STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

INTER-OFFICE MEMORANDUM

DATE: April 20, 2011

TO: Grover J. Fugate, Executive Director

FROM: CRMC Policy and Permitting staff (signature sheet at end of report)

SUBJECT: Matunuck Erosion

Project:	Development of "Temporary Structural Shoreline Protection" guidelines and staff recommendations for long-term solutions to address Matunuck erosion issues
Location:	Matunuck Beach Road – South Kingstown
Water Type/Name:	Type 1
Coastal Feature:	Coastal beach backed by manmade shoreline and/or altered coastal bluff/erosive dune scarp

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STAFF REPORT

Matunuck Erosion

As an outcome of the CRMC and South Kingstown Town Council joint work session public meeting held at the South Kingstown town hall on March 29, 2011, CRMC staff were directed by the Chairman, Michael Tikoian, to address the following three tasks[1]:

1. Develop standards or guidelines for CRMC permitting of temporary wooden bulkhead structures;
2. Develop recommendations on potential CRMC water type change along the Matunuck shoreline; and
3. Develop recommendations for potential coastal program changes to address long-term erosion control solutions along the Matunuck shoreline.

It is typical of Coastal Zone Management (CZM) Programs nationwide, including Rhode Island (RICRMP), to prohibit structural shoreline protection both for practical as well as resource protection reasons. Although structural shoreline protection measures are currently prohibited along the Matunuck shoreline, the Chairman of the Coastal Council has directed staff to review its potential for use in the Matunuck area and develop some proposed recommendations. More detail and information regarding these solutions, including adverse consequences, are provided by staff herein. As requested by the CRMC Chairman and Town Council, CRMC staff met with South Kingstown town staff (Principal Planner and Building Official) on March 31 to discuss potential permitting and installation issues for temporary wooden shoreline protection measures.

CZM programs nationwide are faced with a difficult balancing act in weighing private property interests, protecting long-term resource goals, and protecting public interests. Time and again it has been observed that structural armoring along eroding shorelines has adverse impacts and consequences to beaches, dunes and intertidal areas, including restrictions to or loss of public lateral access along the shore. As provided in the CRMC's enabling legislation, and pursuant to the Rhode Island Constitution in Article 1, Section 17, "[t]he

*Superscript numbers reference corresponding Appendix sections

people shall continue to enjoy and freely exercise all the rights of fishery, and the privileges of the shore, to which they have been heretofore entitled under the charter and usages of this state, including but not limited to fishing from the shore, the gathering of seaweed, leaving the shore to swim in the sea **and passage along the shore**." (emphasis added.) See R.I.G.L. § 46-23-1(a)(1). There are many examples of preexisting shoreline protection structures that impede public access along the shoreline in Rhode Island. See Figure 1.

Figure 1. Lateral access obstruction in front of a shoreline protection structure in Westerly

Despite these adverse and negative impacts to the public resources, private property owners derive benefit where shoreline armoring is located[2]. The problems associated with shoreline protection structures, especially the debate of public versus private interests, is a common issue in coastal areas. The installation of hardened shoreline structures is prohibited along many stretches of Massachusetts beaches to protect sediment sources that maintain the beach profiles. In those areas with severe erosion some property owners who are unable to relocate dwellings farther inland due to cost or unavailable land, will use the dwellings until erosion compromises the structures and then allow them to fall into the sea[3]. Some recent examples from Massachusetts, Maine and Fire Island, NY are shown below in Figures 2, 3, and 4.

The Rhode Island General Assembly has declared "that it shall be the policy of this state to preserve, protect, develop, and, where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long range planning and management designed to produce the maximum benefit for society from these coastal resources; and that **preservation and restoration of ecological systems shall be the primary guiding principle upon which environmental alteration of coastal resources will be measured, judged, and regulated**." (emphasis added.) See R.I.G.L. § 46-23-1(a)(2). Therefore, any new shoreline protection structures authorized by the Council in Type 1 waters may conflict with this policy.

Figure 2. A December 2009 coastal storm proved too much for this Nantucket home.

Figure 3. Patriot's Day coastal storm (April 17, 2007) causing destruction in Saco, ME.

Patriot Day Storm damage Saco, ME (courtesy of P. Slovinsky)

Figure 4. Fire Island, NY coastal erosion forcing relocation of the dwelling

The installation of temporary wooden bulkhead shoreline protection structures is not an appropriate long-term solution to address the erosion issues in the Matunuck area, but may provide some short-term, minor level of protection. These types of temporary structures will ultimately fail during storm events at which point they break apart to become projectiles causing damage to the buildings they were designed to protect or to nearby structures.[4] Because of the potential threat they pose to life and property, and their adverse impacts on beaches, dunes and intertidal areas, the permitting of these structures is inconsistent with the CRMC's federal mandate pursuant to the Coastal Zone Management Act, to manage "coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands." See 16 USC § 1452(2)(B).[11]

Local residents, business owners, and municipal officials are seeking an immediate remedy to the ongoing shoreline erosion and to protect existing, precariously situated public and private structures. It was stated by the South Kingstown Town Council, State Senator Sosnowski, and the local citizens that the erosion has progressed to the point where it now constitutes an emergency situation.[1] The "Matunuck Coastal Area Report," dated April 2010 and prepared by Town staff indicates that continued erosion along the shoreline abutting Matunuck Beach Road could "inevitably result in undermining or loss of the roadway." See Town report at 14.[5] Since 1998, the CRMC has issued about 70 permits for shoreline protection measures along the Matunuck shoreline. Nonetheless, the affected citizens and business owners have stated that all of their previous efforts of non-structural shoreline protection have failed and they must now be allowed to install structural shoreline protection to protect their properties. Because the tidal waters along this shoreline are classified by the RICRMP as Type 1, and therefore new structural shoreline protection is prohibited (see RICRMP Section 300.7.D.1), the Coastal Council must find that the proposed temporary structural shoreline protection measures are indeed "temporary." And, should the Council authorize the proposed temporary structures, they must stipulate that said structures can only be installed for a limited period of time. Absent

this Council determination, the normal permitting procedures must be followed. As directed by CRMC Chairman Tikoian, staff has developed specific guidelines or stipulations for temporary wooden bulkheads.

