large infrastructure projects are also available through this program at discounted interest rates.

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[1] Thompson, E. and R. Kienitz. TEA-21 User's Guide: Making the most of the new transporation bill. Surface Transportation Policy Project, Washington, D.C., STPP, 1998. 202-466-2636 http://www.tea21.org.

Land acquisition bonds may also be available to help purchase open space property as part of the municipal mitigation strategy. Community development block grants can be used to leverage financing, which must serve a certain percentage of low to moderate-income residents. Private-sector funding may also contribute to the mitigation goals of the community.

APPENDIX E

PUBLIC INFORMATION AND OUTREACH

SOUTH KINGSTOWN

AT RISK . . . . .
FROM NATURAL HAZARDS

Seeking Shelter From The Storm.....

Approximately 6700 S.K. residents, most living along the coast, would have to be evacuated during a 'strong' hurricane. The following facilities serve as emergency shelters in South Kingstown:

SK High School
Broadrock Middle School
Curtis Corner Middle School
Tootel-Keaney Gym, URI

. . . . . Be Prepared

Today's technology now allows for advanced warning of hurricanes and major storms. Also, South Kingstown has adopted a Defense Civil Preparedness Plan and a Hurricane Action Readiness Plan.

* * * *

A Hurricane Action Checklist is available to citizens in the Town Clerk's Office and the three public libraries.

Flood Insurance Facts

795 structures (mostly single family homes) in South Kingstown are covered under the National Flood Insurance Program with a total insured value of $118,131,700.

Aerial photo (1954) showing destruction of Potter Pond Bridge and homes along coastal zone in wake of Hurricane Carol.

Funding Opportunities

The Town has established a Local Hazard Mitigation Committee (LHMC) and anticipates approval of a Multi-Hazard Strategy Plan approval by 2006. The Town could then receive funding through FEMA and RIEMA. These programs include:

+ **Flood Mitigation Assistance Program.** Funds are available to communities with a FEMA approved local flood mitigation plan. A 25% local match is required.

+ **Pre-Disaster Mitigation (PDM) Progam.** Funds available to assist States and local governments in implementing cost-effective hazard mitigation activities.

+ **Hurricane and Earthquake Funds.** RIEMA receives federal funds annually, based on a risk formula. No match is required. Cities/towns with approved mitigation plans receive priority for these funds.

+ **Post-Disaster FEMA Mitigation Funds.** The Hazard Mitigation Grant Program (HMGP) is funded upon a Presidential declared disaster. An addition 15% of all assistance funds are provided to RIEMA to repair damages and recover from losses.

Important Phone Numbers

Emergencies 911 Police Dept. 783-3321 (routine calls) Fire Dept. 783-2422
School Dept. 792-9692 Police Dept. 783-3341 (emergency & rescue calls) Town Hall 789-9331
R.I. Emergency Management Agency 946-9996 American Red Cross 1-800-842-1122
Univ. of Rhode Island 874 -1000

HURRICANES

Historically hurricanes have posed the greatest natural hazard threat to South Kingstown and the State in general. At least fifteen significant hurricanes have struck this area since the first recorded hurricane on August 15, 1635. These severe storms have many impacts, most noteworthy being:

* loss of life
* loss of property
* major property damage
* roadway closures
* disruption of many services such as electric power , water supply and postal deliveries

Most damage caused by hurricanes is a result of: storm surge along the coastline; high winds; extensive rainfall; and flooding. There have been five significant hurricanes within the past sixty years:

Hurricane of 1938

* Deaths: 262
* Property Damage: $100 million ($1 billion in today's dollars)
* Winds: 100 miles per hour with gusts to 160 mph (highest winds ever recorded in R.I.)
* Waves: Storm surge along south shore was up to 30 feet above high tide

Hurricane Carol 1954

* Deaths: 19
* Property Damage: $200 million, 3800 homes destroyed 2000 vessels sunk
* Winds: 90 miles per hour with gusts to 130 mph

* Waves: 11.5 foot storm surge
* Potter Pond Bridge destroyed - stranding over 100 people
* Portions of South Kingstown shore line cut back over 80 ft.

Hurricane Diane Backlash 1955

* Deaths: 0
* Property Damage: $170 million

Hurricane Donna 1960

* Deaths: 0
* Property Damage: $5 million
* Rainfall of 8.31" in Kingston
* 170,000 customer lose electrical power

Hurricane Bob 1991

* Deaths: 0
* Damage: $817,000 expended on debris clean-up
* Extensive tree damage results in loss of electricity and impassable roads for up to five days

HAZARDS TO SOUTH KINGSTOWN

The Local Hazard Mitigation Committee has performed a risk assessment of potential hazards for South Kingstown. List includes the following (in priority).

1. *Earthen Dams* - there are private and publicly owned earthen dams subject to flash flooding and erosion that will require inspection and repair to ensure structural integrity.

2. *Town Beach Pavilion Facility* - Portions of the structure undermined by severe erosion from 1997-98 winter storms. Entire structure needs relocation to prevent further damage.

3. *South Shore Area* - Private residences, public facilities / roads subject to flooding, erosion and storm surge. Potential mitigation includes use of dredge materials for shoreline deposition.

4. *South Shore Water System* - Sole potable water system & fire protection for Snug Harbor, East Matunuck and Jerusalem could be undermined during severe storm conditions. Study required to investigate re-location and/or stabilization efforts.

5. *Middlebridge Area* - Flooding of Pettaquamscutt River causing interruption to roadways and impacts to water and sanitary sewer force main systems.

6. *Saugatucket Road* - Flooding causes interruption to roadways and structural failure to water main. Study needed of flood control system.

7. *Potter Pond Channel Bridge* - Risk of washout as in 1954 hurricane - stranding Jerusalem residents. New bridge to be built in Fall 2000.

8. *Tree Damage* - High winds, heavy snow/ice resulting in loss of power to extensive areas of Town. Town tree maintenance program should help reduce risk by trimming of trees and removal of poor condition trees.

9. *Boat Ramps* - Great demand during pre-hurricane time for vessel removals. Need inspection of ramps and rehabilitation where necessary - investigate adequacy of present ramps to meet demand.

10. *Fire Protection* - Reliable supply of water for fire fighting in heavily wooded rural areas needs to be assured to reduce risk to lives, property, forest resources and wildlife habitat. Study required of needs / existing resources.

11. *Underground Fuel Tanks* - Leaking tanks and risk of floating tanks during flood events. Coordination required between Town & RIDEM.

MEMORANDUM OF MEETING

DATE: April 7, 2008

TO: File

FROM: Craig Pereira

RE: South Kingstown Hazard Mitigation Plan
CRMC Informational Meeting
Pare Project No. 08102.00

Pare Corporation held an informational session with Dr. Jon Boothroyd (State Geologist) and CRMC representatives to introduce the South Kingstown project, present the scope and proposed schedule, and identify additional resources to aid in the project. The following items were discussed:

Objectives:

Primary

- Identify long-term solutions to ensure roadway stability

Secondary

- Study potential upland/relocation of structures
- Long-term stabilizing measures
- Elevating structures

Mitigation Strategies

Beach Nourishment

- Effective short-term solution, although the sand deposited from the last nourishment project has not come back yet, and it is still unknown as to where it went (Patriot's Day Storm)
- Salinity of dredged material can be very high, it hinders revegetation efforts
- Particle size of source material not always the right size for replenishment efforts (National research Council ensures all federal Maintenance dredging undergoes Beneficial Use Analysis for dredged material

Undercurrent Stabilizers

- Sand-filled geotextile tubes, applied perpendicular to the shore, similar to groin – but soft armor
- Considered a 'self-building' capacity technique

Low-Impact Design Principles

- Maintain natural drainage flow
- Raingardens
- Amended soils
- Reduced hardscape through porous pavement
- Preservation of native vegetation

Culvert Improvements

- Not sure culvert improvements are the solution. Unsure as to what is draining from the trailer park into that drainage area/culvert
- Other than maintaining the roadway as passable, what are the other benefits to improving the culvert?
- Dredging the coastal pond for increased capacity/ease of drainage is not a solution, unless there is a trench/cut to the shore as well (which naturally occurred, as it should) during a past storm – Patriot's Day)). Draining trailer park directly into ocean a concern
- Lowering of the culvert may temporarily improve drainage of the trailer park

Coir Vegetated Logs/Mats

- CRMC has permitted this material, employed at Green Hill Beach – Browning Road terminus. Undecided whether effective or not – too early to tell. They have been upgraded twice already since installation (needing to be doubled in diameter), and need to be huge. What happens (secondary impacts) if they become dislodged – what additional damage can they incur?)
- Moonstone beach residence also has these in place

Alternate Evacuation Routes

- CRMC investigated bridging over from terminus of Prospect Road…didn't go anywhere
- Town to implement 'mandatory evacuation'
- Boat launch not feasible, salt pond is too shallow
- Removing percentage of trailers would be a consideration, but the Community Road access would incur wetland impacts/flooding

Additional comments:

- Carpenter's has decided to abandon their revetment
- A seawall is needed to keep the roadway. The Town could be the only applicant to secure a special exception for 'hard armor', and would need to show a compelling argument for the need. Would negatively impact recreational opportunities (fishing, surfing)
- Need to identify social impacts to mitigation measures

PUBLIC INFORMATION MEETING

Matunuck Area Coastal Erosion / Matunuck Beach Road Study

August 26, 2008 - 7:00PM
at Matunuck Elementary School

Please feel free to contact the South Kingstown Planning Dept. at 789-9331 ext. 1245 for additional information.

South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Public Information Session
Tuesday, August 26, 2008

Agenda

1. Introduction/Overview of FEMA Grant/Hazard Mitigation Planning
   Town of South Kingstown

2. Part 1: Hazard Mitigation Plan Update
   Pare Corporation

3. Part 2: Identification/Assessment of Alternative Mitigation Measures
   Pare Corporation

4. Next Steps

5. Public Comments/Open Discussion

Public Information Session

2008 Update

Multi-Hazard Mitigation Strategy Plan, Strategies for Reducing Risks from Natural Hazards in South Kingstown, Rhode Island

August 26, 2008

Process

Phase 1...

- Data Collection for Plan Update
- Research Range of Alternative Mitigation Measures
- Coordination with Town, Local Hazard Mitigation Committee and CRMC
- Presentation to the Public

Phase 2...

- Summary of Public Information Session
- Coordination with Town, CRMC, RIDEM
- Benefit-Costs Analysis Review
- Selection of Mitigation Measure
- Implementation Matrix
  - Responsible Parties
  - Time Frames
  - Funding Sources
- Submit Update to Town for Adoption/FEMA for Approval

* Town can then move forward to implement mitigation measure (s)

Project Overview

To update and expand the local hazard mitigation plan entitled, *'Multi-Hazard Mitigation Strategy Plan, Strategies for Reducing Risks from Natural Hazards in South Kingstown, Rhode Island'*.

Part 1: Hazard Mitigation Plan Update

- Evaluate present conditions
- Utilize FEMA's guidance document *Local Hazard Mitigation Plan Review Crosswalk* to complete the 2008 update

Part 2: Identification/Assessment of Alternative Mitigation Measures

- Identify and assess potential mitigation measures to ensure the integrity of Matunuck Beach Road
- Identify and assess potential mitigation measures to protect properties within the study area

Part 1: Hazard Mitigation Plan Update

Historical Analysis/Background of the 2006 Plan

Risk Assessment

- Inventory of Existing Conditions
- Profile of Hazard Events

Vulnerability Assessment

- Vulnerability Chart
- Land Uses/Development Trends
- Identification of Assets/Estimating Losses

Part 1: Hazard Mitigation Plan Update

Historical Analysis/Background of the 2006 Plan

South Kingstown Multi-Hazard Mitigation Strategy Plan

- RIEMA Review – November 2005
- Town Council Approval – January 2006
- FEMA Approval – April 2006

- Town has received $100,000 Pre-Disaster Mitigation Planning Grant to perform a Hazard Mitigation Plan Update through a detailed study of Matunuck Beach Road/Matunuck area

Risk Assessment

Inventory of Existing Conditions

- Natural Hazard Identification
- Climate Change/Sea Level Rise
- Shoreline Erosion

Profile of Hazard Events

- Weather Events 2004 to Present

Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification

- A natural hazard is defined as, *"any event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, and agricultural loss, damage to the environment, interruption of business, or other types of harm and/or loss."*

- In the 2006 Plan, The Town identified a range of hazards that potentially threaten South Kingstown. For the purposes of this Multi-Hazard Mitigation Strategy Plan Update, hazards with a *high* future occurrence have been addressed with having the most probability of impacting the Matunuck Beach Road study area.

Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification

Coastal Erosion

- 5.5 miles of exposed shoreline make it particularly susceptible to sea level rise
- Rising sea levels push beaches inland covering coastal marshes
- Waves break higher on dunes, increasing erosion rates
- Storm surge can also flood/erode coastal areas

Photo courtesy of the Town of South Kingstown, April 16, 2007 storm surge Matunuck Beach.

Coastline Erosion Comparison 1939 - 2006

Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification

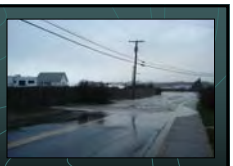
Coastal Storms

- Travel up the eastern United States coast, in a counter-clockwise wind pattern surrounding a low-pressure center
- Sustained wind speeds of 10-40 mph resulting in flooding/erosion damage
- An average of 1 to 2 per year, and suspended duration of high surge and winds, nor'easters are a primary concern for South Kingstown residents

Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification



Flood

- Can result from nor'easters, heavy rainstorms, tropical storms and hurricanes
- The Town contains A, B, C, and V flood zones
- A-zones comprise areas inundated by a 100–year flood, with a one percent chance of occurring in any given year
- V-zones are areas of 100-year coastal flood with velocity (wave action) where waves greater than 2.9 feet are expected during a 100-year flood or storm surge
- Development can increase the height and extent of flooding due to the loss of ground permeability and reduction in flood storage

Winter Storms

- Nor'easter could bring heavy rains or a blizzard, dependent on the temperature

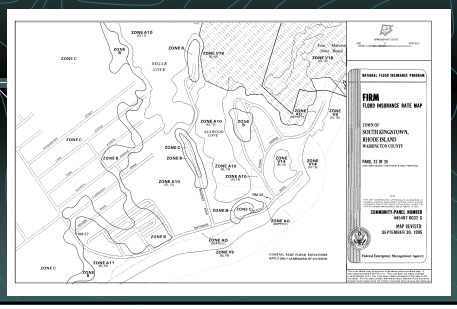
Photo courtesy of the Town of South Kingstown, April 16, 2007 coastal flooding Matunuck Beach Road.

Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification

FEMA Flood Insurance Rate Map (FIRM) Community Panel No. 445407 0032G



Risk Assessment

Inventory of Existing Conditions

Natural Hazard Identification

Hurricane

- Develop over warm waters through the collision of warm air with cooler air (atmospheric instability)
- As a hurricane nears land, it can bring torrential rains, high winds, storm surges, coastal flooding, inland flooding, and occasionally, tornadoes
- National Climate Data Center identifies hurricane season for the Atlantic Coast traditionally occurring from June 1– Nov. 30 (on average, 5 strikes per year)
- Can be characterized by water – a rainy or wet hurricane which can flood both coastal and inland areas, or dry – a windy or dry hurricane which can affect coastal areas with high winds and storm surge

The Town remains susceptible to other hazards not listed in this inventory, yet identified in the 2006 Plan:

- A low probability to drought and earthquakes
- A moderate-low probability of dam failure and wildfire

Risk Assessment

Inventory of Existing Conditions

Climate Change/Sea Level Rise

- Rising sea levels, as a direct result of warmer temperatures and glacial ice melt, threaten low lying coastal areas through coastal flooding, coastal erosion, wetland inundation and salt water intrusion

- Management approaches include:

Accommodation

* Building Elevation
* Flood Preparation
* Salt-tolerant Technology

Retreat

* Anticipatory Land Regulation (Building Codes)

Protection

* Structural and Non-structural

Risk Assessment

Inventory of Existing Conditions

Climate Change/Sea Level Rise

CRMC's response to climate change and sea level rise:

Section 145 CRMC Regulations (Red Book) – Adopted March 4, 2008

- The Council will integrate climate change and sea level rise scenarios into its operations to prepare Rhode Island for these new, evolving conditions and make our coastal areas more resilient.

- The Council's sea level rise policies are based upon the CRMC's legislative mandate to preserve, protect, and where possible, restore the coastal resources of the state through comprehensive and coordinated long-range planning.

- For planning and management purposes, it is the Council's policy to accommodate a base rate of expected 3 to 5 foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities and to insure proactive stewardship of coastal ecosystems under these changing conditions. In addition, this long term sea level change base rate will be revisited by the Council periodically to address new scientific evidence.

Risk Assessment

Inventory of Existing Conditions

Shoreline Erosion

- Coastal areas are constantly undergoing change in response to a multitude of factors including sea level rise, wave and current patterns, hurricanes, coastal flooding, and human influences
- Erosion rates along the South Shore vary, ranging from 1 foot per year to 4 feet in some critical erosion areas
- Chronic erosion is caused by repetitive episodes of high surf drawing sand from upland areas (beach position is slowly shifted inland)
- Episodic erosion is caused by a single, unusually large wave event (if followed by a long period of normal wave conditions, beach will most likely accrete back to pre-event location)
- Erosion rates will continue to rise due to increased frequency of storms resulting from climate change

Risk Assessment

Inventory of Existing Conditions

Shoreline Erosion Changes Mapping (CRMC)

Image generated from CRMC's Shoreline Change Maps.

Risk Assessment

Profile of Hazard Events

Weather Events 2004 – Present

- 25 significant storm events for South Kingstown since the 2006 Plan, totaling $1.1 million in damages county-wide, with one specific rain event (10/15/05) resulting in $1.6 million in damages statewide
- 75% classified as winter and wind-related events

Vulnerability Assessment

Vulnerability Matrix
- Frequency/Severity of Future Events

Land Use/Development Trends
- Building Permit Activity
- Real Estate Sales/Transactions
- CRMC Permit Activity
- NFIP Information

Identification of Assets/Estimating Losses
- Economic
- Social
- Environmental
- Infrastructure

Vulnerability Assessment

Vulnerability Matrix…2008 Update
- Developed based on the identification and profile of the natural hazards that have occurred throughout South Kingstown from 2004 – Present

Hazard	Future Occurrence	Potential Damage
Coastal Erosion	High	Severe/Moderate
Coastal Storm	High	Severe/Moderate
Dam Failure	Med./Low	Moderate
Drought	Low	Low
Earthquake	Low	Severe
Flood	High	Moderate
Hurricane	High	Severe/Moderate
Winter Storm	High	Moderate
Wildfire	Med./Low	Mod./Low

Vulnerability Assessment

Land Use/Development Trends…since 2006 Plan

Building Permit Activity
- Approximately $1.3 million invested towards new and/or improved structures

Real Estate Sales/Transactions
- Estimated $8.2 million in real estate investments

CRMC Permit Activity
- As development within at-risk areas continues to increase, the number of hazard-related remediation project applications and costs associated with these is also increasing:

Beach Nourishment	4 applications
Erosion Control	4 applications
Structural/ISDS	5 applications

Vulnerability Assessment

Land Use/Development Trends

NFIP Information…1978 - Present
- Since 2004, additional 35 loss claims/$550,000 additional payments
- The investments in coastal development directly correlate with the magnitude of damages associated with hazard-related remediation work.
- Town-wide National Flood Insurance Program (NFIP) information:

Total Policies In Force	Whole Insurance In Force	Total Losses	Total Payments	Number of Repeat Losses	Repeat Loss Properties
1,033	$220,145,700	188	$1,407,799	6	$220,000

NFIP, current as of May 31, 2008.