Task 1 – Guidelines for Temporary Wooden Bulkheads

As requested, CRMC staff has developed guidelines for the installation of temporary wooden bulkhead shoreline protection structures for use by property owners along a specific segment of the Matunuck shoreline. These temporary structures were discussed at the March 29 joint work session and were further described in the February 25, 2011[6] memorandum from CRMC Executive Director Grover Fugate to South Kingstown Town Manager Stephen Alfred. It is imperative to develop temporary guidelines with strict limited application, as approved by the Council, to avert the inappropriate use of such temporary structures elsewhere in the State. CRMC staff caution the Council, the Town of South Kingstown, and any potential applicants that these are temporary structures that will, as with any "hardened" structure, create a reflective surface resulting in scour and erosion particularly at the base and end points, accelerate the loss of the beach fronting such structures, and impede lateral access along the shore, especially at high tide.[2 & Fig 1] Should the Council permit these temporary shoreline protection structures, CRMC staff recommend precautionary measures should be stipulated in any permits issued (see Engineering Issues and Potential Stipulations section below).

In the event that the full Council determines that temporary structures are permissible in this area, CRMC staff recommend that the installation of these temporary structures be limited to the shoreline segment between parcels 92-2:47 and 92-3:9, which contain some existing hardened shoreline structures (rip-rap revetment or concrete sea wall). Additionally, these temporary wooden bulkheads must be installed as close as practicable to the existing buildings, including their pile supports, and the existing beach scarp as depicted in Figure 5 below. Furthermore, it is recommended that the Council require the endpoints of the temporary structures to not only tie in with the existing hardened shoreline structures at either end of this shoreline segment, but also be connected to one another and installed concurrently. Otherwise any gaps in the line of temporary structures will result in the premature failure of the entire system. Accordingly, this approach requires that the affected property owners and the Town coordinate their efforts. The limited area identified above was selected because it is the most highly impacted segment of this particular shoreline by ongoing shoreline erosion. And, as the Town points out in their "Matunuck Coastal Area Report," dated April 2010[5], the public roadway and a 12-inch town water line that serves the area, as well as two commercial businesses and other structures along this shoreline segment, are imminently threatened. Matunuck Beach Road is the only roadway providing access and exit for over 500 dwellings. See Town report at 2.[5] The shoreline segment identified for the installation of temporary shoreline protection structures is depicted in Figure 5 below.

Figure 5. Potential location of temporary wooden bulkhead shoreline protection structures

It is CRMC staff's opinion that these temporary wooden bulkhead shoreline protection structures are not appropriate as a long-term solution to address the erosion issues in this area, but may provide some short-term, minor level of protection while potential long-term solutions are further examined by the Town of South Kingstown and the private property owners. Specific guidelines for these temporary wooden bulkheads (detailed in the Engineering Issues and Recommended Stipulations section below) will provide criteria for the preparation of individual applications to the CRMC. CRMC staff will incorporate specific stipulations into any permits issued by the Council for this type of structure. We note also that should any portion of these temporary structures be installed at or below the Mean High Water (MHW) mark, or fill material placed behind these structures (seaward of the Highest Annual Tide), such actions will invoke federal jurisdiction and require the review and authorization by the Army Corps of Engineers. See Figure 21. Further discussion on this issue is provided in the Engineering Issues and Recommended Stipulations section below. In addition, CRMC staff recognizes that some properties within the designated area shown in Figure 5 above currently have unauthorized timber bulkheads.

Task 2 – Potential Water Type Change

As requested, CRMC staff has carefully examined the possibility of changing the current CRMC water type designation for the Matunuck area from Type 1 to Type 2. The existing Type 1 designation was adopted in 1983 and encompasses the entire southern Rhode Island coastline from Watch Hill to Point Judith. Type 1 waters include "water areas that are particularly unsuitable for structures due to their exposure to severe wave action, flooding, and erosion." See RICRMP Section 200.1.[7] Based on a review of damage resulting from the 1938 and 1954 hurricanes, and in light of projected sea level rise and associated storm surge impacts, the Type 1 classification continues to be appropriate for the Matunuck section of shoreline.

Figure 6. Matunuck Beach three days after the September 21, 1938 hurricane (Connecticut State Library Digital Photo Collections no. 00127)

Changing the CRMC water type designation from Type 1 to Type 2 would allow for certain activities or alterations along the shoreline that are prohibited under Type 1. For example, new structural shoreline protection is prohibited along headland areas (*e.g.*, Matunuck) abutting Type 1 waters, but is an allowable activity in Type 2 waters with approval by the full Council. Type 2 waters are defined as supporting "low intensity recreational and residential uses." See RICRMP Section 200.2.[8] In addition to new structural shoreline protection, Type 2 waters also accommodate "residential docks, minor dredged channels, and small-scale shoreline protection structures." *Id*. The Matunuck shoreline is not an appropriate area for residential docks due to the high wave energy environment. Further, this shoreline segment contains several pre-existing, large-scale shoreline protection structures and non-water dependent commercial structures. CRMC staff recommends that the Type 1 water designation remain unchanged to avert any unforeseen and unintended consequences, and to protect the integrity of the coastal program.