Vulnerability Assessment

Identification of Assets/Estimating Losses
Economic

Property Damage: Residential/Commercial

Land Use	Parcels	Land Value	Building Value	Tangibles
Seasonal Residential	342	$13,500,000	$2,200,000	$9,000,000
Year-Round Residential	168	$91,500,000	$36,000,000	
Commercial	4	$4, 000,000	$3,500,000	

South Kingstown Tax Assessor 's database February, 2008.

Vulnerability Assessment

Identification of Assets/Estimating Losses
Economic

Property Damage: Commercial
- Reduction in revenues to proprietors
- Lost wages to employees
- Reduction in state/local tax revenue
- Significant impacts to travel/tourism industry

Vulnerability Assessment

Identification of Assets/Estimating Losses
Social

- Closure of Institutions
- Loss of Vital Services
  ...Communication, Transportation Systems
- Disruption to the Movement of Goods/Services
  ...Particularly where residents are forced to evacuate and become subject to shortages of basic supplies

Vulnerability Assessment

Identification of Assets/Estimating Losses
Environmental

Direct
- Loss of buffering dunes
- Loss of habitat
- Salinization of land/groundwater

Indirect
- Widespread inland damage to built environment and distribution of debris
- Threats to ecosystems and species
- Contamination of potable water supply

Vulnerability Assessment

Identification of Assets/Estimating Losses
Infrastructure

Transportation Systems
- Loss of access/egress to significant residential areas
- Evacuation routes
- Municipal expenditures to repair

Lifeline/Utility Systems
- South Shore Municipal Water System
- Disruption of electric, telephone
- Municipal expenditures to repair

Part 2: Identification/Assessment of Alternative Mitigation Actions

2006 Mitigation Action Plan

No Action Alternative

Alternatives Considered but not Carried Forward
- Structural Projects

Potential Alternatives to be Considered
- Regulatory Applications
- Structural Projects
- Soft-Armor Structural Shoreline Applications
- Hard-Armor Structural Shoreline Applications

Identification/Assessment of Alternative Mitigation Actions

Mitigation Action Plan

Risks and vulnerabilities identified in the *Multi-Hazard Mitigation Strategy Plan, Strategies for Reducing Risks from Natural Hazards in South Kingstown*, specific to the Matunuck Beach Road area include:

Priority Objective

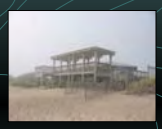
Vulnerable Area #2C Matunuck Beach Road

Mitigation Action #1: Engineering / Planning Study - Undertake comprehensive study to identify long-term solutions to ensure roadway stability.

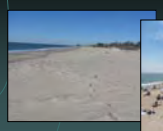
Secondary Objectives

Vulnerable Area #2A Town Beach

Mitigation Action #1: Pavilion / Boardwalk Setback - Study potential upland relocation of structures.



Mitigation Action #2: Beach Nourishment Project - Investigate long term stabilizing measures.



Secondary Objectives

Vulnerable Area #2B South Shore

Mitigation Action #1: Shoreline Management Plan - Develop plan emphasizing non-structural solutions.

Mitigation Action #2: Over wash sand removal - Develop procedures for over wash removal and stockpiling.

Mitigation Action #3: Setback, Retrofit, and Elevation Program - Develop post storm policies regarding structures.

Mitigation Action #4: Educational Outreach - Develop exhibit documenting historical flood damage in South Kingstown.

Secondary Objectives

Vulnerable Area #2C Matunuck Beach Road

Mitigation Action #2 Evacuation / Shelter Information Outreach - Develop distribution plan for storm related information to summer residents and tourists.

Project Study Area

No Action Alternative

Infrastructure Impacts

- Municipal water supply (approximately $1 million for proposed relocation project)
- Electric/Telephone service (approximately $40,000 per utility pole)
- Costs to reconstruct roadway (variable dependent upon extent of damage)
- Loss of access to significant residential development

Economic Impacts

- Land, building and tangible value $160 million
- Travel and tourism industry

Social Impacts

- Loss of vital services
- Emotional strain (financial losses, displacement)

Environmental Impacts

- Loss of habitat
- Remediation costs (variable dependent upon extent of damage)

Alternatives Considered but not Carried Forward

Structural Projects

- Retreat
- Bulkheads
- Floating Breakwaters/Wave Fences
- Groins
- Raise the Roadway Grade

Alternatives Considered but not Carried Forward

Retreat – *the act or process of moving inland, away from coastal hazards*

- Not carried forward due to the existing conditions within the project area
- Majority of structures south of Matunuck Beach Road and fronting on the ocean are within 2 – 5 feet of the edge of pavement
- Would be cost-prohibitive to consider retreat as an alternative

Alternatives Considered but not Carried Forward

Bulkheads

- Structures including timber and steel sheet piling bulkheads, common in harbors and along areas of low-energy shoreline, were not carried forward for this location
- The high-energy wave climate with breaking waves would provide lateral forces in excess of the capabilities of these structures

Photo from RIDEM, State Pier 9 Newport, RI.

Alternatives Considered but not Carried Forward

Floating Breakwaters/Wave Fences

- Breakwaters, including rubble-mound breakwaters, floating breakwaters and wave fences can be employed to dissipate wave energy and reduce wave action along an area of shoreline
- Floating breakwater and wave fence alternatives are not considered practical due to the severity of the wave climate

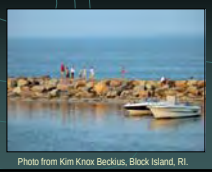


Photo from Kim Knox Beckius, Block Island, RI.

Alternatives Considered but not Carried Forward

Groins

- Groins are installed along a shoreline to encourage sand deposition as part of the littoral process
- Groins tend to cause downdrift effects which are not desirable

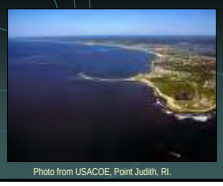


Photo from USACOE, Point Judith, RI.

Alternatives Considered but not Carried Forward

Raise the Roadway Grade

- Drainage issues created with existing residences and businesses
- Accessibility (ADA) issues to residences and businesses
- Aesthetic issues

Potential Alternatives to be Considered

Regulatory Applications

- Low-Impact Development (LID) Standards
- No Adverse Impact (NAI) Coastal Land Management Guidelines
- FEMA's Community Rating System (CRS)
- FEMA's Home Builder's Guide to Coastal Construction
- FEMA's Coastal Construction Manual
- Land Acquisition
- Post-Disaster Reconstruction Plan

Potential Alternatives to be Considered

Regulatory Applications

Low-Impact Development (LID) Standards

- More suitable land development pattern in which thoughtful site planning focuses on preservation of the natural resources and maintenance of the natural hydrology of a site
  - * Preservation and clustering
  - * Utilization of natural drainage systems
  - * Disconnection/minimization of impervious surfaces

Potential Alternatives to be Considered

Regulatory Applications

Low-Impact Development (LID) Standards

- Urban Land Institute (ULI) recently published *'Ten Principles for Coastal Development'* which looks to break the cycle of historic, destructive trends and prevent the continued degradation of coastal systems:

  * Enhance value by preserving/protecting natural systems
  * Identify natural hazards/reduce vulnerabilities
  * Apply comprehensive assessments to the region/site
  * Lower risk by exceeding standards for siting/construction
  * Adopt successful practices from dynamic coastal conditions
  * Use market-based incentives to encourage appropriate development
  * Address social/economic equity concerns
  * Balance the public's right of access/use with private property rights
  * Protect fragile water resources on the coast
  * Commit to stewardship that can sustain coastal areas

Potential Alternatives to be Considered

Regulatory Applications

No Adverse Impact (NAI) Coastal Land Management Guidelines

- New and effective coastal management philosophy that incorporates future conditions (sea level rise, changing storm patterns)
- 'Do no harm' policy based on the concept that everyone benefits when the actions of every property owner does not adversely affect others
- Calls for anticipating the potential negative effects of any development or flood control action on other people, their property, and on the coastal environment itself
- Creates a solid foundation that reduces community legal vulnerability to 'takings' and negligence claims

* Chatham, MA has been successful recently in controlling private land management practices.

Potential Alternatives to be Considered

Regulatory Applications

FEMA's Community Rating System (CRS)

- Voluntary initiative of the National Flood Insurance Program (NFIP) that encourages communities to undertake activities that exceed minimum NFIP floodplain management standards
- Provides policy holders discounts (5% – 45%) on annual flood insurance premiums, based on the community's CRS Classification, improved by performing floodplain management activities organized under 4 series:

  * Public Information
  * Mapping and Regulations
  * Flood Damage Reduction
  * Flood Preparedness

* Identified as a goal/next step in Section 1.2 *Hazard Mitigation Planning Benefits* of the 2006 Plan.

Potential Alternatives to be Considered

Regulatory Applications

FEMA's *Home Builder's Guide to Coastal Construction*

(FEMA Publication #499)

- Series of 31 fact sheets that provide technical guidance and recommendations relative to the construction of coastal residential buildings
- Information is targeted towards improving the performance of buildings subject to flood and wind in coastal environments
- Utilizes photographs and drawings to clearly illustrate National Flood Insurance Program (NFIP) regulatory requirements regarding:

  * Proper siting of coastal buildings
  * Design and construction practices
  * Information of building envelopes, utilities, and accessory structures

Potential Alternatives to be Considered

Regulatory Applications

FEMA's *Coastal Construction Manual*

(FEMA Publication #55CD Third Edition)

- Highlights tasks and decisions that must be made before actual construction
- Identifies the best design and construction practices that can be used to build a disaster-resistant structure
- Guidance documents include:

  * Identification and evaluation of site alternatives
  * Investigation into regulatory requirements and identification of hazards
  * Siting the building
  * Determination of loads and design of the building
  * Construction of the building
  * Maintenance of the building

Potential Alternatives to be Considered

Regulatory Applications

Land Acquisition

- Strong tool for protecting coastal property and resources by keeping floodprone areas undeveloped
- Provides additional credits to communities participating in CRS program
- Multiple sources of federal funds exist:

  * NOAA's National Estuarine Research Reserves (NERR)
  * Coastal and Estuarine Land Conservation Program (CELCP)
  * FEMA's Pre-Disaster Mitigation Program
  * FEMA's Post-Disaster Hazard Mitigation Grant Program (HMGP)

- The Community Partnership's Land Acquisition Committee which includes the South Kingstown Land Trust, The Nature Conservancy, Town of South Kingstown, U.S. Fish and Wildlife Service, Narrow River Land Trust, and RIDEM has been instrumental in protecting land in South Kingstown

Potential Alternatives to be Considered

Regulatory Applications

Post-Disaster Reconstruction Plan

Investigate the potential for the development of a regional Post-Disaster Reconstruction Plan:

- Once critical life and safety issues and vital public services have been addressed and re-established, emphasis should be placed on the long-term recovery of the community
- Communities must balance the need to rebuild rapidly and return to normal against the objective of building back better and stronger
- Use the opportunity of the disaster to improve the community's disaster resilience

Potential Alternatives to be Considered

Structural Projects

- Retrofit Structures
- Alternative Evacuation Routes
- Culvert Improvements

Potential Alternatives to be Considered

Structural Projects

Retrofit Structures

- Making changes to an existing building to protect it from flooding or other hazards.
- FEMA identifies several methods:
  - * Elevation
  - * Wet Floodproofing
  - * Dry Floodproofing

Potential Alternatives to be Considered

Structural Projects

Elevation – Raising the existing structure at or above the Base Flood Elevation (BFE) on an open foundation with bottom of lowest horizontal structure member at or above BFE

Construction Type	Existing Foundation	Retrofit	Cost (per square foot of house footprint)
Wood Frame	Basement or Crawlspace	Elevate 2 feet on continuous foundation walls or open foundation	$17
	Slab-on-Grade	Elevate 2 feet on continuous foundation walls or open foundation	$47
Masonry	Slab-on-Grade	Elevate 2 feet on continuous foundation walls or open foundation	$47
	Basement, Crawlspace, or Slab-on-Grade	Extend existing walls 2 feet and create new elevated living area	$35

FEMA Publication No. 499 Home Builder's Guide to Coastal Construction.

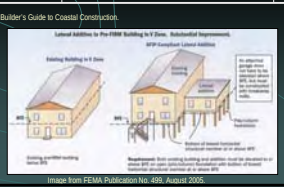


Image from FEMA Publication No. 499, August 2005.

Potential Alternatives to be Considered

Structural Projects

Wet Floodproofing – Modifying the uninhabited portions of the house so that flood waters can enter, but not cause damage (To equalize the interior and exterior hydrostatic pressure)

Construction Type	Height of Wet Floodproofing	Existing Foundation	Cost (per square foot of house footprint)
Wood Frame Or Masonry	2	Basement	$1.70
		Crawlspace	$1.30
	4	Basement	$3.50
		Crawlspace	$3.25
	8	Basement	$10.00
		Crawlspace	N/A

FEMA Publication No. 499 Home Builder's Guide to Coastal Construction.

Potential Alternatives to be Considered

Structural Projects

Dry Floodproofing – Making a house water tight below the Flood Plain Elevation (FPE) (Does not bring a structure into compliance with regulations)

Component	Cost	Per
Sprayed-on Cement (above grade)	$3.30	Square foot of wall area covered
Asphalt (2 coats on foundation below grade	$1.10	Square foot of wall area covered
Waterproof Membrane (above grade)	$1.10	Square foot of wall area covered
Drainage Line Around Perimeter of House	$31	Linear foot
Plumbing Check Valve	$620	Lump Sum
Sump and Sump Pump (with battery backup)	$1,000	Lump Sum
Metal Flood Shield	$73	Square foot of shield surface
Wood Flood Shield	$23	Square foot of shield surface

FEMA Publication No. 499 Home Builder's Guide to Coastal Construction.

Potential Alternatives to be Considered

Structural Projects

Alternative Evacuation Routes

Mary Carpenter's Development

- Creation of emergency evacuation route through extension of northern perimeter road into vacant parcel (AP 92-2/Lot 56), running west along parcel, reconnecting with Matunuck Beach Road north of sand overwash location
- Several existing cottages would require relocation
- Culvert crossing (at approach to Matunuck Beach Road) would need to be addressed
- Approximate Cost: $100,000

Prospect Road to Atlantic Avenue

- Bridge crossing wetlands/stream from the terminus of Prospect Road to Atlantic Avenue
- Several private properties impacted
- Low lying area subject to occasional flooding
- Approximate Cost: $1.25 million

Potential Alternatives to be Considered

Structural Projects

Potential Alternatives to be Considered

Structural Projects

Culvert Improvements

- Remove stone plug
- Install rubber check valve at outlet to coastal pond to allow flow (including pumped flow from Fire Department) into the pond and prevent flow from the pond into Carpenter's development
- Investigate drainage/infiltration improvements within western portion of Carpenter's development

Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

- Beach Nourishment Program
- Geotube Shore Protection
- Coir Vegetative Logs

Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

Beach Nourishment Program – A designed, engineered process where a specified volume of sand is added to a beach and/or dune system to provide a desired level of storm protection and flood control.

- Minimizes impacts of storm surge (wave action, run-up, coastal flooding)
- Mitigates coastal erosion
- Dissipates wave energy
- Allows for greater redistribution of sediment
- Increases public access opportunities
- Designed to retain/rebuild natural systems
- Disadvantages include vulnerability to unusually large wave events with frequent maintenance and repair likely
- Conceptual cost estimates range from $8 to $12 million (dependent on the volume replenished)

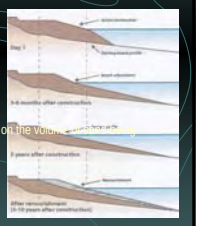


Image from USACOE Shore Protection Assessment.

Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

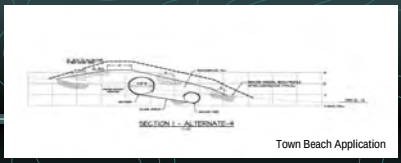
Geotube Shore Protection

- Provides a reinforced dune to prevent further erosion of the shoreline
- Physical considerations include specific points of access to the beach with stop logs or stairs/ramps
- Potentially raised crest elevation to provide protection against wave run-up and sea level rise
- Relatively new design, proving to be subject to damage when exposed during significant weather events
- Minimal adverse water quality impacts during construction
- Conceptual cost estimates range from $1,600 to $2,200 per linear foot

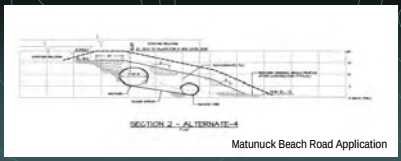
Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

Geotube Shore Protection



Town Beach Application



Matunuck Beach Road Application

Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

Coir Vegetative Logs

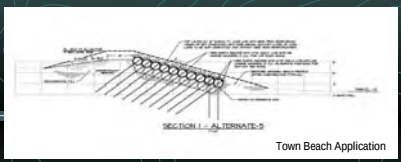
- Provides soft-armoring of sand dunes through physical anchoring of 16-inch diameter fibrous logs and promotion of vegetative cover
- Suitable for low-energy applications, with limited life span of approximately 5 to 7 years (primary purpose is to provide protection for dune restoration)
- Physical considerations include sloped beach access with dedicated paths
- No adverse water quality impacts as installation is typically above the high tide level
- Disadvantages include vulnerability to unusually large wave events with frequent maintenance and repair likely
- Conceptual cost estimates range from $8 to $10 million

Browning's Cottages Historic District, Coir 'Taco' installation.

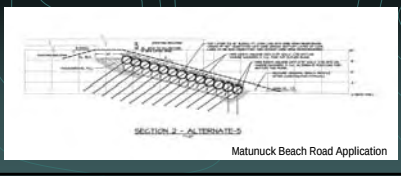
Potential Alternatives to be Considered

Soft-Armor Structural Shoreline Applications

Coir Vegetative Logs



Town Beach Application



Matunuck Beach Road Application

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

- Offshore Breakwater
- Riprap Revetment
- Concrete Seawall on Steel Sheet Pile Foundation
- Concrete Gravity Seawall

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

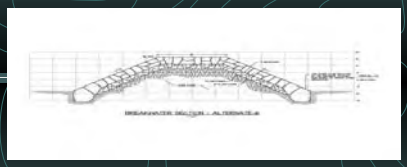
Offshore Breakwater

- Designed to mitigate shoreline erosion over the long-term
- Includes the potential for the creation of additional habitat and beach widening due to accretion
- Disadvantages include the reduced recreational (body/board surfing) opportunities, altered hydraulic/wave energy conditions, potential loss of habitat, and reduced longshore transport of sediment
- Conceptual cost estimates range from $14 to $25 million

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Offshore Breakwater



Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Offshore Breakwater

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Riprap Revetment

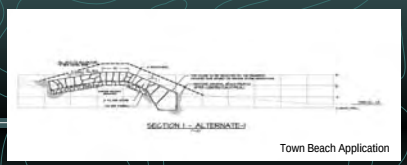
- Provides a hard structure to absorb/dissipate wave energy and to prevent erosion of the shoreline
- Physical considerations include compromised public access to the beach, requiring specific points with stairs/ramps,
- Stone revetments are a proven design using readily available materials, yet require periodic maintenance after major events
- Minimal adverse water quality impacts during construction
- Disadvantage includes the physical area of the beach required for the structure
- Conceptual cost estimates range from $8 to $11 million

Revetment prohibits public access along the shoreline.