Task 3 – Potential Coastal Program Changes

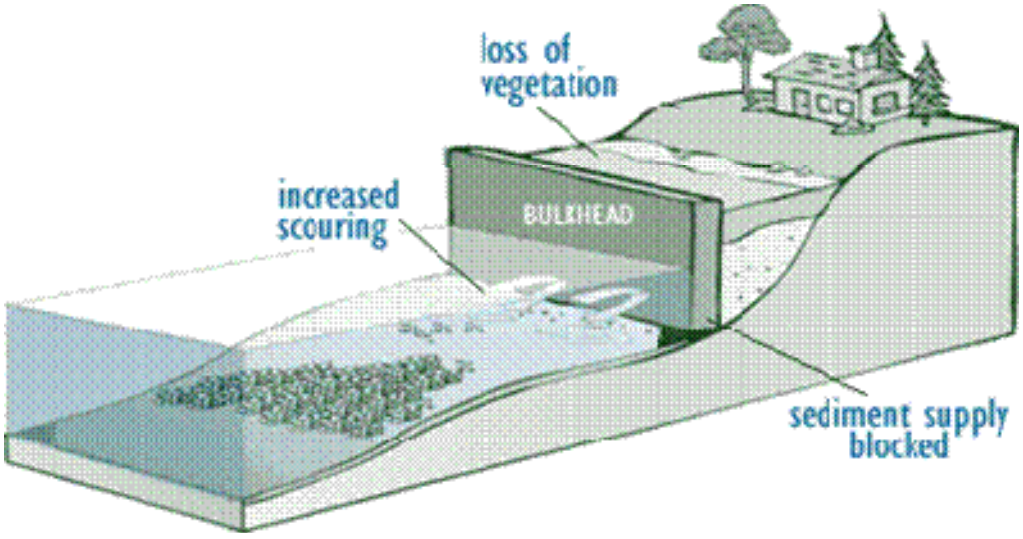
As requested, CRMC staff has reviewed possible program changes to address potential long-term solutions to the coastal erosion along the Matunuck shoreline. Given the ongoing conditions, however, erosion will continue into the future with each storm event and will be further exacerbated by sea level rise. Indeed, the Council recognized that Rhode Island can expect between three and five feet of sea level rise by 2100 (less than 90 years from now) in RICRMP Section 145, the Climate Change and Sea Level Rise policy adopted by the Council in January 2008. Furthermore, it is the Council's policy to consider this expected rate of sea level rise in the "siting, design, and implementation of public and private coastal activities and to insure proactive stewardship of coastal ecosystems under these changing conditions." See RICRMP Section 145.C.3.[9]

The coastal shoreline erosion and sea level rise impacts are not unique to Matunuck, but are occurring up and down the East coast from Maine to Florida. See recent newspaper articles.[3] The two recommended CRMC staff strategies to address long-term erosion solutions include inland retreat and beach nourishment. Inland retreat involves the relocation of public infrastructure, roadways, and other non-water dependent public and private structures to an inland and more elevated location wherever feasible. This option removes structures from vulnerable positions to more protected inland locations, while allowing the headlands or barriers to naturally erode providing the sediment sources necessary to maintain the beaches.

With the installation of hardened shoreline protection structures, whether temporary or long-term, the sediment sources are "locked" behind the shoreline protection structures, preventing renourishment of sediments to the beach. Over time, the beaches located east of Matunuck may experience sediment loss and possibly see diminished beach widths. Furthermore, shoreline protection structures, by design, cause scour and erosion at the base of the structure resulting in the permanent loss of beach sediment and public lateral access along the shoreline, especially during high tide. See Figures 1, 7 and 8.

Beach nourishment is the second preferred option whereby beaches are replenished with sediment from local dredging projects or other sand sources to rebuild the beach and maintain its storm protection profile. Renourished beaches also provide local residents and tourists with desirable recreational opportunities that also support local businesses while maintaining public lateral access along the shoreline.

Figure 7. Shoreline structures result in the loss of beach (courtesy Washington State Dept. of Ecology)

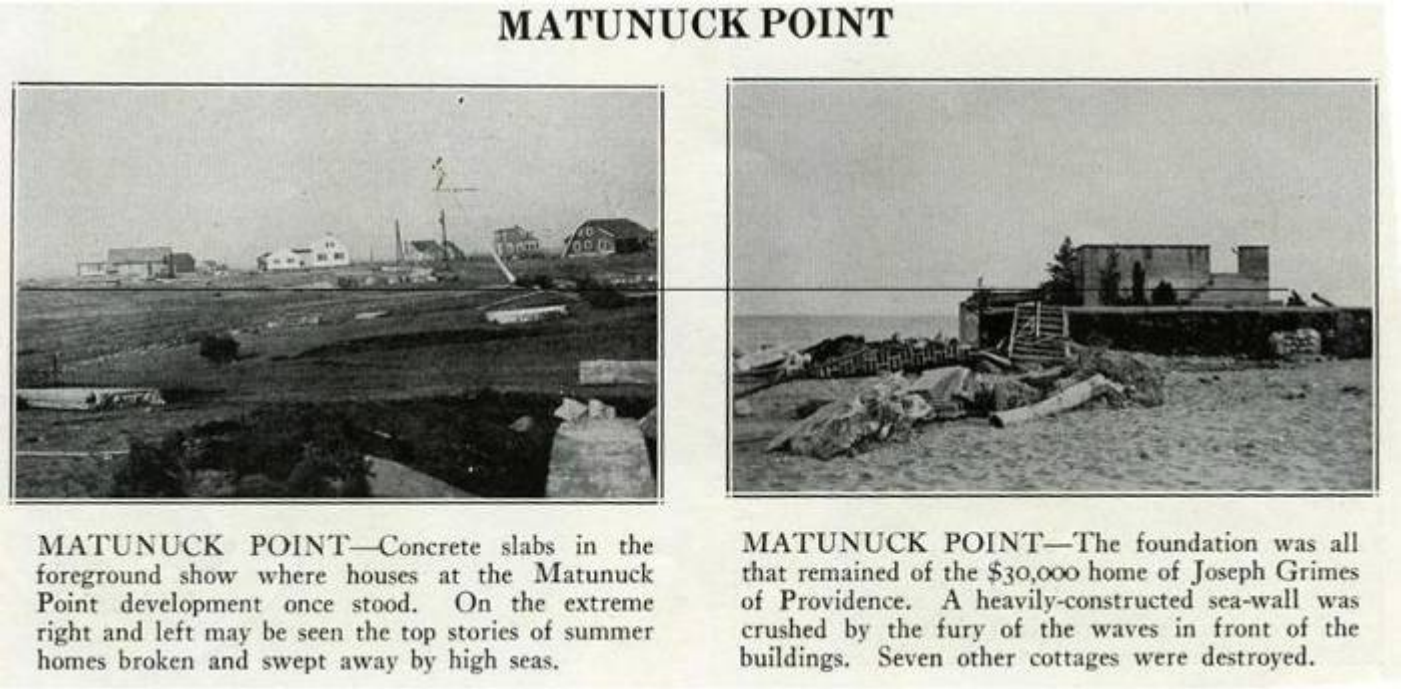


*Superscript numbers reference corresponding Appendix sections

Figure 8. Comparison of 1985 and 2008 aerial photographs of Matunuck. Note the loss of beach fronting the shoreline protection structures where arrows are located.

The two CRMC staff recommended strategies of inland retreat and beach nourishment are the preferred options to address the long-term solution to the ongoing erosion issues at Matunuck, especially given the ongoing increase in sea level rise. Structural shoreline protection measures have failed in the past and will continue to fail into the future, as we cannot "engineer" a solution to the natural progression of shoreline change, coastal storms, and the ongoing increase in sea level. See Figure 9.

Figure 9. Matunuck shoreline protection structure failure from the September 1938 hurricane (from Greene, L. R, 1938, The Hurricane September 1938, Westerly, RI and Vicinity, Utter Co., Westerly, RI)