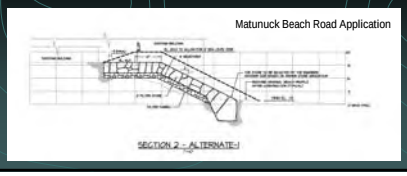
Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Riprap Revetment



Town Beach Application



Matunuck Beach Road Application

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Concrete Seawall on Steel Sheet Pile Foundation

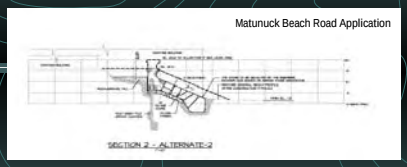
- Provides a hard structure to absorb and dissipate wave energy and to prevent erosion of the shoreline
- Physical considerations include specific points of access to the beach, with stop logs and stairs/ramps
- Potentially raised crest elevation to provide protection against wave run-up and sea level rise
- Concrete seawalls are a proven design using readily available materials suitable for high-energy locations, typically have a high initial cost
- Minimal adverse water quality impact during construction
- Conceptual cost estimates range from $17 to $19 million

Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Concrete Seawall on Steel Sheet Pile Foundation

Matunuck Beach Road Application



Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

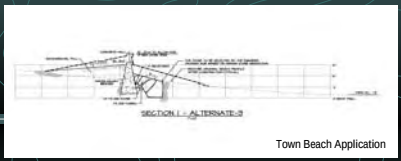
Concrete Gravity Seawall

- Provides a hard structure to absorb and dissipate wave energy and to prevent erosion of the shoreline
- Physical considerations include specific points of access to the beach, with stop logs and stairs/ramps
- Potentially raised crest elevation to provide protection against wave run-up and sea level rise
- Concrete seawalls are a proven design using readily available materials suitable for high-energy locations, but typically have a medium to high initial cost
- Minimal adverse water quality impact
- Conceptual cost estimates range from $15 to $17 million

Potential Alternatives to be Considered

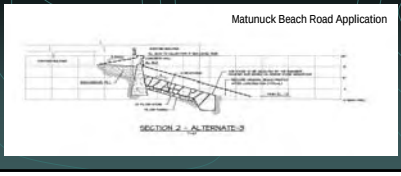
Hard-Armor Structural Shoreline Applications

Concrete Gravity Seawall



Town Beach Application

Matunuck Beach Road Application



Potential Alternatives to be Considered

Hard-Armor Structural Shoreline Applications

Matrix of Mitigation Measures

Structure		Advantages/Disadvantages	Rule in Shoreline Protection/Design Life	Cost
Beach Nourishment	Advantages	Increases public access opportunities Allows for greater redistribution of sediment No adverse effects on adjacent coastal areas Accentuates wave action/breaking; run up, coastal flooding to facilitate shore restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires continual nourishment Design Life = 5 to 7 years (without significant events)	$10M - $12M
	Disadvantages	Vulnerability to seriously large wave events Adverse impacts on benthic and pelagic species Low sediment recovery; increase costs; Large initial volume required		
Groins/ Shore Protection	Advantages	Allows for greater redistribution of sediment Provides a structural divot / Requires lesser initial volume/nourishment Accentuates wave action/breaking; run up, coastal flooding to facilitate shore restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires continual nourishment Design Life = 10 to 15 years (without significant events)	$5M - $8M
	Disadvantages	Vulnerability to seriously large wave events Frequent maintenance/repair Low sediment recovery; increase costs Adverse impacts on benthic and pelagic entry points / Aesthetics		
Coir Vegetative Logs	Advantages	No adverse water quality impacts Allows for greater redistribution of sediment Accentuates wave action/breaking; run up, coastal flooding to facilitate shore restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires continual nourishment Design Life = 5 to 7 years (without significant events)	$1M - $10M
	Disadvantages	Vulnerability to larger wave events Frequent maintenance/repair; short design life expectancy Low sediment recovery; increase costs Public access considerations at specific entry points		
Offshore Breakwater (Reef and Rubblemound)	Advantages	Reduces intensity of wave action and thereby reduces coastal erosion Provides for creation of additional habitat Potential for beach widening from accretion	Reduces intensity of wave action and thereby reduces coastal erosion Design Life = 25 to 50+ years (without major events)	Reef $1.2 - $1.6M Rubblemound $250M+
	Disadvantages	Potential recreational opportunities (kayak/canoe surfing) due to directional wave action High initial costs; Potential for altering adjacent coastal profile; Aesthetic impacts with rubblemound Requires intensive wave and impacts of sea level rise over the long term Requires periodic maintenance after major events		
Riprap Revetment	Advantages	Mitigates intensive wave and impacts of sea level rise over the long term Minimal adverse water quality impacts during construction Potential for additional habitat/ benthic habitat	Provides landward limit of coastal erosion Provides coastal erosion protection / land ward of structure Best located higher up on beach Design Life = 25 to 50+ years	$1M - $11M
	Disadvantages	Public access constraints, requires stairs/ramping Requires periodic maintenance after major events Aesthetic considerations		
Concrete Seawall on Steel Sheet Pile Foundation	Advantages	Mitigates intensive wave and impacts of sea level rise over the long term Minimal adverse water quality impacts during construction Potential design / Small Footprint (higher up on beach) / less landward disturbance during construction	Provides landward limit of coastal erosion Provides coastal erosion protection / land ward of structure Best located higher up on beach Design Life = 40 to 60+ years	$17M - $19M
	Disadvantages	Public access constraints, requires stairs/ramping High initial costs Aesthetic considerations		
Concrete Gravity Seawall	Advantages	Mitigates intensive wave and impacts of sea level rise over the long term Minimal adverse water quality impacts during construction Potential design / Small Footprint (higher up on beach)	Provides landward limit of coastal erosion Provides coastal erosion protection / land ward of structure Best located higher up on beach Design Life = 40 to 60+ years	$10M - $17M
	Disadvantages	Public access constraints, requires stairs/ramping Reduces in high initial costs Aesthetic considerations		

Next Steps…

Phase 2…

- Summary of Public Information Session
- Coordination with the Town, CRMC, and RIDEM
- Benefit-Costs Analysis Review
- Selection of Mitigation Measures
- Implementation Matrix
  - Responsible Parties
  - Time Frames
  - Funding Sources
- Submit Updated Plan for Local Adoption/ FEMA Approval

- Town can then move forward to implement mitigation measure (s)

Shoreline Structure Matrix

Structure		Advantages/Disadvantages	Role in Shoreline Protection/Design Life	Cost
Concrete Gravity Seawall	*Advantages*	Mitigates shoreline erosion and impacts of sea level rise over the long-term Minimal adverse water quality impacts during construction Compact design / Small Footprint / Higher up on beach	Provides landward limit of coastal erosion Provides coastal erosion protection landward of structure Best located higher up on beach Design Life = 40 to 60+ years	$15M - $17M
	Disadvantages	Public access constraints, requires stairs/ramping Medium to high initial costs Aesthetic considerations/Erosion of fronting beach/ Direct loss of landform Potential for end scour/ decrease ecological value		
Concrete Seawall on Steel Sheet Pile Foundation	*Advantages*	Mitigates shoreline erosion and impacts of sea level rise over the long-term Minimal adverse water quality impacts during construction Compact design / Small Footprint / Higher up on beach , less backland disturbance during construction	Provides landward limit of coastal erosion Provides coastal erosion protection landward of structure Best located higher up on beach Design Life = 40 to 60+ years	$17M - $19M
	Disadvantages	Public access constraints, requires stairs/ramping High initial costs/ Erosion of fronting beach/ Direct loss of landform Aesthetic considerations Potential for end scour/ decrease ecological value		
Riprap Revetment	*Advantages*	Mitigates shoreline erosion and impacts of sea level rise over the long-term Minimal adverse water quality impacts during construction Potential for additional hard-bottom habitat	Provides landward limit of coastal erosion Provides coastal erosion protection landward of structure Best located higher up on beach Design Life = 25 to 40+ years	$8M - $11M
	Disadvantages	Public access constraints, requires stairs/ramping/ Decrease of ecological value Large physical area (footprint) required for construction and installation Require periodic maintenance after major events Aesthetic considerations / Erosion of fronting beach/ Direct loss of landform		
Offshore Breakwater **(Reef and Rubblemound)**	*Advantages*	Mitigates shoreline erosion over the long-term Potential for creation of additional habitat Potential for beach-widening from accretion	Reduces intensity of wave action and thereby reduces coastal erosion. Design Life = 25 to 40+ years (without major events)	Reef $12 - $15M Breakwater $25M+
	Disadvantages	Reduced recreational opportunities (body/board surfing) due to decreased wave action High initial costs/Potential for altering adjacent coastal profile/ Aesthetic impacts with rubblemound Altered hydraulic/wave energy conditions causes loss of bottom habitat, longshore transport of sediment		
Beach Nourishment	*Advantages*	Increases public access opportunities/ High energy wave environment Allows for greater redistribution of sediment/ Enhances wildlife habitat and recreational opportunities No adverse effects on adjacent coastal areas Minimizes wave action/energy, run-up, coastal flooding to facilitate dune restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires on-going nourishment program Design Life = 5 to 7 years (without significant events)	$8M - $12M
	Disadvantages	Vulnerability to unusually large wave events Frequent maintenance/repair, impacts to benthic species Low sediment reserves increase costs / Large initial volume required		
Coir Vegetative Logs	*Advantages*	No adverse water quality impacts Allows for greater redistribution of sediment Minimizes wave action/energy, run-up, coastal flooding to facilitate dune restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires on-going nourishment program Design Life = 5 to 7 years (without significant events)	$8M - $10M
	Disadvantages	Vulnerability to lesser wave events/ Potential for end scour Frequent maintenance/repair and short design life expectancy Low sediment reserves increase costs Public access considerations at specific entry points		
Geotube Shore Protection	*Advantages*	Allows for greater redistribution of sediment Provides a reinforced dune / Requires lesser initial nourishment volume Minimizes wave action/energy, run-up, coastal flooding to facilitate dune restoration/stabilization	Replenishment of sand by mechanical means reduces erosion of existing bank. Requires on-going nourishment program Design Life = 10 to 15 years (without significant events)	$6M - $8M
	Disadvantages	Vulnerability to unusually large wave events Frequent maintenance/repair Low sediment reserves increase costs Public access considerations at specific entry points / Aesthetics		

Shoreline Structure Matrix

Structure		Advantages/Disadvantages	Role in Shoreline Protection/Design Life	Cost
Bulkheads (Sheet Piles, Steel/Timber Cribbing	*Advantages*	Mitigates shoreline erosion and impacts of sea level rise over the long-term Minimal adverse water quality impacts during construction Compact design / Small Footprint / Higher up on beach	Provides landward limit of coastal erosion	$18M
	Disadvantages	Public access constraints, requires stairs/ramping Medium to high initial costs Aesthetic considerations/Erosion of fronting beach/ Direct loss of landform Potential for end scour/ decrease ecological value	Design Life = 15 to 20 years (without significant events)	
Bank Stabilization (Soil Bioengineering) Live Staking, Live Fascines, Brushmattresses, Crib Walls, Reed Clumps	*Advantages*	Amenity for wildlife/habitat/aesthetics/no adverse water quality impacts (improves water quality) Provides a reinforced dune/ Generally lower costs Minimizes wave action/energy, run-up, coastal flooding	Facilitates reinforced dune/backshore to dissipate wave energy Short term solution in high-energy wave climates	$8M - $10M
	Disadvantages	Vulnerability to unusually large wave events/short-term solution May harbor, encorage overpopulation of wildlife Public access considerations at specific entry points	Design Life = variable, dependent upon weather events	
Sand Drift Fence with Beach Nourishment	*Advantages*	No adverse water quality impacts/High energy wave environment Allows for greater redistribution of sediment/littoral transport Minimizes wave action/energy, run-up, coastal flooding to facilitate dune restoration/stabilization	Allows for littoral transport of sand, minimizes erosion of existing bank. Facilitates bank/dune re-establishment. Short term solution in high-energy wave climates Design Life = variable, dependent upon weather events	$8M - $12M
	Disadvantages	Vulnerability to lesser wave events Frequent maintenance/repair and short design life expectancy in high energy wave climates Public access considerations at specific entry points		
Retreat/ Relocation	*Advantages*	Mitigates damages to structures/ Short term Provides additional area for wave run-up/dissipation	Reduces damage, remediation costs to structures Short term solution with sea level rise, climate change projections	High (Market Driven)
	Disadvantages	Structural integrity/availability of land may be a constraint Short term solution…may be in same situation within several years High costs/ Requires significant site preparation	Design Life = variable, dependent upon weather events and accelerated impacts of sea level rise, climate change	
Gabion Mattresses	*Advantages*	Mitigates shoreline erosion Minimal adverse water quality impacts during construction Supports growth of vegetation	Provides coastal erosion protection/ Short term solution	$6M - $9M
	Disadvantages	Public access constraints/ Barrier to wildlife habitat Vulnerability to unusually large wave events/ Erosion of fronting beach/ Direct loss of landform Requires regular maintenance/repair Aesthetic considerations / Decreases ecological value	Design Life = variable, dependent upon weather events	
Gabion Wall	*Advantages*	Applicable in moderate-energy wave climates Supports growth of vegetation Mitigates shoreline erosion and impacts of sea level rise/ Short term	Provides coastal erosion protection/ Short term solution	$6M - $9M
	Disadvantages	Public access constraints, requires stairs/ramping Aesthetic considerations/Erosion of fronting beach/ Direct loss of landform Requires regular maintenance/repair Decreases ecological value	Design Life = variable, dependent upon weather events	
Vegetated Gabion Wall	*Advantages*	Increases stability with vegetation Aesthetically more pleasing Provides wildlife habitat	Provides coastal erosion protection/ Short term solution	$6M - $9M
	Disadvantages	High failure rate (vegetation) within first 2 years Public access constraints, requiring stairs/ramping Requires high maintenance/monitoring	Design Life = variable, dependent upon weather events	

Shoreline Structure Matrix

Structure		Advantages/Disadvantages	Role in Shoreline Protection/Design Life	Cost
Groins	*Advantages*	Encourages accretion of sand/sediment Mitigates shoreline erosion, short term	Facilitates sand accretion, trapping sand from the longshore drift Design Life = variable, dependent upon weather events	Moderate, dependent upon type/configuration (Est. $5M - 8M for 3 @ 500LF)
	Disadvantages	Impacts to water quality/habitat/ Secondary impacts to downdrift locations (inhibits littoral transport) Large physical area (footprint) required for construction and installation Requires periodic maintenance / Direct loss of landform Aesthetic considerations / Recreational boating hazard		
Sills/ Perched Beaches	*Advantages*	Amenity for wildlife/habitat/aesthetics Maintains coastal landform/ Provides public access and recreational opportunities	Provides coastal erosion protection through sand accretion facilitated by a low-profile retaining wall Design Life = variable, dependent upon weather events	High, dependent upon height/length and nourishment program costs (Est. $12M - 14M)
	Disadvantages	Vulnerability to unusually large wave events/Short-term solution Low energy wave environments Hazard for swimmers/bathers Secondary impacts to downdrift locations (inhibits littoral transport)		
Beach Cones/ Stabler Disks	*Advantages*	Provides hard-bottom stabilization for sand accretion Potential for additional habitat Maintains landform	Provides coastal erosion protection by reducing wave energy, sand accretes around disks Design Life = variable, dependent upon weather events	Moderate-High dependent upon quantity and nourishment program costs
	Disadvantages	Vulnerability to higher energy wave events Hazard to boaters/surfers May become destructive/armor if washed ashore		
Undercurrent Stabilizers	*Advantages*	Builds nearshore profile through accretion Dissipates wave energy	Provides coastal erosion protection Facilitates sand accretion, while minimizing wave energy Design Life = variable, dependent upon weather events	High, dependent upon length/type of shoreline (Est. $3M - 5M for 3 @ 500LF)
	Disadvantages	Altered hydraulic/wave energy conditions Decreases ecological value/inhibits longshore transport of sediment Induces nearshore shoaling		

South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Public Information Session

Tuesday August 26, 2008
7:00 AM
Matunuck Elementary School
Please Sign In!

Name	Address	E-mail
[illegible]	854 Matunuck Beach Rd	JCAINE1@VERIZON.
[illegible]	57 Seabreeze Terrace	lkarin9184@cox.
L M Wante Jr	21 Ocean Ave Matunuck	LWANTE@AOL.Com
[illegible]	854 Matunuck BEACH RD	
[illegible]	854 Matunuck RD	
Barbara Gallagher	799 Matunuck Beach RD	BRGALLAGHER799@ M
Paul Hagerty	48 PROSPECT RD	pmhagerty@verizon.
[illegible]	181 Washington St	THE LETDYS@AOL.C
Mr. + Mrs. William George	181 Peninsula Rd.	WILLIAMEGEORGE@C
Barbara Sullivan	160 Ocean Ave	babsullivan@verizon
Frances DeFranco	4 & 6 Roy Carpenters	
Dennis Ramsey	854 Matunuck Beach Rd #2	DRAMS624@COX.NET
Terry Anderson	811 MTK BEACH RD	
Ambrose + Sally Miller	161 Peninsula Rd	sally@ambrosemill
DAVID S. CARTER	844 ASH. ST	DAVE-MARYKEHOE C SBCGLOBAL.N
Joyce Card	210 Washington ST	joycardcor@aol
Bob Fox	MATUNUCK SURF SHOP	foxjr@ride.ri.net
Kim D. McHugh	91 SEABREEZE TERR S.K	KIMMCHUGH@COX.N
Linda R Duggan	102 Ocean Ave Matunuck	lrduggan@
Donna Sassi	10 Nimgret Matunuck	lrduggan@hotm
Mr. + Mrs. Edmund Terbe	854 Matunuck Beach Rd	NONE

South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Public Information Session

Tuesday August 26, 2008
7:00 AM
Matunuck Elementary School
Please Sign In!