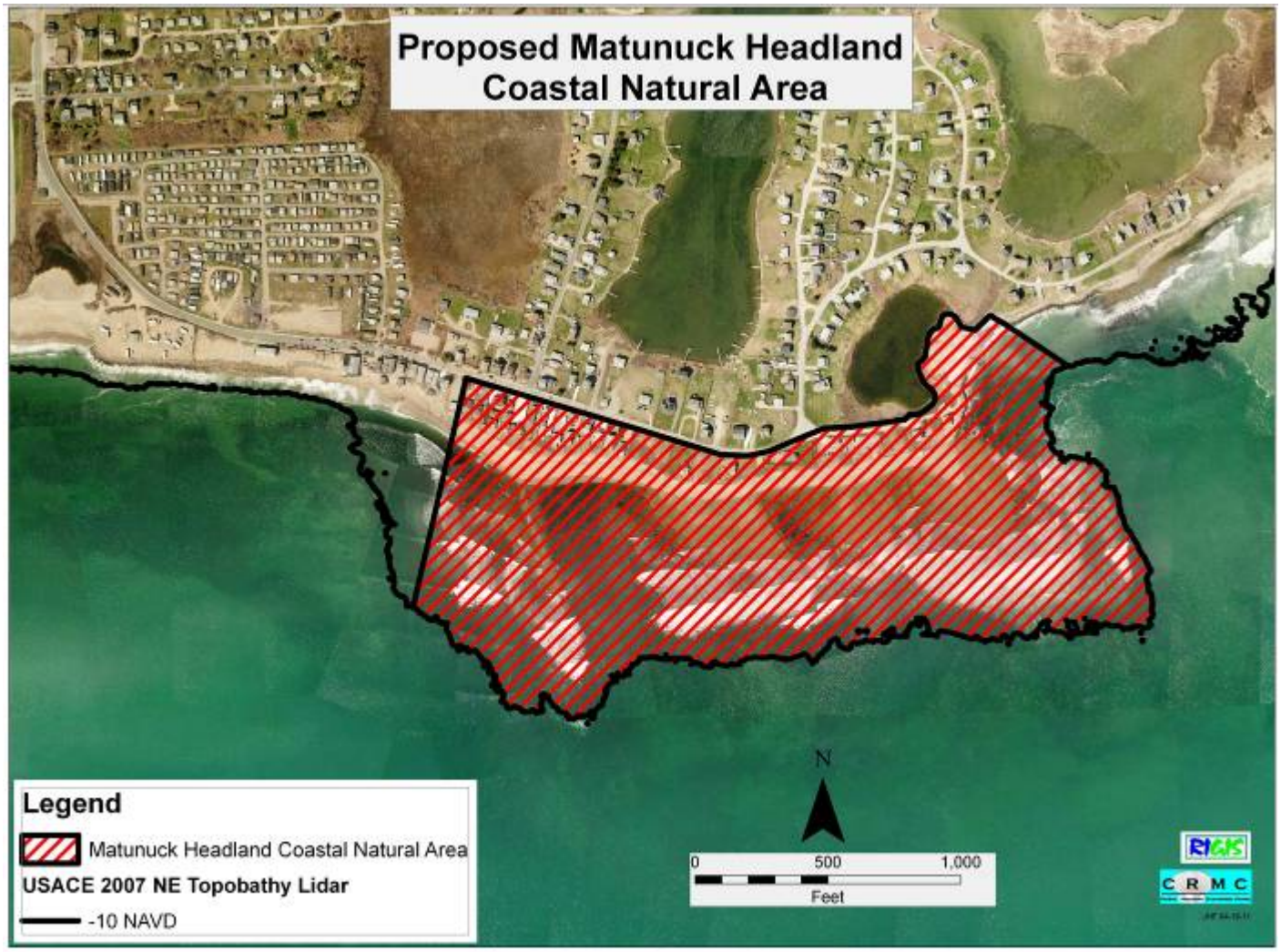


If the Council determines that these two CRMC staff recommended strategies are unacceptable, another option, although not recommended, is to reclassify the segment of shoreline along Matunuck Beach Road starting with and inclusive of parcel 92-2:46 eastward to and inclusive of parcel 92-3:9. Such a reclassification, however, should be accomplished within the Salt Pond Region Special Area Management Plan (SAMP). Reclassifying this particular segment as a manmade shoreline, as defined in RICRMP Section 210.6, would allow the option of installing and maintaining structural shoreline protection, which is a permissible activity on man-made shorelines along Type 1 waters with approval of the full Council. The purpose of reclassifying this shoreline segment within the Salt Pond SAMP itself is that the SAMP provides the Council with an existing CRMC regional-specific management tool that provides more flexibility in applying a rule to a localized issue rather than state-wide. In the event the Council adopted this approach, CRMC staff recommends that the Council designate, pursuant to RICRMP Section 210.4, a "Matunuck Headland Coastal Natural Area" for the shoreline segment area located between the Matunuck Business District, where the temporary shoreline protection structures are proposed to be installed, and the Deep Hole recreational area. This proposed Matunuck Headland Coastal Natural Area, as depicted in Figure 10 below, would preserve the many existing recreational uses and natural coastal features. As described in more detail below, the geologic features of this area help to protect the structures located landward of the beach from waves and storm surge. Figure 13 shows a portion of the proposed Coastal Natural Area as looking east from the Matunuck Business District.

The Council's adoption of this proposed coastal natural area would ensure that the headland beach and dune area remain unaltered and their current functions preserved to protect inland areas without the use of man-made structures. Moreover, by adopting the proposed Matunuck Headland Coastal Natural Area, the Council would be fulfilling its statutory mandate of balancing competing uses of the shoreline and preserving and restoring the coastal resources of the state, as articulated in R.I.G.L. §46-23. The Council's designation of a segment of the Matunuck shoreline as man-made shoreline (parcel 92-2:46 to 92-3:9), accompanied by the designation of the proposed coastal natural area would be consistent with and supportive of the Council's policy to "balance multiple uses of the region, while preserving and, where possible, restoring the

environmental quality." See RICRMP Section 325.B.1.[10] Further, the designation by the Council of the proposed Matunuck Headland Coastal Natural Area would fulfill its mandate pursuant to the Coastal Zone Management Act, to manage "coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands." See 16 USC § 1452(2)(B).[11]

Figure 10. CRMC proposed Matunuck Headland Coastal Natural Area.



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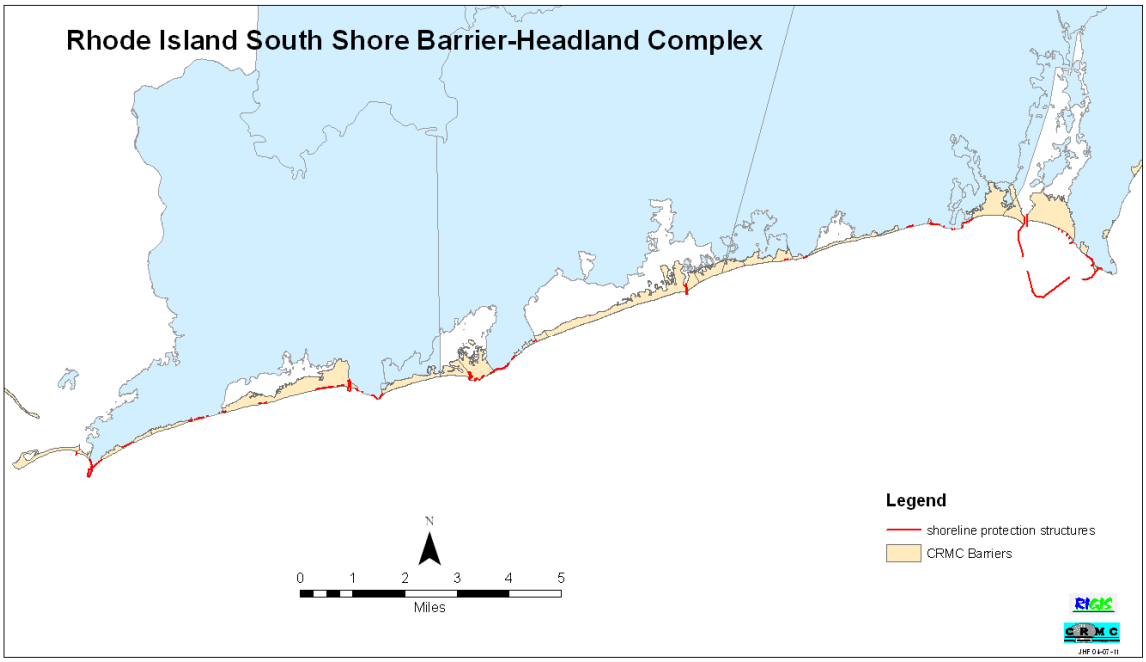
Background Data, Recreational Uses, Engineering Considerations and Potential Standards

Coastal Features and Coastal Erosion

The Matunuck Headland is part of the barrier/headland complex that extends approximately twenty miles from Napatree Point in Westerly to the Point Judith Headland in Narragansett. See Figure 11. This south facing coastline is subjected to high energy coastal erosion processes, including storm surge and large waves during tropical and extra-tropical storms (*i.e.*, hurricanes and Nor'easters). These processes erode the beaches, dunes and bluffs along this shoreline and the eroded sediment is transported along the shoreline into the coastal lagoons, back barrier and low lying headland areas, and offshore. These processes are constantly rearranging and reforming these familiar coastal features along this entire southern shoreline.

Figure 11. Rhode Island South Shore Barrier-Headland Complex showing existing shoreline structures.



The headland areas in the barrier/headland system for the most part consist of Pleistocene-age till or glacial fluvial sediment with wind blown loess deposits covering much of the glacial fluvial sediment. Welded barriers or sand beaches front most of the headlands. These headland areas tend to be less susceptible to erosion than the barriers which are composed of unconsolidated sediment transported by waves and currents. Each headland area, however, has slightly different characteristics with some areas having higher erosion rates that are equal to the erosion rates on the barriers.

The Matunuck Headland is one of many enclaves along the Rhode Island south shore that is subject to storm surges and high wave energy during coastal storms. The Matunuck Headland is located on Block Island Sound and receives direct onslaught from high energy events that shape the shoreline. Except for the shoreline abutting the large revetment on land owned by the Matunuck Beach Trailer Association and Mary Carpenter (parcels 92-2:46 and 92-2:47, respectively), all of the Matunuck Headland has both dry and intertidal sand beaches seaward of the headland deposits. The headland bluff, consisting of wind blown loess overtopping glacial fluvial sand and gravel, is the predominant inland coastal feature from the South Kingstown Town Beach west to the Cards Pond Barrier and is highly susceptible to erosion. See Figure 12.

Figure 12. Headland bluff at the South Kingstown Town Beach showing glacial fluvial sediment and wind-blown loess. The bluff provides sediment for the beach.

The upland section of shoreline between Deep Hole and the Matunuck Business District has very thick overwash sand deposits that extend inland tens of feet. Wind blown sand has formed dunes in these overwash deposits. See Figure 13. However, because this section of shoreline is classified as a headland, the inland edge of the coastal feature is the dune scarp rather than twenty-five feet landward of the dune crest as per RICRMP Section 210.7. The upper shoreface seaward of this section of shoreline consists of a cobble terrace that extends several hundred feet offshore and it dissipates some wave energy before reaching the shoreline. See Figure 14. Thus, this section of shoreline has experienced less dramatic shoreline change than shoreline segments to the west.

Figure 13. Dunes form in thick overwash deposits on Matunuck Headland east of the Matunuck Business District.

Figure 14. Matunuck Shoreline showing the offshore cobble terrace that dissipates wave energy and helps mitigate erosion along a portion of the Matunuck Headland shoreline. The delineated shorelines indicate which areas change very little over time (lines closer together) and which sections undergo radical change (lines farther apart). The Matunuck Business District has a moderate erosion rate and likely benefits from the offshore cobble terrace which dissipates wave energy.

*Superscript numbers reference corresponding Appendix sections

It should be noted that the CRMC shoreline change maps underestimate the erosion potential in this area. See: http://www.crmc.ri.gov/maps/maps_shorechange.html. The average annual erosion rates used for the CRMC shoreline change maps are based on the endpoint dates, in this case 1939 and 2004. The entire Matunuck area has gone through cycles of erosion and accretion over this time period. See Figures 15, 16 and 17 for comparison. Total shoreline changes should be used instead of the endpoints. These range from shoreline displacement of ~ 20 feet at the cobble terrace; ~ 150 feet at the Ocean Mist and ~ 250 feet at the South Kingstown Town Beach between 1939 and 2006 (120 feet at the Ocean Mist and 210 feet at the South Kingstown Town Beach between 1939 and 2004). The high rates of erosion on the unprotected headland areas at the Ocean Mist and the South Kingstown Town Beach are comparable to segments of the south shore barriers over a similar time period when comparing CRMC shoreline change maps.

Figure 15. Emergency erosion control west of Deep Hole after 1999 extra-tropical storm.

Figure 16. Same section of shoreline in 2009 showing sand accretion on the beach and the dunes.

Figure 17. Same section of shoreline after a 2010 extra-tropical storm. The post-storm erosional scarp is in approximately the same position as the 1999 scarp shown in Figure 15 above.

The coastal bluff and dune scarp show net erosion, and anecdotal accounts suggest that erosion rates at Matunuck have accelerated since the mid 1980s. Comparing the location of the visible seaward edge of vegetation on 1985 and 2008 aerial photographs the landward migration ranges from a low of ~ 10 feet behind the cobble terrace to a high of 120 to 140 feet at the South Kingstown Town Beach. The migration of the bluff at the Matunuck Headland Business District was hard to determine for that time period due to lack of vegetation on either set of aerial photographs. Photos taken on site over the last 12 years, however, show that the bluff has migrated less than 20 feet since 1999 as shown in Figures 18 and 19. The perception is that the erosion has been far greater in this location because of the adverse impacts to the many structures and septic systems, some of which have been on the site prior to the 1938 hurricane.

Figure 18. Matunuck Business District in 1999

Figure 19. The same structures in 2010 as shown in Figure 18 above. Approximately twenty feet of bluff landward of the house has eroded since 1999.

Coastal shoreline erosion is not limited to just the Matunuck area, as many other segments of the Rhode Island shoreline are also eroding. For example, the east ends of both the East Beach and Quonochontaug Barriers have experienced rapid erosion between 1985 and 2008 as indicated by the vegetation line on East Beach, which has shifted 125 to 150 feet inland. On Quonochontaug the vegetation line shift is about 90 feet. Other areas such as the Misquamicut Headland in Westerly have not changed dramatically, which is due in part to the preponderance of pre-existing shoreline protection structures. Additionally, overwash sand following storm events is removed from Atlantic Avenue and relocated to the beaches. Many of these beaches are supplemented with yearly beach renourishment projects that are paid for by local hotel and business owners to create more beach frontage and beach blanket space in front of their hotels. The CRMC has issued 112 permits for such activity since 1975.