Name	Address	E-mail
Don & Celia Baker	76 Peninsula Rd.	DONANDCELIA401@VERIZON.
Pat McDevitt	114 Hillard Ave (7 Atlantic) Warwick, RI 02886	pmcdevitt4@cox.net
Paul Ainsworth	151 South Walden Rd	PAinsworth@Cox.
R.J. Fitzgerald	58 Prospect Rd	RJFITZ828@AOL.C
David A. York	66 Prospect Rd	BY44133@SBCGLOBAL
Kevin V. Finnegan	895 A&B Matunuck Beach Rd	OMistbar@aol.com
Carol A. O'Donnell	854 Matunuck Beach Rd. #52	
Frank Tassoni	884 Matunuck Beach Rd 179	Lawyg1258@aol.
Regina Brannon	22 Howard Circle 02879	RJBTAB@cox.net
Gene Nichols	28 Hollow Trl	Ellunds6@Verizon.
Cory & Beverly Bender	Mary Carpenters	
Leo [illegible]	92 Sweeden Rd	LEORI@VERIZON.CO
Jerry J. Thiessen	240 Cards Pond Rd (Roy's)	N/A
Tom & Marie Tetreault	#754 Matunuck Beach Rd	
Marion & Fred [illegible]	858 Matunuck Rd. Beach Road	
DAVID PRESCOTT	91 COUNCIL RD CHARLESTOWN	dprescott@sonicbay.org
Michael Marran	1 Secluded Dr. Wakefield	mmarran@marranlaw.co
John Dolan	18 Howard Circle. MATUNUCK RI	
Tara Melroy	907 Matunuck Beach Rd	TaraMelroy@[illegible]
Fran O'Brien	907 Matunuck Beach Rd.	F.O'Brien@Cox.N

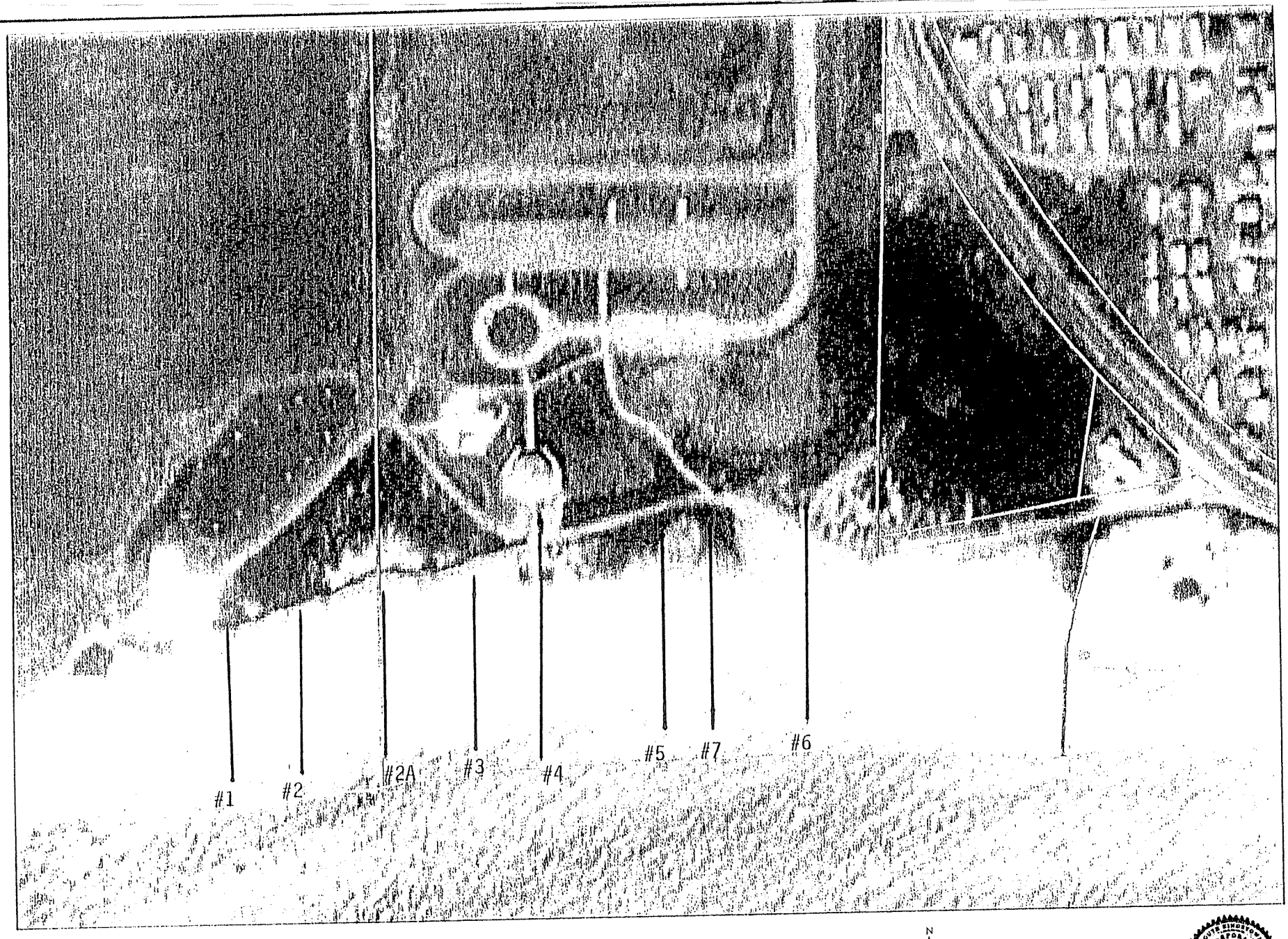
South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Public Information Session

Tuesday August 26, 2008
7:00 AM
Matunuck Elementary School
Please Sign In!

Name	Address	E-mail
Ella M. Whaley	518 A Shannock Rd Wakefield	ellawhaley@cox.net
Geo. Goneconto	209 Washington ST	Goneconto@Verizon.N

APPENDIX F

1998 TOWN BEACH NOURISHMENT PROJECT



Parcel Boundaries

Data Source:
USGS Ortho Photo: Flown March 1995
Parcel Boundaries: Tax Assessor Maps: March 1996

South Kingstown Town Beach

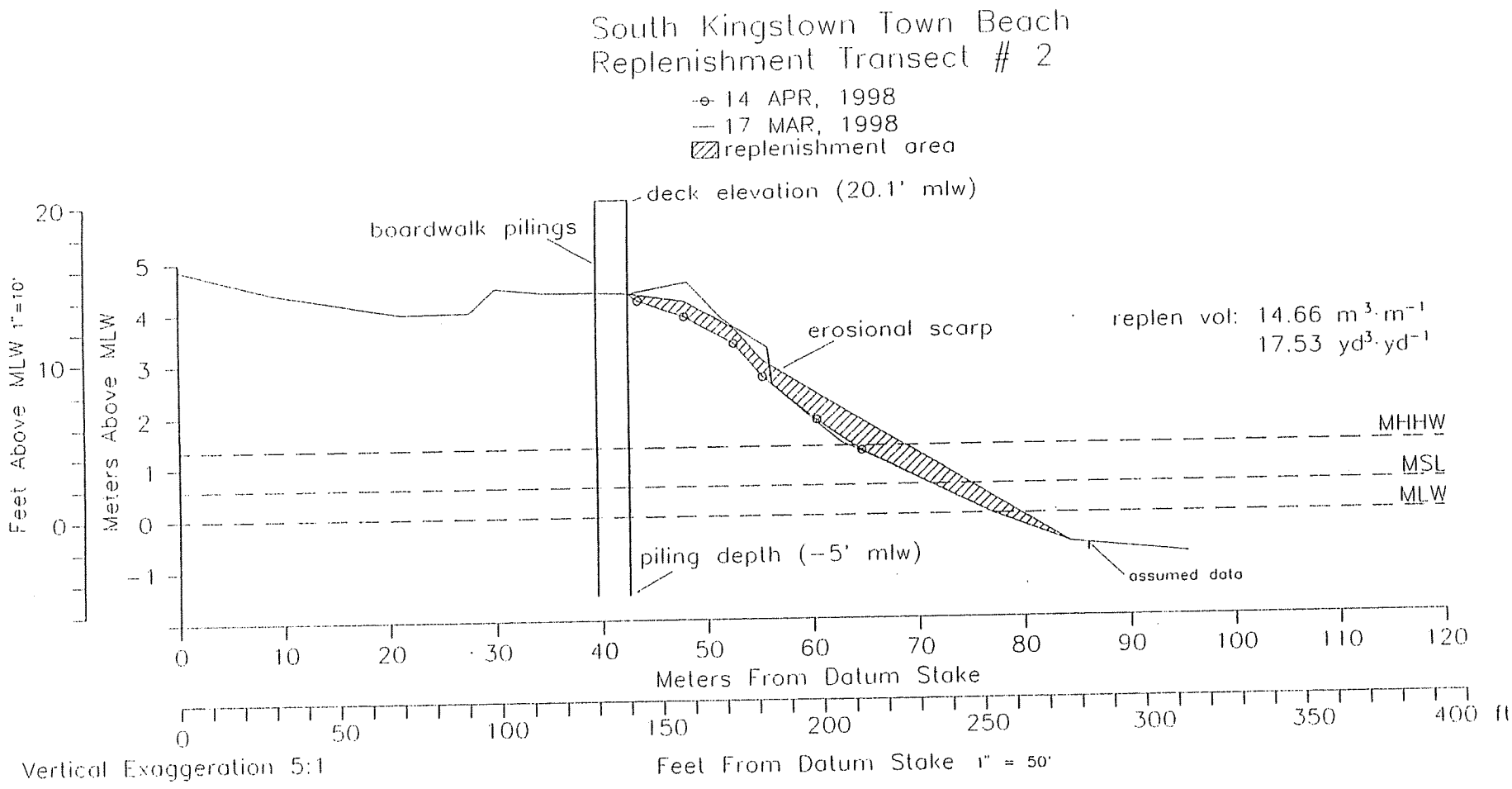
(Cross Section Locations)

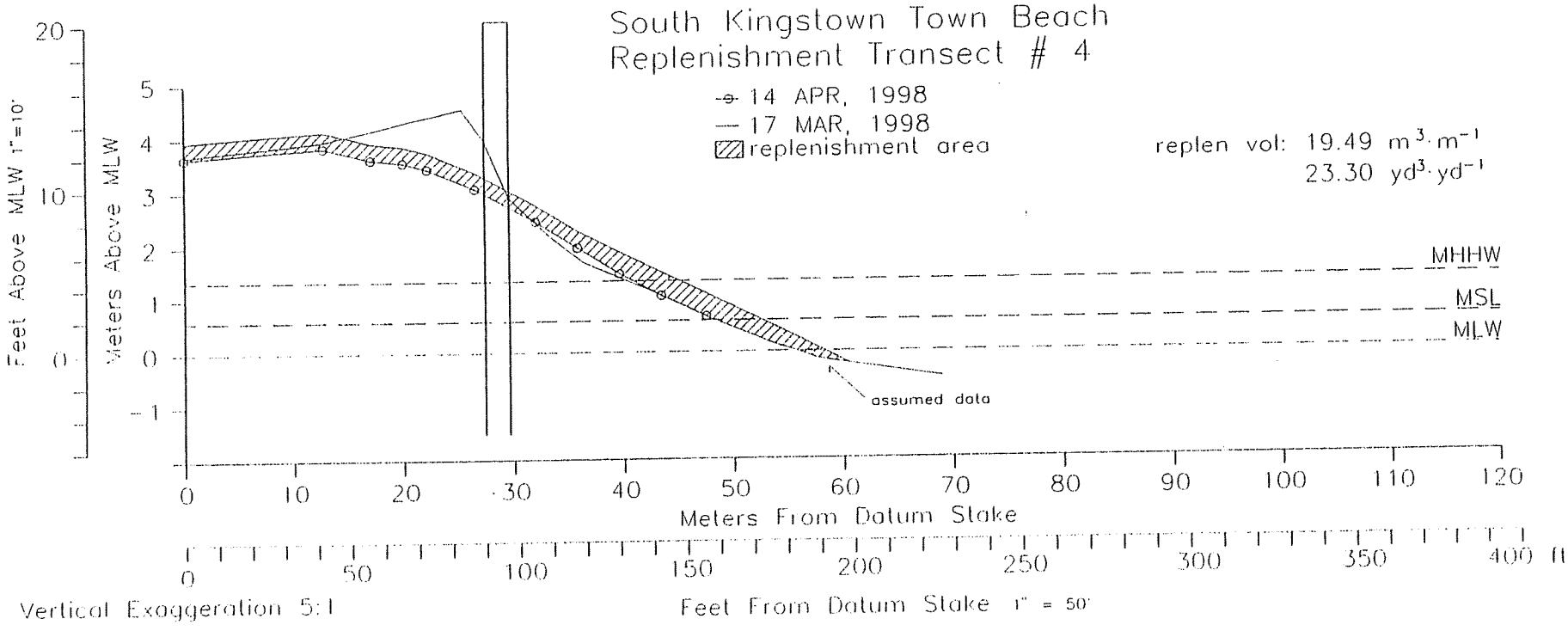
N W E S

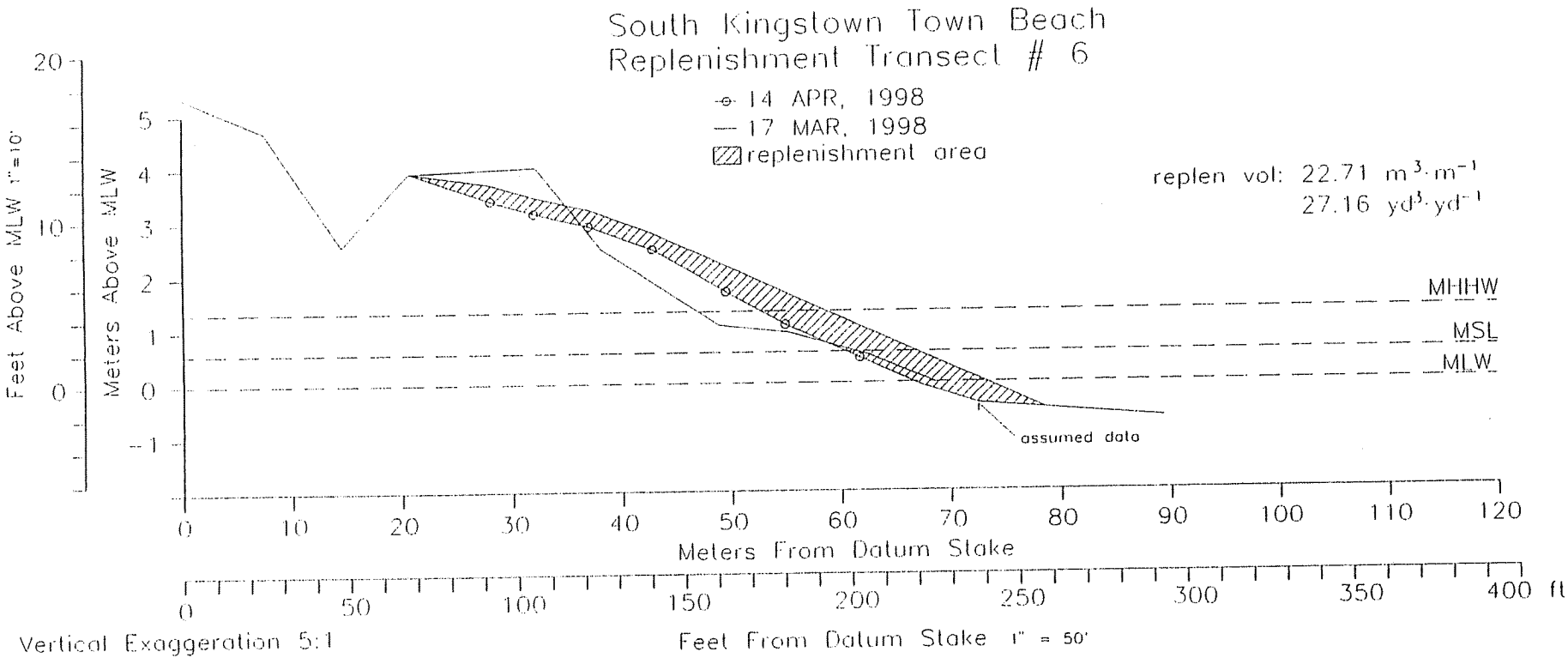
100 0 100 200 Feet

Scale 1 : 1800
One inch = 150 feet

Geographic Information System


South Kingstown Town Beach
Replenishment Transect # 2
14 APR, 1998
17 MAR, 1998
replenishment area
deck elevation (20.1' mlw)
boardwalk pilings
erosional scarp
replen vol: 14.66 m³·m⁻¹
17.53 yd³·yd⁻¹
MHHW
MSL
MLW
piling depth (-5' mlw)
assumed data
Feet Above MLW 1"=10'
Meters Above MLW
Meters From Datum Stake
Feet From Datum Stake 1" = 50'
Vertical Exaggeration 5:1


South Kingstown Town Beach
Replenishment Transect # 4
14 APR, 1998
17 MAR, 1998
replenishment area
replen vol: 19.49 m³·m⁻¹
23.30 yd³·yd⁻¹
MHHW
MSL
MLW
assumed data
Feet Above MLW 1"=10'
Meters Above MLW
Meters From Datum Stake
Feet From Datum Stake 1" = 50'
Vertical Exaggeration 5:1


South Kingstown Town Beach
Replenishment Transect # 6
14 APR, 1998
17 MAR, 1998
replenishment area
replen vol: 22.71 m³·m⁻¹
27.16 yd³·yd⁻¹
MHHW
MSL
MLW
assumed data
Feet Above MLW 1"=10'
Meters Above MLW
Meters From Datum Stake
Feet From Datum Stake 1" = 50'
Vertical Exaggeration 5:1
ft

APPENDIX G

SHORELINE CHANGE MAPS

RHODE ISLAND SOUTH SHORE:
Cards Pond-Matunuck, South Kingstown
SHORELINE CHANGE 1939-2006
Rachel E. Hehre and Jon C. Boothroyd
EXPLANATION
DIGITAL SHORELINE ANALYSIS
DSAS Transect
Baseline
SHORELINE
Wet/Dry Lines
1939
1975
1988
2004
2006
SHORELINE CHANGE
End Point Distance 27.5 ft 8.4 m
End Point Rate 0.4 ft 0.15 m
Scale
0 500 1,000
0 100 200
2006 South Kingstown Orthophoto Base (2004 USGS - Water)
-2.17 ft -0.66 m
-1.94 ft -0.59 m
-1.80 ft -0.55 m
-1.84 ft -0.56 m
-1.64 ft -0.50 m
-1.74 ft -0.53 m
-2.00 ft -0.61 m
-1.93 ft -0.59 m
-1.90 ft -0.58 m
-2.49 ft -0.76 m
-2.66 ft -0.81 m
-3.08 ft -0.94 m
-3.18 ft -0.97 m
-3.51 ft -1.07 m
-3.74 ft -1.14 m
-3.61 ft -1.10 m
-0.34 ft -0.41 m
-1.01 ft -0.31 m
-1.51 ft -0.46 m
-0.75 ft -0.23 m
-0.52 ft -0.16 m
DRAFT: 07 JUNE 2007

RHODE ISLAND SOUTH SHORE:
Cards Pond-Matunuck, South Kingstown

SHORELINE CHANGE 1939-2006

Rachel E. Hehre and Jon C. Boothroyd

EXPLANATION

DIGITAL SHORELINE ANALYSIS

- DSAS Transect
- Baseline

SHORELINE
Wet/Dry Lines

- 1939
- 1975
- 1985
- 2004
- 2006

SHORELINE CHANGE

End Point Distance 27.5 ft 8.4 m

End Point Rate 0.4 ft 0.13 m

RHODE ISLAND GEOLOGICAL SURVEY

UNIVERSITY OF Rhode Island

CRMC

RIGIS

Scale

0 500 1,000 ft

0 100 200 m

2006 South Kingstown Orthophoto Base (2004 USGS - Water)

-177.4 ft -54.1 m -2.66 ft -0.81 m

-205.3 ft -62.6 m -3.08 ft -0.94 m

-212.2 ft -64.7 m -3.18 ft -0.97 m

-234.9 ft -71.6 m -3.51 ft -1.07 m

-250.8 ft -76.4 m -3.74 ft -1.14 m

-241.5 ft -73.7 m -3.61 ft -1.10 m

-89.4 ft -27.3 m -0.34 ft -0.41 m

-87.7 ft -26.8 m -1.01 ft -0.31 m

-101.9 ft -31.1 m -1.51 ft -0.46 m

-50.1 ft -15.3 m -0.75 ft -0.23 m

-34.9 ft -10.6 m -0.52 ft -0.16 m

APPENDIX H

HURRICANE CHECKLIST

HURRICANE ACTION CHECKLIST FOR SOUTH KINGSTOWN

Listed below are many things you should consider before, during and after a hurricane.