A recent US Geological Survey report (Hapke *et al.*, 2010)[12] investigates shoreline change throughout the northeast United States and concludes that sixty-eight (68) percent of the shoreline is eroding. Erosion rates were generally lower in New England, but nevertheless a higher percentage of the shoreline was eroding. Table 6a from the USGS report is provided below, and it compares the long term shoreline change rates for segments of the New England and Mid-Atlantic Coasts. The New England South region and includes the southern coastlines of Westport, MA, Little Compton, Newport, Jamestown and the RI south shore from Point Judith to Napatree Point in Westerly. The table compares the average annual erosion rates and uncertainties for the shoreline segments that were studied, and it shows that the average annual erosion rates for the New England South section are less than one (1) foot per year. This analysis includes bedrock headlands as well as barriers and unconsolidated headland bluffs like those found in Matunuck. This average number may not be helpful in predicting future shoreline change at specific locations, but it's a way to look at changes occurring along the Rhode Island shoreline in a regional context. Rhode Island erosion rates are lower than those found in the Mid Atlantic and the Cape and Islands in Massachusetts.

Table 6a. Long-term shoreline change rate uncertainties for New England and Mid-Atlantic regional averages.

[m/yr, meters per year; m, meters; uncertainty numbers in red are confidence interval values that are less than the average rate indicating that the average rate is significant]

	Region	Average rate (m/yr)	Number of transects	Average uncertainty (m)	Independent n	Uncertainty reduced for independent n (m)
New England	New England North	0.1	1,642	0.4	77	0.05
	Greater Boston	-0.09	2,005	0.3	100	0.03
	Cape Cod	-0.4	1,666	1.5	10	0.5
	Massachusetts Islands	-1.4	1,775	0.6	43	0.09
	New England South	-0.2	1,136	0.2	45	0.03
Mid-Atlantic	Long Island	0.08	3,518	0.6	11	0.2
	New Jersey North	-0.6	2,234	0.9	22	0.2
	New Jersey South	0.8	1,408	1.3	22	0.3
	Delmarva North	-0.5	2,235	0.7	19	0.2
	Delmarva South and Southern Virginia	-2.9	2,165	1.7	10	0.5
	New England total	-0.4	8224	0.6	39	0.1
	Mid-Atlantic total	-0.6	11,560	1.0	61	0.1
	Total	-0.5	19,784	0.8	91	0.09

Shoreline Protection Structures

While properly designed and installed shoreline protection structures can protect coastal property and infrastructure, they can also cause considerable harm to adjacent coastal properties or those properties down-drift from the structure. Shoreline protection structures by design reflect wave energy, causing erosion around the sides of the structure and scouring immediately seaward of the structure. Overtopping of the structure by storm surge and waves results in damage to the buildings that are located too close to the shoreline protection structure itself. Shoreline protection structures can also have detrimental impacts on the natural coastal features such as beaches, dunes and nearshore habitat. Shoreline protection structures are designed to "draw a line in the sand," however, over time the fronting beaches narrow and eventually disappear due to wave reflection eroding the fronting beach and through passive erosion as the unarmored shoreline migrates landward around the structure (see Figures 1 & 7).

The primary sources of sediment on the south shore of Rhode Island come from the eroding headlands, the eroding foredune zones on the barriers, and sediment on the nearshore face located in depths of less than 40 feet. There are no major rivers or other significant sediment sources. Shoreline protection structures disrupt sediment transport, both by sequestering sediment that would normally erode from a bank or dune to form new beaches, and by physically blocking the sand movement laterally along the shoreline. Moreover, structural shoreline protection structures are a significant factor in the narrowing and loss of beaches, and they obstruct the public's right to lateral shoreline access.

Shoreline protection structures may help protect the property where they are built, but often harm adjacent properties by accelerating beach erosion and in some cases by actually causing a reduction in property values. A recent study by O'Connell (2010)[2] examined shoreline protection structures in Massachusetts and

Hawaii and found that shoreline structures preserved the property values for individual waterfront homes. Property values, however, decreased for homes a few blocks inland due to the shoreline armoring and also to some extent for the waterfront properties if shoreline armoring was extensive.

Shoreline protection structures (*i.e.*, revetments, sea walls and bulkheads) cover approximately 21 percent of the Rhode Island south shore. This is less than the Massachusetts south shoreline that is reported to have approximately 30% of the shoreline hardened with shoreline protection structures. With the exception of about 1800 linear feet of revetment on the east end of the Misquamicut Barrier, there are only isolated shoreline protection structures on this barrier (~ 4% of the entire barrier lengths along the south shore have shoreline protection structures). It takes only one structure, however, to impede constitutionally guaranteed public access to miles of shoreline beaches if alternative routes around the structure are not available.

Matunuck/Deep Hole Environment and Recreational Use

It is important to note that the CRMC and South Kingstown Town Council joint work session public meeting of March 29 did not have any speakers who discussed the significant number of recreational users of the Matunuck area and the potential impacts of short-term or long-term "solutions" on recreational users. CRMC staff has documented popular recreational uses that contribute to the importance of the Matunuck area and its distinctive character. The report appendices contain citations, web articles and other data that support the popularity of recreational uses of this area.