Stay or Leave ?

When a hurricane threatens your area, you will have to make the decision whether you should evacuate or whether you can safely 'ride out the storm' in your home. If local authorities recommend evacuation, you should leave!! Their advice is based on knowledge of the strength of the storm and its potential to cause death and destruction.

In General:

- If you live along the coastline or offshore islands, plan to leave
- If you live in a mobile home, plan to leave
- If you live near a river or in a flood plain, plan to leave
- If you live on high ground, away from coastal beaches, consider staying

In any case the ultimate decision to stay or leave will be yours. Study the following list and carefully consider the factors involved - especially the items pertaining to storm surge.

When a 'Hurricane Watch' is Issued for your Area:

- Check often for official bulletins on radio, TV, on-line or NOAA Weather Radio (Call Sign WXJ39, Frequency 162.4)
- Fuel automobile
- Check mobile home tie-downs
- Moor small craft or move to safe shelter
- Stock up on canned provisions
- Check supplies of medicines and drugs
- Check supply of batteries for radio and flashlights
- Secure outdoor furniture and other loose items
- Tape, board or shutter windows to prevent shattering
- Wedge sliding glass doors to prevent their lifting from tracks

When a 'Hurricane Warning' is Issued for your Area:

- Stay tuned to radio, TV or NOAA Weather Radio for official bulletins

- If you live in a structural sound dwelling located on high ground and choose to stay:
  - Board up garage and porch doors
  - Move valuables to upper floors
  - Bring pets inside
  - Fill containers (and bathtub) with several days supply of water - 1 gallon of drinking water per person per day
  - Use land line phones only for emergencies
  - Stay indoors on down wind side of dwelling away from windows
  - Remain indoors during calm period when hurricane eye passes over
- Leave mobile homes
- Leave areas that might be affected by storm tide or stream flooding
  - Leave early, during daylight if possible
  - Shut off gas, water and electricity at main stations
  - Take small valuable and important papers but travel light
  - Leave food and water for pets (shelters will not take them)
  - Lock up dwelling
  - Drive carefully to nearest designated shelter using recommended evacuation routes
  - Small craft and mobiles homes may be moved on highways up to ten hours before expected storm

After the 'All Clear' is Given:

- Drive carefully; watch for dangling electrical wires, undermined roads and flooded low areas
- Don't sight see
- Report broken or damaged water, sewer, gas and electrical lines
- Use caution when re-entering your dwelling:
  - Check for gas leaks
  - Check food for spoilage and water for contamination

Town of South Kingstown Emergency Shelters

South Kingstown High School, 215 Columbia St.
Broad Rock Middle School, 351 Broad Rock Rd.
Curtis Corner Middle School, 307 Curtis Corner Rd.
Tootel-Keaney Gym Complex, URI, Kingston Campus (regional shelter)

Important Phone Numbers

Emergencies	911	Police Dept.	783-3321 (routine calls)
Fire Dept.	783-2422	Police Dept.	783-3341 (emergencies)
School Dept.	792-9692	Town Hall	789-9331
RIEMA	946-9996	URI	874-1000
Red Cross	1-800-842-1122		

APPENDIX I

LHMC MEETING MINUTES

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the South Kingstown Local Hazard Mitigation Committee (LHMC) was held on February 3, 2005, at 2:00 p. m. in the Public Safety Complex Conference Room. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Public Services Dept.
Ray Nickerson	Principal Planner
Carol Baker	GIS Administrator
Keith Richards	EMS
Nate Barrington	Chief, Kingston Fire District

1. Mr. Nickerson stated that the primary meeting purpose was to review the revised final draft strategy plan and incorporate any additional recommended amendments from LHMC members.

2. Mr. Barrington stated that 2.2.3 (second paragraph) should include Kingston Water and the URI water system.

3. Mr. Barrington recommended that 2.2.3 (fourth paragraph) should be revised to change '2500' to '3000' gallon truck. Further, the paragraph should note that both South Kingstown fire departments participate in the Southern New England Emergency Fire Assistance Plan.

4. Mr. Schock recommended the following revisions:

- ✓ Dams/Impoundments (pg. 20) section should be changed to note that the dams are earthen structures that have been upgraded by installation of concrete spillways
- ✓ Mitigation Action #1 (pg. 26) should note that a dam inspection was undertaken in 1999
- ✓ Mitigation Action #4 (pg. 27) should be eliminated
- ✓ Mitigation Action #3 (pg. 31) has been completed and should be deleted
- ✓ Mitigation Action #1 (pg. 32) has been completed and should be deleted

5. Members present were in concurrence that the recommendations of Mr. Barrington and Mr. Schock should be incorporated in the final draft strategy plan.

Schock moved, Richards seconded; motion unanimously carried: "To approve the final draft of the Multi-Hazard Mitigation Strategy Plan, dated November 2004, with those amendments recommended by Nate Barrington and Jon Schock."

The meeting adjourned at 3:05 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on November 4, 2002 at 1:00 p. m. in the South Kingstown Town Council Chambers. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Public Services Dept.
Tim Wolken	Parks & Rec. Dept.
Ray Nickerson	Principal Planner
Carol Baker	GIS Administrator
Keith Richards	EMS
Nate Barrington	Chief, Kingston Fire District
Lt. Geoff Peckham	SKPD

1. Mr. Nickerson presented the final draft of the Multi-Hazard Mitigation Strategy Plan. Member voted unanimously to submit the document to RIEMA and FEMA as presented.

2. Lt. Peckham addressed the issue of evacuation routes. At present the project is on-going and the GIS mapping make not reflect the final information. Ms. Baker will work with RIDEM to ensure that GIS mapping is revised periodically to reflect applicable updates.

3. Mr. Nickerson reviewed the next steps, in chronological order. The process is as follows:

a. Review and approval by RIEMA
b. Review and approval by FEMA
c. Advertise public hearing for Comprehensive Plan amendment
d. Public hearing with South Kingstown Planning Board
e. Public hearing with South Kingstown Town Council

4. The Multi-Hazard Mitigation Strategy Plan (in it's entirety) will be incorporated into the South Kingstown Comprehensive Community Plan. Specifically, the Services and Facilities Element, Section M (Emergency Management) 2. (Mitigation Measures) will be revised to note that the Multi-Hazard Mitigation Strategy Plan is now part of the Comprehensive Plan.

5. Discussion ensued regarding the projected time frame. Mr. Nickerson noted that the actual Comprehensive Plan amendment would occur following RIEMA and FEMA approval. Approving the Comprehensive Plan amendment prior to FEMA approval could result in having the Plan amended with a text that required additional amendments per

FEMA review comments. As such additional hearings might be required. By waiting for final FEMA approval the Town can move forward with a Comprehensive Community Plan that is based on a document approved by the applicable Federal and State agency.

6. Mr. Nickerson will keep LHMC members apprised of the RIEMA and FEMA review process. Periodic updates on the review status will be sent to members.

7. Chief Vespia thanked all LHMC members for their hard work and dedication in development of the strategy plan.

8. Chief Vespia indicated that a LHMC meeting will be scheduled once results of the RIEMA and FEMA reviews are known. At that time members will address comments from RIEMA and FEMA.

The meeting adjourned at 3:35 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on July 30, 2001 at 1:00 p. m. in the Public Safety Building. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Public Services Dept.
Tim Wolken	Parks & Rec. Dept.
Ray Nickerson	Principal Planner
Carol Baker	GIS Administrator
Keith Richards	EMS
Robert Perry	Chief, Union Fire District
Nate Barrington	Chief, Kingston Fire District
Lt. Geoff Peckham	SKPD

1. Mr. Nickerson distributed copies of the revised strategy plan. He noted that the most recent amendments incorporate suggestions made by RIEMA staff.

2. Members agreed that a few weeks would be needed to review the amended strategy plan.

3. Ms. Baker will speak with RIDEM regarding amendments to the 'critical facilities' and 'risks' mapping.

4. Mr. Schock informed members that the Public Services Dept. prefers the Indian Run Dam Reconstruction project be considered for any available FEMA grant funding. Members were in agreement and directed Mr. Nickerson to develop a draft applicable, when applicable.

5. Members agreed to schedule the next meeting after all have had ample opportunity to review the most recent draft strategy plan.

The meeting adjourned at 2:05 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on July 23, 2001 at 1:00 p. m. in the South Kingstown Town Council Chambers. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Public Services Dept.
Tim Wolken	Parks & Rec. Dept.
Ray Nickerson	Principal Planner
Paul Erickson	Engr. Dept.
Keith Richards	EMS
Robert Perry	Chief, Union Fire District
Nate Barrington	Chief, Kingston Fire District
Lt. Geoff Peckham	SKPD

1. Mr. Nickerson gave a status report of the draft multi-hazard mitigation strategy plan and risk matrix. He informed members that many suggestions had been received from RIEMA staff in response to submission of the most recent draft. The draft is being revised to incorporate some recommendations from reviewers. It is anticipated that the revised draft will be available for LHMC review at next week's scheduled meeting.

2. Lt. Peckham noted he was in receipt of grant availability information. Mr. Nickerson also received the same package from RIEMA. Discussion ensued regarding potential projects for funding. Members identified a) the Town Beach Pavilion relocation and, b) the Indian Run Dam Reconstruction project as two possible grant application submissions. Staff will discuss this matter with the Town Manager.

3. Mr. Nickerson distributed copies of the most recently amended risk matrix. There was unanimous consent that the matrix, as drafted, should be incorporated into the multi-hazard mitigation strategy plan.

4. Mr. Nickerson noted that, during recent discussion with RIEMA, it appears that mitigation planning grants will become available to cities and towns. Members were requested to give thought to possible planning effort projects that might be eligible for those grant funds.

The meeting adjourned at 2:35 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on May 23, 2000 at 1:00 p. m. in the South Kingstown Police Station. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Public Services Dept.
Tim Wolken	Parks & Rec. Dept.
Ray Nickerson	Principal Planner
Paul Erickson	Engr. Dept.
Keith Richards	EMS
Carol Baker	GIS Coordinator
Nate Barrington	Chief, Kingston Fire Dept.
Lt. Geoff Peckham	SKPD
Joseph Klinger	RICRMC liason

1. Chief Vespia inquired as to the time frame for submission of a draft strategy plan to RIEMA. Mr. Nickerson indicated the draft is expected to be forwarded to Mr. Almeida o/a July 15.

2. Mr. Nickerson presented the draft of a two page Hazard Mitigation Fact Sheet that staff is developing. The fact sheet would be distributed to the Town Clerk Office, Police Dept., Building Official's Office and each of the three (3) public libraries.

3. Lt. Peckham informed members that there are existing hurricane preparedness fact sheets developed a few years ago in-house. He suggested that those fact sheets be reviewed.

4. Mr. Nickerson was delegated the task of reviewing the hurricane preparedness data for comparison / contrast with the draft fact sheet.

5. Discussion ensued regarding pertinent information that should be included in the new fact sheet. It was agreed that less focus should be placed on prior natural disasters and more attention paid to preparedness instruction for the property owner.

6. LHMC members will review the draft fact sheet and submit recommendations to the Planning Dept. within four weeks.

7. Mr. Schock recommended that a copy of the draft strategy plan be sent to the Town Tree Warden. He noted the impact to certain neighborhoods from fallen trees during storms. Mr. Nickerson will send a copy to Mr. Wallace.

8. Members reviewed the most recently revised risk matrix and were in general agreement with the document as presented.

9. There was a consensus that risk matrix item #12 (light poles at municipal facilities) should remain on the matrix. Members agreed there is little chance of federal funding (i.e. grants) being expended for item but it should be identified as a risk area of concern.

The meeting adjourned at 2:45 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on November 5, 1999 at 10:00 ~~p.m.~~ a.m. in the South Kingstown Police Station. In attendance were:

Chief Vin Vespia, Chair	SKPD
Al Curnow	Public Services Dept.
Jon Schock	Utilities & Water Dept.
Tim Wolken	Parks & Rec. Dept.
Dave Pinsonneault	Parks & Rec. Dept.
Ray Nickerson	Principal Planner
Paul Erickson	Engr. Dept.
Keith Richards	EMS
Carol Baker	GIS Coordinator
Nate Barrington	Chief, Kingston Fire Dept.
Lt. Geoff Peckham	SKPD
Joseph Klinger	RICRMC liason

1. Mr. Klinger presented an overview of the successful Town Beach Replenishment project. Recent efforts indicate beach nourishment can probably be removed from the risk matrix (in light of the remediation action taken).

2. Mr. Klinger discussed the environmental and permitting issues related to the Beach Pavilion Relocation project. He recommended that a meeting be scheduled with FEMA, RIEMA and regulatory agencies to consider and discuss options.

3. Mr. Nickerson reviewed the draft Multi-Hazard Mitigation Strategy Plan as developed by the Planning Dept. in concert with Kelly Knee (URI/CRC student intern). It was agreed that Mr. Nickerson will provide a discussion document detailing draft plan compliance with FEMA guidelines for strategy plan development.

4. Mr. Nickerson presented the draft risk matrix to members. Discussion ensued regarding the order of priorities. There was a consensus that the issue of dams should be moved to priority #1A and the Town Beach and Pavilion Facility should be listed as #2A. Mr. Shock and Mr. Curnow are of the opinion that the shoreline change mapping should be prioritized below the South Shore Water System Main issue.

5. Members agreed to review the draft strategy plan within a month forward comments and recommendations to the Planning Dept. Mr. Nickerson will make

necessary revisions to the strategy document and risk matrix. Copies of those revised documents will then be forwarded to LHMC members prior to another meeting being scheduled.

6. Members directed Mr. Nickerson to contact Mr. Almeida (RIEMA) and provide a status of the strategy plan development to date.

7. Ms. Baker will work with Mr. Nickerson and Lt. Peckham in development of needed mapping.

The meeting adjourned at 12:15 p. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on September 29, 1998 at 10:00 a. m. in the South Kingstown Police Station. In attendance were:

Chief Vin Vespia, Chair	SKPD
Jon Schock	Utilities & Water Dept.
Ray Nickerson	Principal Planner
Paul Erickson	Engr. Dept.
Carol Baker	GIS Coordinator
Nate Barrington	Chief, Kingston Fire Dept.
Keith Richards	EMS
Lt. Geoff Peckham	SKPD
Dave Pinsonneault	Parks & Rec. Dept.

1. Mr. Nickerson reviewed the Matunuck Beach erosion and Town Beach pavilion relocations issues. He has met with CRMC staff regarding shoreline erosion. CRMC may be able to provide technical support and assist in drafting environmental permits (i.e. Army Corp Permit, RIDEM wetlands, Water Quality Certification). He also met with the Public Services Director to review Town Beach Pavilion plans. Staff will develop possible alternative schemes for review and discussion.

2. Mr. Schock stated he is still continuing review of the Matunuck / East Matunuck Water Main relocation. He has met with Town of Narragansett representatives regarding this matter. He reviewed his memo of 2/26//98 that showed a construction cost estimate of $400,000.

3. Mr. Nickerson has met with Dr. Jon Boothroyd (URI Geology Dept.) concerning wave barrier devices. It was agreed that both CRMC and Army Corps are reluctant to support and/or permit installation of these devices without detailed study data. Such data would include an impact analysis pertaining to the Town Beach and adjacent shoreline areas.

4. Lt. Peckham is working with Carol Baker in the identification of hurricane evacuation route mapping. It is anticipated the mapping phase to be completed within two to three weeks.

5. Mr. Erickson noted that an engineering assessment of the designated shelters has yet to be scheduled. It is anticipated such study would be undertaken this coming late Fall or early Winter.

6. Mr. Barrington reviewed status of the Rural Area Wildlife Mitigation Study. At this time efforts are still on-going with no specific completion date estimate at this time.

7. Mr. Erickson noted that the Public Services Dept. Director has been in contact with RIDEM regarding evaluation of in-town dams. Mr. Curnow is compiling past State dam reports.

8. It is noted that, due to scheduling conflicts, the LHMC was not able to meet with RIEMA representatives regarding development of the preliminary matrix.

9. Mr. Schock reviewed his memorandum of 2/26/98 as it concerns the Middlebridge Bridge utility relocation issue. The construction cost estimate is $100,000. Mr. Schock notes that RIDOT is presently undertaking a preliminary reconstruction design for the bridge.

10. Mr. Nickerson distributed copies of the preliminary draft matrix. LHMC members will review the document and provide comments to the Planning Dept. no later than 11/1/98.

11. It was agreed that the Planning Dept. will take the lead on coordinating LHMC matters. Mr. Nickerson will notify members in the future regarding scheduled meetings.

The meeting adjourned at 11:17 a. m.

MEETING MINUTES

Local Hazard Mitigation Committee

A meeting of the Local Hazard Mitigation Committee (LHMC) was held on September 21, 1998 at 1:00 p. m. in the South Kingstown Police Station. In attendance were:

Chief Vin Vespia, Chair	SKPD
Al Curnow	Public Services Dept.
Jon Schock	Utilities & Water Dept.
Ray Nickerson	Principal Planner
Paul Erickson	Engr. Dept.
Carol Baker	GIS Coordinator
Nate Barrington	Chief, Kingston Fire Dept.
Lt. Geoff Peckham	SKPD
Lori Watson	URI/Coastal Resources Center

Chief Vespia stated that the LHMC meeting had been arranged to provide an opportunity for Lori Watson (Hazard Mitigation Specialist at URI/CRC) to discuss development of the South Kingstown hazard mitigation strategy plan.

Ms. Watson detailed the strategy plan development, review and approval process.

Ms. Watson provided the following materials for Committee members:

- A draft of the Town of Narragansett strategy plan
- The Town of Narragansett Comprehensive Plan amendment text
- Examples of risk matrix
- Excerpts from a recent training manual
- NFIP information for South Kingstown
- Information from an Emergency Operations Plan

Ms. Watson explained that the NFIP information will be valuable in applying for FEMA's Community Rating System.

Members agreed that once the draft risk matrix, mission statement and capability assessment are completed it should be forwarded to Ms. Watson for her review and comment.

Ms. Baker gave LHMC members a brief primer on the Town's GIS capabilities and how GIS may be used as a vital tool in development of the strategy plan.

The meeting adjourned at 2:35 p. m.

South Kingstown Police Department

Memorandum

To: Town Manager, Stephen Alfred/ Chief Vincent Vespia, Jr.
From: Lt. Geoffrey Peckham
Subj: Hazard Mitigation Committee Meeting
Date: February 23, 1998

This date was the first meeting of the Hazard Mitigation Committee for the Town of South Kingstown. Chief Vincent Vespia, Jr, Chaired the meeting. In attendance were the following:

Alfred Curnow- Public Works Director
Jon Schock- Utilities and Water Department
Ray Nickerson- Planning Department
Paul Erickson- Engineering Department
Carol Baker- G.I.S. Coordinator
Nate Barrington- Chief Kingstown Fire Deparrtment
Robert Perry- Dep. Chief Union Fire Department
Keith Richards- Director Emergency Medical Services
Lt.Geoff Peckham-Administrative Assistant to Police Chief

The purpose of the first meeting was to brainstorm and identify possible mitigation projects within the Town of South Kingstown. The following projects were identified and the respective member of the committee will respond with a written synopsis of the project in the area of their expertise:

1. Matunuck Beach Erosion Replacement and Pavilion Relocation Project- Mr. Ray Nickerson will address this project.

In essence, this project would entail replacement of the sand eroded as result of the winter storms, which have taken a severe toll this winter season, and the relocation of the Matunuck Beach Pavilion and board walks set back from the beach area.

2. Relocation of the Matunuck/ East Matunuck Water Main- Jon Schock will address this project.

This project would require the relocation of the water main which is presently buried in the barrier beach at East Matunuck and services the Matunuck area of South Kingstown. Hazard- should erosion continue or a large Hurricane hit it could take out the water main and Matunuck and East Matunuck could be without water services for an extended period of time.

3. Construction of a Wave Barrier in the Matunuck Town Beach Area- Ray Nickerson will address this project.

This project would require large cement abutments placed away from shore at a certain distance which would cut down wave movement and prevent the sand from washing out the beach area.

4. Middlebridge Utilities Relocation- Jon Schock

This would require the removal of the utilities attached to the Narrow River Bridge at Middlebridge and a new method of crossing the river to Narragansett of the Utilities services. Hazard- deteriorating Bridge could fall or be destroyed during a hurricane causing disruption of Utility Services.

5. Hurricane and Winter Storm Evacuation Route Signs- Lt. Peckham

This would require the establishment of evacuation routes and then have sign posting from those coastal areas to the designated shelters in South Kingstown.

6. Shelter Evaluation- Lt. Peckham/ Paul Erickson

This would require the engineering department to review the presently designated shelters in South Kingstown as to structural integrity during high winds and possibly earth quake.

7. Rural Area Wildfire Mitigation- Chief's Barrington and Perry

This would entail a study of the rural area of town and the possible establishment of fire breaks or construction of Water trenches/ portable water pools for fire season.

Hazard- Destruction of personal property/loss of wildlife refuge.

8. Evaluation and Reconstruction of Local Inland Water Dams- Alfred Curnow.

This would require the engineering evaluation of each of the manmade and or natural dams in South Kingstown for prevention of Dam Break in the future. Hazard- loss of property and life, destruction of the ecology of the area.

Each of the above mentioned projects and their synopsis will be presented to Chief Vespia within ten working days.

At the next meeting of the committee a member of the R.I.E.M.A. will be asked to attend and have the preliminary list presented to him for his review to see if the project, or projects would qualify for Federal Funds under the Mitigation Program.

A preliminary Matrix will be made up and presented at that meeting for review and corrections.

PARE
CORPORATION

Revised Schedule

DATE: June 10, 2008

FROM: Craig Pereira

RE: South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Pare Project No. 08102.00

Task 1 Inventory of Existing Conditions
(January – April 2008)

1. Review/update of Multi-Hazard Mitigation Strategy Plan, November 2005 (rev. March 2006). Interview property owners along MBR. Coordination with Larry Macedo – Planning Supervisor RIEMA (#401.462.7126), approval process for updating local hazard mitigation plans. CRMC file review (on-line) of private property owners' application activity.
   - Identifying all physical hazards that could affect the community
   - Profile hazard events and determine if there are additional maps or new hazard studies available
   - Determine if chances of future events have changed
2. Coordination with Jon Boothroyd – State Geologist University of Rhode Island (Department of Geosciences, #401.874.2265).
   - Investigate and identify effects of erosion, wave action, and tidal surges
3. Complete Suitability Analysis. Coordination/meeting with Rhode Island Department of Environmental Management/Coastal Resources Management Council, RI's history BMP's.
   - Identify any physical constraints that will limit the viability of a mitigation measure
   - Identify environmental constraints that will come into play that may restrict or eliminate a potential mitigating measure. A coordination meeting with the Rhode Island Department of Environmental Management and the Rhode Island Coastal Resources Management Council will be scheduled early on in the process to receive their feedback.
4. Coordination with Building Inspector's office for new development permits. Coordination with Ray Nickerson – Principal Planner South Kingstown (#401.789.9331).
   - Determine if recent or future development(s) in the project area have been checked for their effect on hazard areas. Review any new studies performed related to hydrologic, watershed, traffic, or demographics that may provide information that can impact the study area. (PARE recently performed an hydrologic analysis for the Carpenter's Beach Meadows ISDS design.)
5. Coordination with Assessor's office.
   - Inventory all assets including the updating of existing structures and determine the population in high risk areas.
6. Review of FEMA's website.
   - Estimate losses that may have occurred since the last update to the Mitigation Strategy Plan.

Task 2 Analysis of Prior Coastal Conditions and Damage
(January – April 2008)

1. Review/update of Multi-Hazard Mitigation Strategy Plan, November 2005 (rev. March 2006). Interview property owners along MBR. Review of Town files for mitigative measures completed to date (Chronology/history of measures).

Task 3 Identification of Potential Mitigation Measures
(May - July 2008)

- Raising the grade of Matunuck Beach Road
- Incorporate the design of a seawall to protect Matunuck Beach Road
- Investigate improvements to the culvert design at Carpenter's Beach
- Investigate the possibility of potential emergency routes to evacuate the residents if Matunuck Beach Road is not passable
- Investigate means to increase storage at the coastal pond
- Investigate alternatives to permanently stabilize the shoreline
- Investigate long term stabilizing measures for the beach area

Task 4 Assessment of Measures Identified
(May – July 2008)

1. During this task an assessment of the potential mitigating measures will be performed. The main goal of this phase will be to analyze the mitigation measures identified and to determine the potential impacts of performing the mitigation. The mitigation measures will be analyzed by comparing different alternatives for solutions and detailing the results of either a "No Action" alternative, "Alternatives Considered But Not Carried Forward" due to cost and/or feasibility, or a "Proposed Action" Alternative. Environmental impacts will be a major factor in the assessment of any alternative.
2. Impacts to the geology, water resources, and biological resources including flora and fauna and threatened and endangered species, will be investigated.
3. In addition, the importance of a mitigating measure in how it serves an area such as for transportation or emergency rescue services will be identified.
4. Complete Benefit-Costs Analysis.
5. Public Meeting #1 to present work/findings completed to date (proposed for late July/early August to include as many seasonal owners within the Matunuck Beach Road area in the process).
6. Presentation/recommendations to Town (Hearing/Workshop? – to be resolved) - (to be scheduled within one month of the Public meeting and include summary of public input).

Task 5 Selection of Mitigation Measures
(August/September 2008)

1. Based on the input/feedback from the Public meeting and recommendations from the Town, the selection of the measures will be developed to create a better institutional awareness and involvement in hazard mitigation as part of "regular" day-to-day activities. The update to the Plan will include the steps that were taken to determine the plan of action and how the involvement of others was incorporated into the decision making process.

- The revised Plan will be reviewed by all stakeholders for its validity and proceed through a formal adoption process as required by local and state laws. (Adoption of Plan by Town of South Kingstown).

Task 6 Detail of Responsible Parties
(September 2008)

1. Implementation matrix.
   - Responsible parties
   - Time frames
   - Funding sources

Task 7 Cost Estimate of Selected measures
(September 2008)
1. (A revision of BCA completed in Task 4).

Town/RIEMA/FEMA Submissions
(October 1, 2008)

1. Submit final plan for review/approval to RIEMA/FEMA.

MEMORANDUM OF MEETING

DATE: August 16, 2008

TO: File

CC: Ray Nickerson, John Shevlin

FROM: Craig Pereira

RE: **South Kingstown Multi-Hazard Mitigation Plan Update**
Local Hazard Mitigation Committee Meeting
Pare Project No. 08102.00

A meeting of the South Kingstown Local Hazard Mitigation Committee was held yesterday at 11 am at the South Kingstown Town Hall. The purpose of the meeting was to present the draft PowerPoint presentation developed for the Public Information Session which includes findings of the data collection process for the update of the Town's Multi-Hazard Mitigation Plan, a range of alternative mitigative measures for the long-term stabilization of Matunuck Beach Road, as well as other mitigative measures for the protection of property within the Matunuck Beach Road area (study area). Members of the LHMC in attendance included:

Ray Nickerson – Principal Planner
Janet Freedman – CRMC
Andy Nota – Parks and Recreation
Jon Schock – DPW director
Carol Baker – GIS Administrator

Craig Pereira, Karl Hammond – Pare Corporation

The following comments were received regarding revisions to the PowerPoint presentation:

- Utilize the Town's 2006 color orthophoto for all images instead of the RIGIS 2004 orthophoto.
- In CRMC's Shoreline Comparison Map graphic, expand the viewport to include more of the Town Beach area.
- Under the 'No Action Alternative', add loss of access/egress to transportation impacts.
- Define 'Retreat'.
- Include reef/rubblemound breakwaters as a potential alternative carried forward.
- When referencing 'Carpenter's development', refer to it as 'Mary Carpenter's development'.
- Include some typical representative photos associated with the structural applications.
- A matrix of potential mitigative measures needs to be created to compare the advantages/disadvantages, role in shore protection/design life, and total conceptual cost estimates – possibly the concluding slide in the presentation.

- Develop a plan view graphic that identifies the approximate limits for the structural applications.
- Need to stress that implementing structural applications is essentially 'trading access for protection'.
- Need to stress that sand replenishment reserves are not plentiful in the state, and substantially increase the costs associated with beach nourishment projects.

South Kingstown
Local Hazard Mitigation Committee Meeting
SOUTH KINGSTOWN, RHODE ISLAND

Friday August 15, 2008
11:00 AM
South Kingstown Town Hall
Please Sign In!

Name	Address	E-mail
RAY NICKERSON	Town of South Kingstown	rnickerson@southkingstown.r.c
JANET FREEDMAN	CRMC	jfreedman@crmc.ri.ga
Andy Nota	S.K. Parks and Recreation	ANOTA@ southkingstown.co
JON SCHOCK	TSK PUBLIC SERVICES	jschock@ southkingstown
Carol Baker	GIS Administrator, TSK	cbaker@ southkingstown
CRAIG PEREIRA	PARE CORPORATION	
KARL HAMMOND	PARE CORPORATION	

PARE CORPORATION

South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Local Hazard Mitigation Committee Meeting
Thursday December 4, 2008

Agenda

1. Review Structure Matrix and Cut-Sheets

2. Mitigation Action Plan
    - Review and Selection of Mitigation Measures
    - Prioritization of Selected Measures
        a) Review Benefits/Costs
        b) STAPLEE

3. Next Steps: Schedule, Posting, Submission

MEMORANDUM OF MEETING

DATE: December 12, 2008

TO: File

CC: Ray Nickerson, John Shevlin

FROM: Craig Pereira

RE: **South Kingstown Multi-Hazard Mitigation Plan Update**
Local Hazard Mitigation Committee Meeting
Pare Project No. 08102.00

A meeting of the South Kingstown Local Hazard Mitigation Committee was held yesterday at 9 am at the South Kingstown Town Hall. The purpose of the meeting was to present the expanded, final Structure Matrix and Cut-sheets (as requested by the Town), review the Mitigation Action Plan through review of recommended mitigation measures, review of Benefits/Costs, and prioritization of selected measures). Members of the LHMC in attendance included:

Ray Nickerson – Principal Planner
Janet Freedman – CRMC
Lance Whaley – Fire Department
Carol Baker – GIS Administrator

Craig Pereira, Karl Hammond – Pare Corporation

The following comments were received:

Review of Structure Matrix and Cut-Sheets

- No comments received – additional copies submitted to Ray Nickerson for review by Public Services Director and Town Manager.

2004 Risk Assessment Matrix

- The Risk Assessment Matrix was evaluated and revised/prioritized to acknowledge/reflect completed remediation projects in Town and to consider any new vulnerable areas/action items that should be included, relative to hazard mitigation. The specific order of priority was based on the LHMC's review of hazards in light of potential risks.
- Vulnerable Area #1 – Dams, Earthen and Stone Masonry types…
  -remediated since the 2004 plan, and thus, recommended to be moved to the low priority end of the matrix.
- Recommend a review of all measures (status of Ocean Avenue Pedestrian Ramp?)

Mitigation Action Plan

- The draft Mitigation Action Plan packet was disbursed. A review of each mitigation measure recommended to be incorporated into the plan Update followed…the action item was identified and defined with a brief descriptive paragraph, including Lead/Responsible Parties, Financing Options, Timeframe, and Cost.

- Comments were received immediately after each action item for clarity:

    - Beach and Dune Nourishment Project:
      - Include the ACOE *'Regional Sediment Management Study'* as a resource for the Town to consider as an alternative for disposal and source options (Janet Freedman).
    - Create an Educational Display
      - Janet Freedman is currently working with several other individuals (local photographer and Jon Boothroyd) to develop a photographic display of historic weather/event shoreline damage at Roy Carpenter's seasonal development. The potential for resource sharing exists.
    - Community Rating System
      - The Town should contact Michelle Burnett (State Floodplain Coordinator) to initiate the CRS Audit that is required to start the enrollment process. Pam Rubinoff is supposedly working with URI interns to develop a statewide credit for work municipalities are already undertaking (as a state requirement) (Janet Freedman).

Prioritization of Action Items

- The initial approach towards prioritizing the recommended action items included Method D: Quantitative Method – Weighted Score to compensate for limitations associated with the Simple Score Method by adding emphasis to those factors judged to be more important. At the request of the LHMC, it was decided to utilize Method B: Qualitative Method – Relative Rating for ease of understanding/scoring. The following ranking resulted:

<u>Vulnerable Area #1 Town Beach and Pavilion</u>

1 Pavilion Facility
2 Beach/Dune Nourishment
3 Create Educational Display

<u>Vulnerable Area #2 South Shore Bordering Atlantic Ocean</u>

1 Open Space Acquisitions
2 Develop Shoreline Management Plan
3 Recovery/Reconstruction Ordinance
4 CRS
5 Volunteer Disaster Assistance Program
6 Develop Retrofit Program
7 Overwash Sand Removal
8 Beach Closings
9 Low Impact Development
10 Business Continuation
11 Public Information/Outreach/Incentives

<u>Vulnerable Area #3 Matunuck Beach Road</u>

1 Evaluate/Fund/Install Hard-Armor Structure

2 Maintain Viable Evacuation Route
3 Tourist Evacuation Route

- The Public Services Director and Town Manager (and others identified by the Town) need to complete the prioritization ranking as well. When all parties have completed the process, a new average will be retabulated, and the measures will be incorporated into the plan Update as such.

BANK STABILIZATION (SOIL BIOENGINEERING)

LIVE STAKING, LIVE FASCINES, BRUSHMATTRESS, CRIBWALL

GENERAL DESCRIPTION:

SOFT-ARMOR STRUCTURAL SHORELINE APPLICATIONS

All of the measures identified encompass a similar application - utilizing live plant materials in conjunction with varied site preparation (timber logs, staking, and fill/rock mix).

ADVANTAGES:
- No adverse water quality impacts
- Amenity for wildlife/ habitat
- Minimizes wave action/energy run-up to facilitate dune rehabilitation
- Provides a reinforced dune

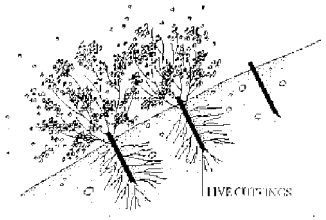
DISADVANTAGES:
- Vulnerable to unusually large wave events
- May encourage, harbor overpopulation of wildlife
- Public access considerations at specific entry points
- Low design life expectancy (particularly in high-energy wave environments)

APPROXIMATE COSTS:

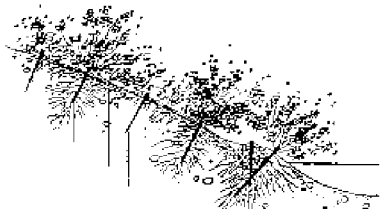
Project costs range from $8 to $10 million (Dependent on plant species/ size/quantity/application)

REPRESENTATIVE SECTIONS:

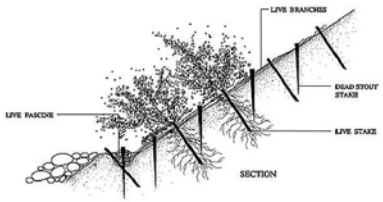
Live Staking



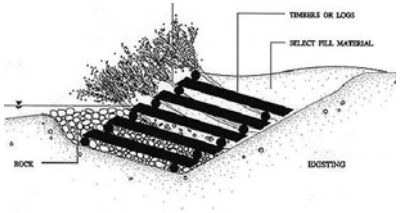
Brushmattress



Live Fascines



Crib Wall



Sections obtained from www.georgia.gov

REPRESENTATIVE PHOTO:

Photo courtesy of www.landandwater.com

BEACH CONES / STABLER DISKS

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Stabler Disks or Beach Cones are concrete disks 4 feet in diameter attached to pilings and placed at the storm high tide mark. Installed in a geometric pattern, they are intended to reverse the daily cycle of build-up and erosion by accelerating the build-up and preventing the recurring washout of sand material picked up and carried out by retreating waves.

ADVANTAGES:

- Provides hard-bottom stabilization for sand accretion
- Potential for creation of additional bottom habitat
- Maintains natural landform (aesthetically pleasing)

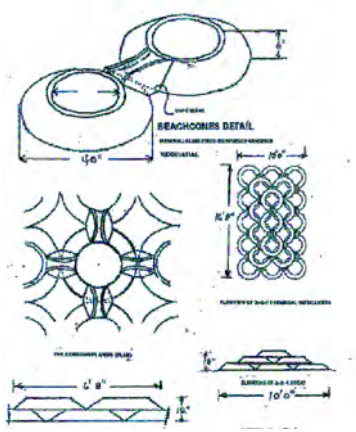
APPROXIMATE COSTS:

Moderate to high, dependent upon quantity and nourishment program.

DISADVANTAGES:

- Vulnerable to higher energy wave events
- Physical hazard to bathers and boaters
- May become destructive when detached
- Variable design life expectancy (dependent upon severity of weather event)

REPRESENTATIVE SECTION:



Section courtesy of www.osti.gov

BEACH NOURISHMENT

GENERAL DESCRIPTION:

SOFT-ARMOR STRUCTURAL SHORELINE APPLICATION

A designed, engineered process where a specific volume of sand is added to a beach and/or dune system to provide a desired level of storm protection and flood control.

ADVANTAGES:

- Minimizes wave action/energy, run-up, coastal flooding
- No adverse effect on adjacent coastal areas
- Enhances wildlife habitat and recreational opportunities
- Allows for greater redistribution of sediment
- Increases public access opportunities

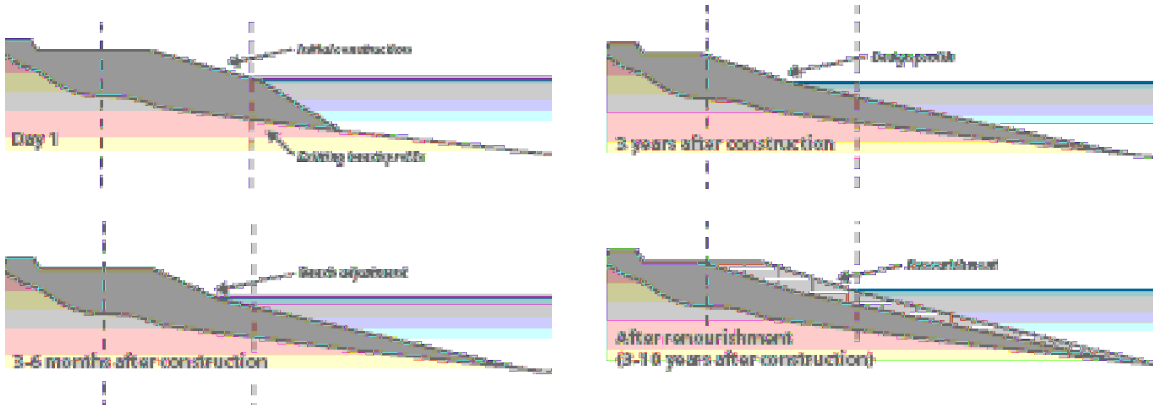
DISADVANTAGES:

- Impacts to benthic species
- Vulnerability to unusually large wave events
- Frequent maintenance/repair/renourishment
- Low sediment reserves increase costs/renourishment requirements (large initial volumes required)
- Low design life expectancy (5 - 7 years) without significant events

APPROXIMATE COSTS:

Total project cost range $8 to 12 million

REPRESENTATIVE SECTIONS:



Images courtesy of USACE Shore Protection Assessment.

REPRESENTATIVE PHOTO:

Federal beach nourishment project Atlantic City, N.J.
Photo courtesy of US Army Corps of Engineers

BULKHEAD

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Bulkheads retain beach-fall material and are not appropriate for high-energy wave environments. Bulkheads may be concrete, steel, or timber. Cellular steel sheet pile bulkheads are used where rock is near the surface and where anchored sheet pile bulkheads cannot penetrate adequately.

ADVANTAGES:

- Mitigates shoreline erosion and impacts of sea level rise over long-term
- Compact design, small footprint, constructed higher up on beach
- Minimal adverse water quality impacts during construction

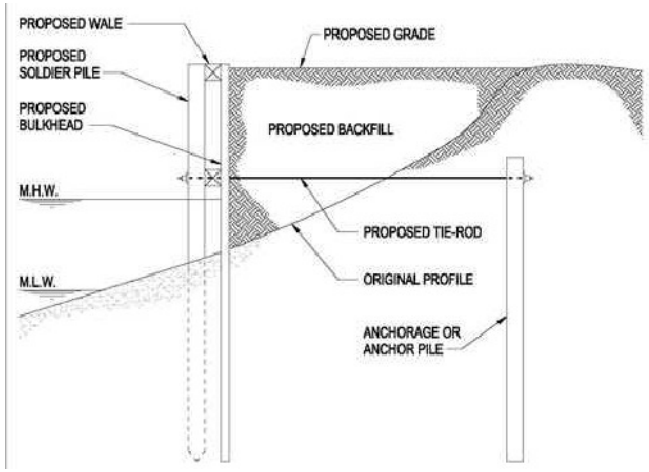
DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Medium to high initial costs
- Decreases ecological value
- Potential for end scour
- Erosion of fronting beach/direct loss of landform
- Medium design life expectancy (15 to 20 years without significant events)

APPROXIMATE COSTS:

Project cost range $18 million

REPRESENTATIVE SECTION:



Section courtesy of www.dcm2.enr.state.nc.us

REPRESENTATIVE PHOTO:

Recently completed bulkhead along Barnegat Inlet, N.J.
Photo courtesy of www.nj.gov/shoreprotection/structures

COIR VEGETATIVE LOGS

GENERAL DESCRIPTION:

SOFT-ARMOR STRUCTURAL SHORELINE APPLICATION

Coir logs are strong, flexible construction modules of a compact roll of coir web covered by an exterior coir mesh netting,which aids in the stabilization and revegetation of sites where steepness or high exposure to waves or currents causes instability. It is 100 % organic/biodegradable and made from the coconut husk. Naturally resistant to rot, molds, and moisture, it provides an excelelnt microclimate for plant establishment.

ADVANTAGES:

- Minimizes wave action/energy, run-up, coastal flooding
- Provides a reinforced dune to facilitate restoration/rehabilitation
- No adverse biological, ecological, environmental impacts
- Allows for greater redistribution of sediment

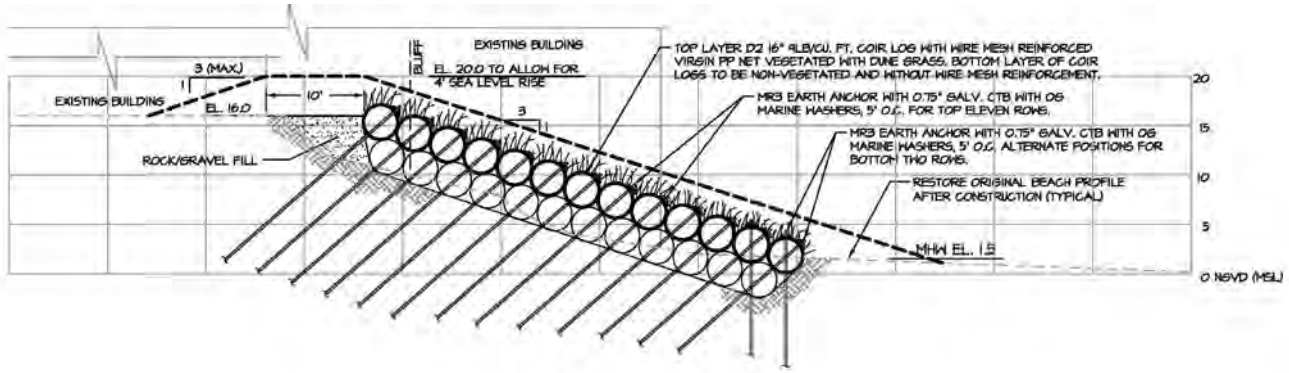
DISADVANTAGES:

- Public access considerations at specific entry points
- Vulnerable to lesser wave events with potential for end scour
- Frequent maintenance/repair/renourishment
- Low sediment reserves increase costs/renourishment requirements
- Short design life expectancy (5 - 7 years) in high-energy environemnts
- Alteration of the coastal feature (Aesthetics)

APPROXIMATE COSTS:

Total project cost range $8 to 10 million

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Browning Cottages Historic District
South Kingstown, Rhode Island

CONCRETE GRAVITY SEAWALL

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. Gravity seawalls rely on the weight of the materials they are constructed of to provide the required stability against wave action. They require strong foundation soils to adequately support their weight.

ADVANTAGES:

- Mitigates shoreline erosion and impacts of sea level rise over long-term
- Compact design, small footprint, constructed higher up on beach
- Minimal adverse water quality impacts during construction

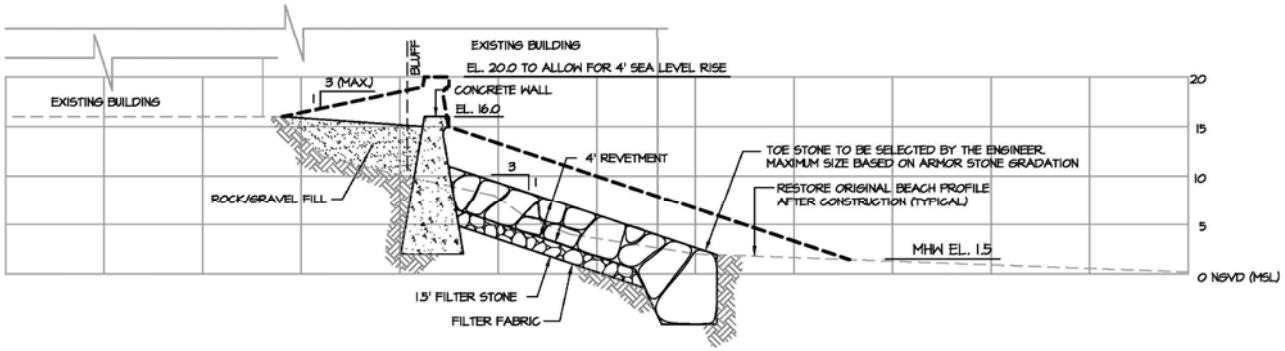
APPROXIMATE COSTS:

Total project cost range $15 to 17 million

DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Medium to high initial costs
- Decreases ecological value
- Potential for end scour
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (40 - 60+ years)

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

CONCRETE SEAWALL ON STEEL SHEET PILE FOUNDATION

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. Steel sheet pile foundation seawalls consist of thin, interlocking sheet piles driven deeply into the ground. Drainage openings are also utilized to provide drainage from the backshore area.

ADVANTAGES:

- Mitigates shoreline erosion and impacts of sea level rise over long-term
- Compact design, small footprint, constructed higher up on beach (less backland disturbance)
- Minimal adverse water quality impacts during construction

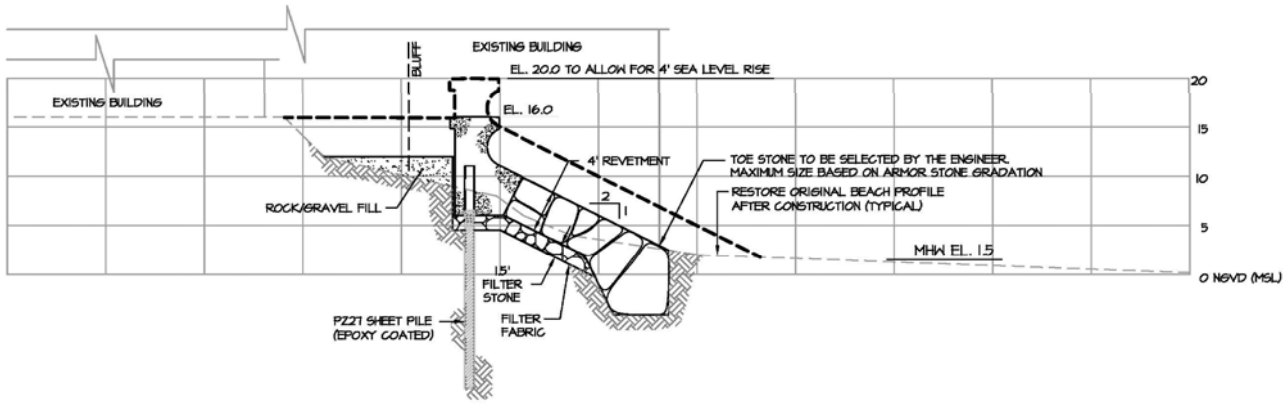
APPROXIMATE COSTS:

Total project cost range $17 to 19 million

DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Medium to high initial costs
- Decreases ecological value
- Potential for end scour
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (40 - 60+ years)

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

GABION MATTRESS, WALL, VEGETATED WALL

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Gabions are rectangular baskets formed into walls or mattresses made of galvanized (and sometimes polyvinyl chloride-coated) steel wire in a hexagonal mesh. The gabion is subdivided into approximately equal-sized cells. At the job site, the baskets are unfolded and assembled by lacing the edges together with steel wire. The individual baskets are then wired together and filled with stone. The lids are finally closed and laced to the baskets, forming a large, heavy mass.

ADVANTAGES:

- Mitigates shoreline erosion
- Supports growth of vegetation
- Minimal adverse water quality impacts during construction

DISADVANTAGES:

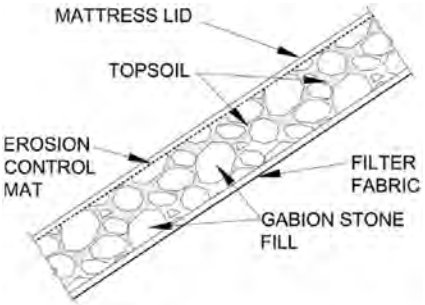
- Public access constraints - requires stairs/ramping
- Decreases ecological value/impacts to habitat
- Require periodic maintenance/repair after major events
- Aesthetic considerations
- Erosion of fronting beach/direct loss of landform
- Variable design life expectancy
- High failure rate (vegetation) within first 2 years

APPROXIMATE COSTS:

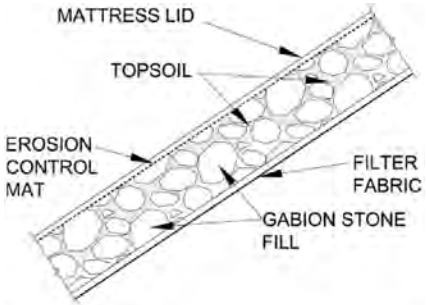
Project cost ranges from $6 to 9 million

REPRESENTATIVE PHOTOS:

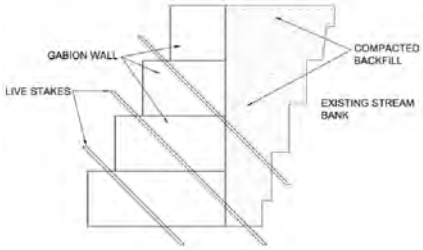
REPRESENTATIVE SECTIONS:



Gabion Mattress



Gabion Wall



Vegetated Gabion Wall

Section and photos courtesy of www.terraaqua.com

GEOTUBE SHORE PROTECTION

GENERAL DESCRIPTION:

SOFT-ARMOR STRUCTURAL SHORELINE APPLICATION

Geo-textile tubes (geotubes) are sediment-filled sleeves of geotextile fabric with an oval cross section of approximately 12 feet. Geotubes rest on a fabric scour apron that has sediment-filled achor tubes along each edge. Geotubes are generally placed in a trench dug parallel to the shore along the back beach or foredunes, with sand nourishment and vegetation cover.

ADVANTAGES:

- Minimizes wave action/energy, run-up, coastal flooding
- Provides a reinforced dune to facilitate restoration/rehabilitation
- Requires less initial nourishment volume
- Allows for greater redistribution of sediment

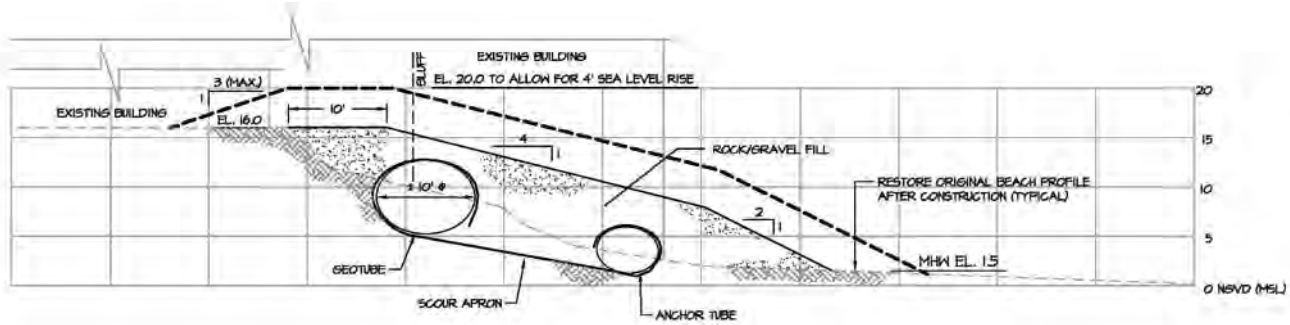
DISADVANTAGES:

- Public access considerations at specific entry points
- Vulnerability to unusually large wave events
- Frequent maintenance/repair/renourishment
- Low sediment reserves increase costs/renourishment requirements
- Moderate design life expectancy (10 - 15 years) without significant events

APPROXIMATE COSTS:

Total project cost range $6 to 8 million

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Geotube installation, Upham Beach, Florida.
Photo courtesy of www.the petitionsite.com

GROIN

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

A groin is a shore-protection structure that adds to a protective beach or retards erosion of an existing or restored beach. Groins trap material being moved by wave-generated littoral currents and are classified by permeability, height, and length. Construction materials for groins include stone, concrete, timber, and steel. They can be built of these materials and still be permeable or impermeable; high or low. Asphalt and sand-filled nylon bags have also been used.

ADVANTAGES:

- Mitigates shoreline erosion short term
- Encourages accretion and sand/sediment

DISADVANTAGES:

- Impacts to water quality and habitat
- Secondary impacts to downdrift locations
- Large physical area (footprint) required for construction and installation
- Requires periodic maintenance
- Direct loss of landform (aesthetics)
- Variable design life expectancy (Dependent upon weather events)

APPROXIMATE COSTS:

Project costs range from moderate to high, dependent upon type/material/configuration (Est. $5 to 8 million for 3 at 500LF).

REPRESENTATIVE SECTION:

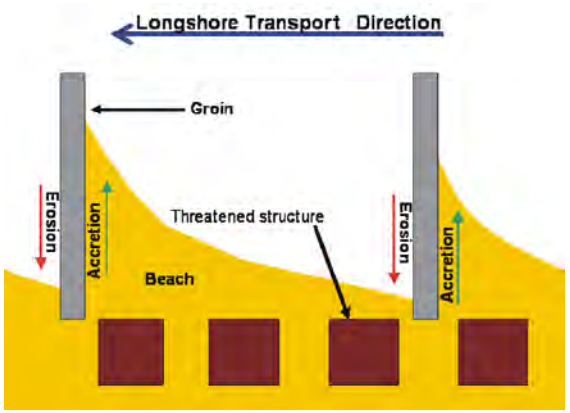


Photo courtesy of www.chl.erdc.usace.army

REPRESENTATIVE PHOTO:

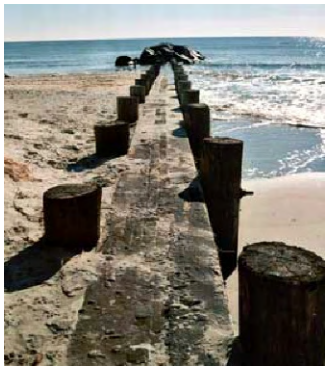


Photo courtesy of www.oceanica.cofc.edu

OFFSHORE BREAKWATER

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Offshore breakwaters, also called bulkheads, reduce the intensity of wave action in inshore waters and thereby reduce coastal erosion. They are constructed some distance away from the coast or can be built with one end linked to the coast. The breakwaters may be small structures, placed one to three hundred feet offshore in relatively shallow water, designed to protect a gently sloping beach and can be either fixed or floating: the choice depends on normal water depth and tidal range.

ADVANTAGES:

- Mitigates shoreline erosion over long-term
- Potential for creation of additional habitat
- Potential for beach widening due to accretion

DISADVANTAGES:

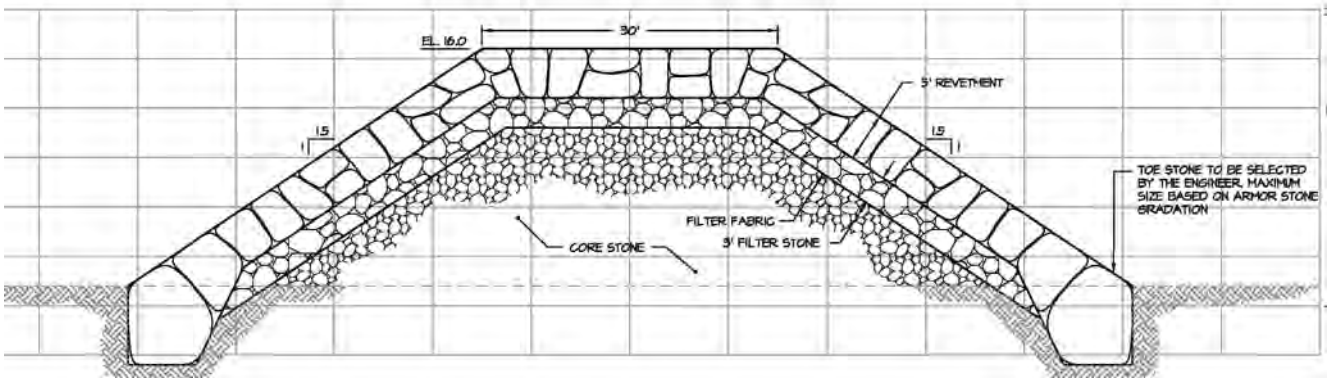
- Reduced recreational opportunities due to incrased wave action
- High initial costs
- Potential for altering adjacent coastal profile
- Altered hydraulic conditions causes impacts to bottom habitat
- Long design life expectancy (25 - 40 years) without significant events

APPROXIMATE COSTS:

Total project cost range reef: $12 - 15 million

Breakwater: 25 million +

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Shilshole breakwater, Pugent Sound, Seattle.
Photo courtesy of www.seaotter.com

RIPRAP REVETMENT

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Riprap revetments are placed on a sloping bank and depend on the stability of the underlying soil for support. Fill material beneath a revetment must be adequately compacted prior to installing the riprap. Riprap revetment, like other revetments, consists of two or more layers (filter and armor).

ADVANTAGES:

- Mitigates shoreline erosion and sea level rise over long-term
- Potential for creation of additional botoom habitat
- Minimal adverse water quality impacts during construction

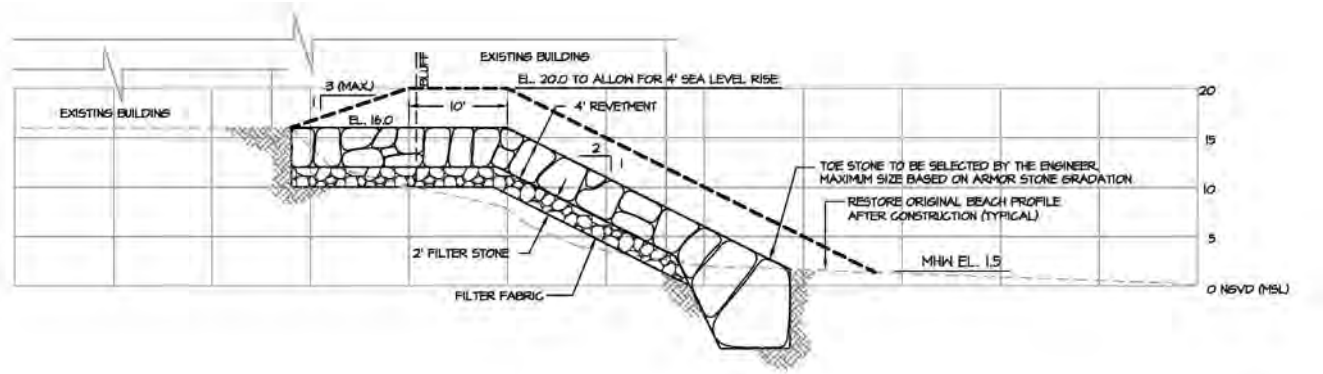
APPROXIMATE COSTS:

Total project cost range $8 to 11 million

DISADVANTAGES:

- Public access constraints - requires stairs/ramping
- Large physical area (footprint) required for construction and installation
- Require periodic maintenance after major events
- Altered hydraulic conditions causes impacts to bottom habitat
- Erosion of fronting beach/direct loss of landform
- Long design life expectancy (25 - 40 years) without significant events

REPRESENTATIVE SECTION:



REPRESENTATIVE PHOTO:

Improved stone revetment, Matunuck Beach Trailer Association.

SAND DRIFT FENCE (w/ Beach Nourishment)

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Sand fencing is an alternative treatment in beach preservation and dune restoration. Sand fencing provides an environmentally friendly system that promotes the retention of sand reserves created by beach reclamation and restoration projects and supports on-going sand dune maintenance programs. Sand fencing not only protects beaches from natural erosion, it also provides a vegetation prevention barrier for the safe habitat of natural sea vegetation and dune ecology.

ADVANTAGES:

- No adverse water quality impacts
- Allows for greater redistribution of sediment/littoral transport
- Minimizes wave action/energy run-up to facilitate dune rehabilitation

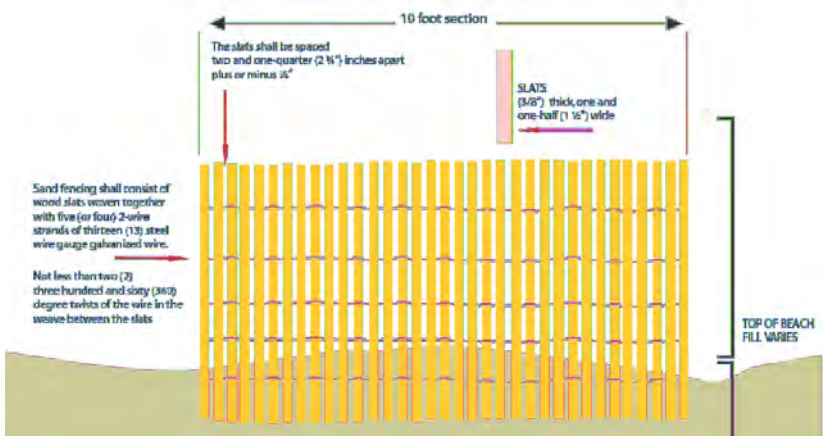
APPROXIMATE COSTS:

Total project cost range $8 to $12 million

DISADVANTAGES:

- Vulnerable to lesser wave events
- Frequent maintenance and repair required
- Public access considerations at specific entry points
- Variable design life expectancy (particularly in high-energy wave environments)

REPRESENTATIVE SECTION:



Section obtained from Kalinich Fence Co.

REPRESENTATIVE PHOTO:

Photo courtesy of www.discountfencesupply.com

SILL / PERCHED BEACH

GENERAL DESCRIPTION:

HARD-ARMOR STRUCTURAL SHORELINE APPLICATION

Sills are typically low, small, continuous rock structures placed at mean low water constructed to trap sand and resulting in in what is known as a "perched beach" (one that is elevated above its original level). Perched beaches have many of the same qualities as natural beaches, and the submerged sill does not intrude on the view of the waterfront. Construction materials and design considerations for perched beach sills are generally similar to those for fixed breakwaters such as armorstone, grout-filled bags, or sheetpiling. The location of the sill should be indicated in some way so that beach users do not step off the perched beach into unexpectedly deep water.

ADVANTAGES:

- Maintains natural coastal landform
- Ease of public access and recreational opportunities
- Aesthetically pleasing
- Amenity for wildlife habitat

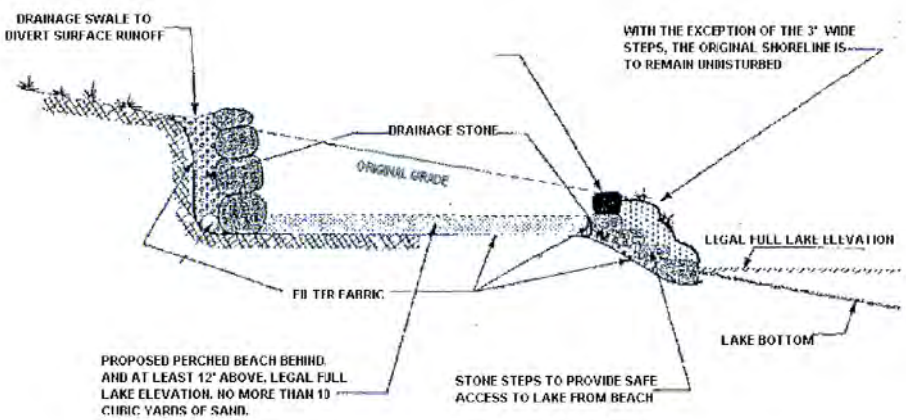
DISADVANTAGES:

- Vulnerable to unusually large wave events (low energy applications only)
- Potential hazard to bathers and boaters
- Secondary impacts to downdrift locations (inhibits littoral transport)
- Variable design life expectancy (dependent upon weather events and beach nourishment programs)
- Potential for scour in high-energy wave environments

APPROXIMATE COSTS:

Project costs range high, dependent upon height/length and nourishment program (Est. $12 to 18 million).

REPRESENTATIVE SECTION:



Section obtained from www.des.nh.gov/organization/divisions/water

REPRESENTATIVE PHOTO:

Photo courtesy of www.arundelmarine.com

Exhibit 1: Measuring Vulnerability Before and After Mitigation

Action: EVALUATE, SEEK FUNDING FOR HARD-ARMOR STRUCTURAL SOLUTION, DESIGN/INSTALL

Vulnerability	Before the Action is implemented*	After the Action is implemented*	Difference
Number of people affected by the hazard	VARIABLES 3/4 OF THE AREA IS SEASONAL	VARIABLE, DEPENDENT UPON WEATHER/ STORM EVENT.	CONSIDERABLY LESS
Area affected (acreage) by the hazard	121 ACRES	26 ACRES	CONSIDERABLY LESS AREA IMPACTED.
Number of properties affected by the hazard	SEASONAL: 342 YR. ROUND: 172 COMMERCIAL: 2	POTENTIAL FOR 25 PARCELS W/ DIRECT FRONTAGE ON THE SHORE	CONSIDERABLY LESS
Property damage (amount in $)	SEASONAL: $24,746,800 YR. ROUND: $127,590,100 COMMERCIAL: $7,491,200	" VARIABLE	"
Loss of use (number of properties/physical assets [e.g., bridges] in number of days)	514 DWELLING UNITS, SOUTH SHORE MUNICIPAL WATER SYSTEM/LINE	" VARIABLE	"
Loss of life (number of people)	STORM/EVENT DEPENDENT	VARIABLE	
Injury (number of people)	STORM/EVENT DEPENDENT	VARIABLE	
**			

*Include measurable items, where possible, based on experience, professional estimate, or judgment.

**Add more categories of risk as appropriate for the specific community's plan.

Exhibit 2: Benefits

Action: EVALUATE, SEEK FUNDING FOR HARD-ARMOR STRUCTURAL SOLUTION, DESIGN/INSTALL

Benefits
Risk reduction (short- or long-term) LONG-TERM RISK REDUCTION
If other community goals are achieved, explain MAINTAINS STRUCTURAL INTEGRITY OF MATUNUCK BEACH ROAD, MAINTAINS SOUTH SHORE WATER LINE, PRESERVES SENSE OF PLACE/DESTINATION/TOURISM
If easy to implement, explain NOT EASY TO IMPLEMENT, TOWN WILL HAVE TO OBTAIN SPECIAL EXCEPTION FROM CRMC, ENVIRONMENTAL ASSESSMENT FOR PERMITTING.
If funding is available, explain FEMA PRE-DISASTER HAZARD MITIGATION PROGRAM
If politically/socially acceptable, explain MIXED, SOME PROPERTY OWNERS IN FAVOR, OTHERS NOT. ENVIRONMENTALISTS/SURFERS NOT SUPPORTIVE. MUNICIPAL OFFICIALS FEEL DUTY TO PROTECT WATER SYSTEM AND ROADWAY.

Exhibit 3: Costs

Action: EVALUATE, SEEK FUNDING FOR HARD-ARMOR STRUCTURAL SOLUTION, DESIGN/INSTALL

Costs*
Construction cost (amount in $) VARIABLE $12-19 MILLION (ESTIMATED)
Programming cost (amount in $, # of people needed to administer) UNKNOWN
Time needed to implement SEVERAL YEARS: CRMC APPROVAL, PERMITTING, FUNDING, ENVIRONMENTAL ASSESSMENTS
If unfair to a certain social group, explain
If there is public/political opposition, explain POTENTIAL OPPOSITION: SURFRIDERS FOUNDATION/RECREATIONAL FISHING, PRIVATE PROPERTY OWNERS
If there are any adverse effects on the environment, explain VARIABLE, DEPENDENT ON STRUCTURE, SITE, MATERIAL.

*If precise costs are not available, use costs based on experience, professional estimate, or judgment.

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	PAVILLION FACILITY		BEACH/DUNE NOURISHMENT		CREATE EDUCATIONAL DISPLAY	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social		M		H		L
Technical			L		L	
Administrative						
Political		H		H		L
Legal			L			
Economic	H	M	H			L
Environmental		L		M		L
Priority	(2) 5		(1) 6		(3) -5	

BENEFIT: POSITIVE EFFECT COST: PERCEIVED OBSTACLE

Definition of rating scale: H = 2, M = 1, 0 = N/A, L = -1
HIGH MEDIUM NOT APPLICABLE LOW

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	DEVELOP SHORELINE MAN. PLAN		OVERWASH SAND REMOVAL		DEVELOP RETROFIT PROGRAM	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social		H		H		H
Technical	M		L		H	
Administrative						
Political		H		H		M
Legal	H		L			
Economic		H		H	H	H
Environmental		H		M		H
Priority	1	11	8	5	2	11

Definition of rating scale: _____

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	BEACH CLOSINGS		PUBLIC INFO. OUTREACH, INCENT.		LOW IMPACT DEVELOPMENT	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social	L	H		M		H
Technical	L		L		H	
Administrative	L		L			
Political		H		M		H
Legal		M			M	
Economic		H		M		M
Environmental				H		H
Priority	10	4	11	3	3	9

Definition of rating scale: _____

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	COMMUNITY RATING SYSTEM		OPEN SPACE ACQUISITIONS		BUSINESS CONTINUATION	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social		H	H		M	H
Technical	M	M	M	M		
Administrative						
Political				H		H
Legal						
Economic		M				H
Environmental				H		
Priority	6	5	4	8	5	7

Definition of rating scale: _____

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	VOLUNTEER DISAST. ASSISTANCE PROGRAM		RECOVERY/RECONST. ORDINANCE		TOURIST EVACUATION SHELTER	
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social	M	H		M	M	H
Technical					M	
Administrative						
Political		H		M		H
Legal	L		L		L	
Economic		M		H		H
Environmental				M		
Priority	7	5	9	4	3	7

Definition of rating scale: _____

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

Exhibit 5: Prioritization Using STAPLEE and Qualitative Scores

Actions → / Criteria ↓	MAINTAIN VIABLE EVACUATION ROUTES		EVALUATE HAND-BUILT STRUCTURE			
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social	L	M		H		
Technical	L		M			
Administrative						
Political		M		M		
Legal	L		M			
Economic		M		H		
Environmental			H	H		
Priority	2 3		1 13			

Definition of rating scale: _____

Exhibit 6: Prioritization Using STAPLEE and Simple Scores

Actions → / Criteria ↓						
	Cost	Benefit	Cost	Benefit	Cost	Benefit
Social						
Technical						
Administrative						
Political						
Legal						
Economic						
Environmental						
Sub-total of cost/benefit						
Total Score						
Priority						

Definition of rating scale: _____

South Kingstown Multi-Hazard Mitigation Strategy Plan Update
Local Hazard Mitigation Committee Meeting

Thursday December 4, 2008
9:00 AM
South Kingstown Town Hall
Please Sign In!

Name	Address	E-mail
CRAIG PERKINS	PARE CORPORATION	
KARL HAMMOND	PARE	KHAMMOND@PARECORP.COM
LANCE WHALEY		LWHALEY@SOUTHKINGSTO
Ray Nickerson		rnickerson@southkingstown
Carol Baker	SKLing	cbaker@southkingstown
JANET FREEDMAN	CRMC	jfreedman@crmc.ri.gov

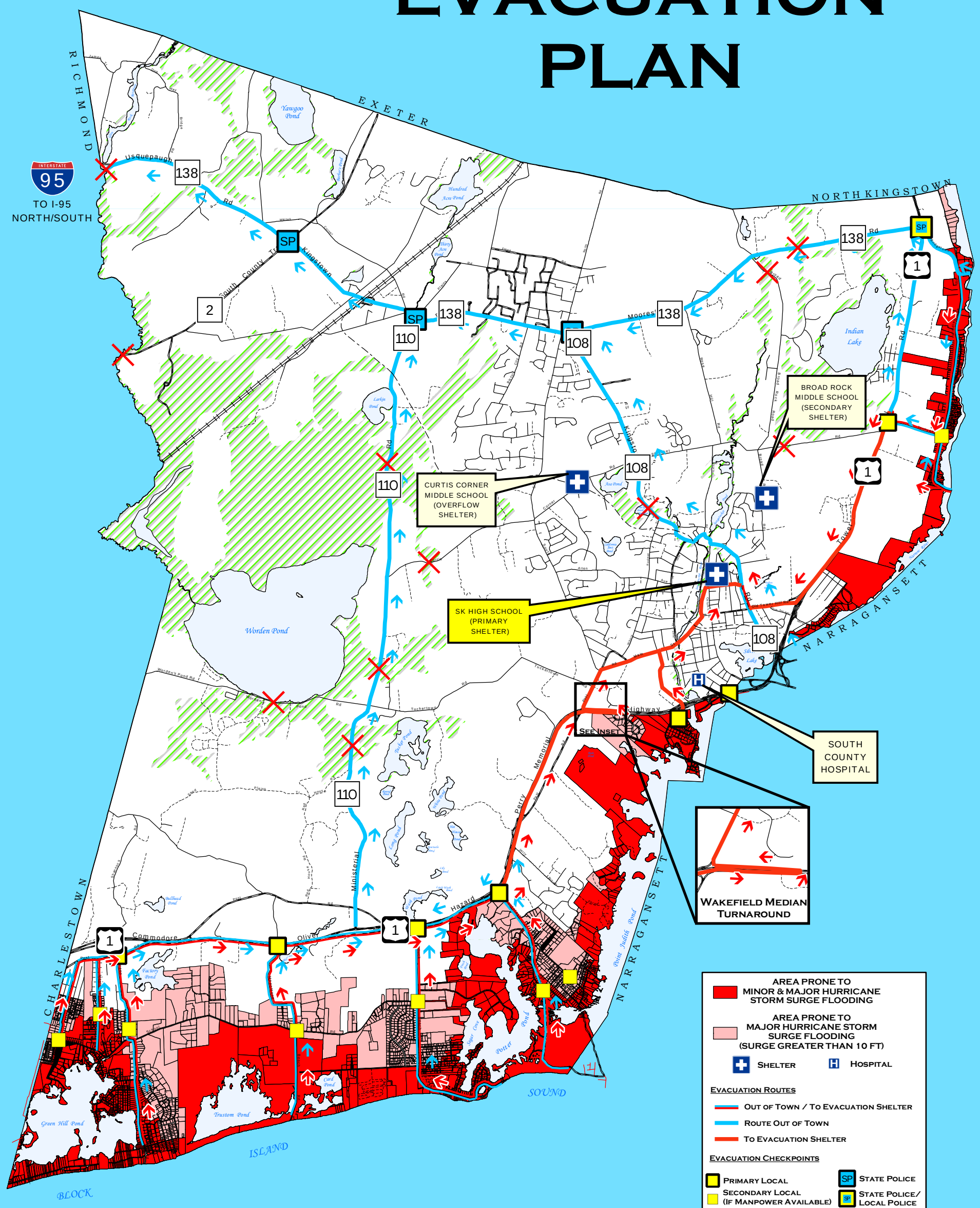
T:\08102.00 South Kingstown HazMit Plan Update\Correspondence\meetings\LHMC 12.4.08\Sign In Sheet.doc

APPENDIX J

EMERGENCY EVACUATION PLAN

Town of South Kingstown

EMERGENCY EVACUATION PLAN



Geographic Information System

JRC PD05-08 9/05

The evacuation routes depicted on this map are designated by the Rhode Island Emergency Management Agency (RIEMA). If local authorities recommend evacuation, you should leave. Their advice is based on knowledge of the strength of the storm and its potential for death and destruction. Information regarding hurricane preparedness is available from Lt. William Buckley of the South Kingstown Police Department at (401) 783-3321.