- **Environment:** The shoreline of Matunuck is often referred to as Matunuck Point. The Point consists of a rocky reef composed of rounded cobble and scattered rocks which creates a shallow cobble terrace extending approximately 500 feet from shore. The shallow reef creates a wave break which "trips" ocean waves prior to reaching the shoreline, thus helping to protect the dwellings and other structures along the beach. The reef at Matunuck is unique to the South Coast of Rhode Island and is used extensively for recreational purposes.
- **Deep Hole Parking Lot:** The Deep Hole parking lot is a state-owned facility managed by RI Department of Environmental Management (RIDEM) and was acquired using federal US Fish& Wildlife Service Sportfish Restoration Program funds (special federal excise taxes on fishing, hunting, and boating equipment). The RIDEM-managed area is part of the South Shore Management Area that provides shoreline access with a small beach access to the reef and parking for approximately thirty cars. **[13 & 14]** The parking area is a fee-free "first come, first served" public parking facility providing recreational access to Matunuck Point. This facility provides for many recreational activities throughout the year and is a unique and important recreational resource.
- **Recreational Use:** In addition to more customary recreational uses, Matunuck Point provides unique opportunities for recreational activities not allowed on any other of Rhode Island's South Shore beaches during the bathing beach season. These uses include: surf fishing, kayaking, surfing, paddle boarding, windsurfing and kite boarding. These activities are incompatible with most bathing beach uses during the beach season and are typically not allowed. Matunuck Point provides a superior environment for these activities primarily due to the existence of an expansive shallow reef unique to the South Shore of Rhode Island. The existence of the reef with convenient shore-side parking attracts large numbers of recreational users to the area who support the local economy which includes shops, bars, hotels and the local real estate market. Matunuck Point is known as one of the most popular recreational destinations in Rhode Island and is widely advertised for the recreational activities it supports.**[15]**

- **Surf Fishing[16]:** The reef provides valuable habitat which attracts many species of fish including tautog, scup, bluefish and striped bass. Deep Hole, as the name implies, is a naturally occurring deep hole that exists immediately east of the reef. The "hole" provides a deep water habitat immediately adjacent to the reef and is utilized by striped bass and other predatory fish that feed on numerous bait fish moving from the reef with the tides and currents. The predominant westerly winds and wind driven tides create a strong current over the reef that sweeps baitfish eastward over the reef and into deep hole where striped bass and bluefish can often be found waiting.
- **Kayaking[17]:** The Deep Hole parking facility provides a popular area for launching kayaks. Opportunities include sea touring along the South Coast, kayak fishing around Deep Hole and the reef, and surf kayaking on the reef break. The reef break provides a dependable wave environment for a broad range of users, ranging from beginner surf kayakers in mild weather conditions to "experts" in the wave break created by storm seas. Matunuck Point is a highly popular destination for kayakers and it is not uncommon to meet kayakers coming from long distances to experience kayaking at Matunuck Point.
- **Surfing and Paddle Boarding[18]:** The Matunuck Point reef break provides the most popular surfing location in Rhode Island. In mild (flat water) weather conditions, the reef "pushes up" a small wave even when most other area of the shoreline are calm and without waves. The conditions provide a dependable location for beginners and surf schools. It is not uncommon to see large groups of school age children learning in an "outdoor classroom" at Matunuck Point. Smaller wave conditions also support paddle boarding, a relatively new form of surfing where the rider stands up on the board with a paddle. Conversely, when the weather gets rough and the storm seas build, Matunuck is known for the most challenging of waves attracting experienced locals and expert surfers from across the Northeast. Several of the breaks at Matunuck Point are named including "Trestles" and "Mary's".
- **Windsurfing[19]:** The conditions preferred by surfers also attract windsurfers. Since windsurfers traditionally harness the power of the wind rather than a wave, windsurfers have many options for sailing including lakes, bays, harbors and flat water ocean sites. However, wave sailing is considered to be the apex of the sport. It combines using the wind to maneuver into a wave break and the ability to surf the waves. Once on a wave, the wind becomes secondary to riding the wave similar to a ride caught by a surfer. Due to the large wave break, Matunuck Point provides windsurfers an expansive area to combine sailing with wave riding. There is no other location in Rhode Island which provides a large reef break suitable for wave sailing.
- **Kite boarding (aka, kite surfing) [19]:** Not unlike windsurfing, an expansive area is needed to ride a kite board. The lines between the kite sailor and the kite are typically in the range of 60 feet which requires a large shoreline area to both launch and retrieve a kite. Once on the water, kite surfing requires sufficient space to maneuver near shore while riding a wave. For this reason kite surfing is particularly incompatible with bathing beaches. Matunuck Point provides the ultimate reef break for riding waves on a kite board. Due to the rocky nature of the Point and the relatively small kite launching area near the Deep Hole parking lot, Matunuck Point typically attracts only expert kite boarders. Where permissible during the bathing beach season, kite boarders will also launch their kites from East Matunuck State Beach and ride out to Matunuck Point to ride the wave break.

Shoreline Access Needs for Recreational Uses: The Deep Hole parking lot provides an exceptional fee-free, state-managed facility for public access to Matunuck Point. The parking area and two small adjacent undeveloped shorefront lots provides a small area of beach for recreational access to the Matunuck Point Reef. However, in order to participate in the recreational sports which occur at Matunuck, lateral shoreline access is required. Due to the wave environment and strong tidal currents over the reef, kayakers, surfers, windsurfers and kite boarders often end up getting swept down shore, particularly in storm seas that generate the preferred waves on the reef. Shoreline revetments eliminate the beach fringe preventing lateral shoreline access. It is also relatively common for kayakers, surfers, windsurfers and kite boarders to get into trouble in the strong reef currents and wave break. Those familiar with Matunuck Point know from experience to avoid getting trapped in front of the existing shoreline revetments that do not allow for a safe shoreline exit. In these areas, the waves often break directly on the boulder revetments making getting back to shore impossible in rough seas and currents. Many people have seen their gear (surf boards, windsurfers, kites, etc.) destroyed on the existing revetments while trying to get back to shore. There's even a case where a surf fisherman was swept off the reef into Deep Hole and drowned. An existing line of revetments immediately east of Deep Hole, along with the large revetment in front of the Matunuck Beach Trailer Association property, pose significant safety hazards for recreational users in this area when trying to gain the shoreline from the water during high surf conditions. See Figure 20.

Figure 20. Surf conditions at the Matunuck Beach Trailer Association property on April 17, 2011.

Engineering Issues and Potential Stipulations

Should the Council determine that the current situation in Matunuck warrants its authorization of temporary wooden bulkheads as a short-term erosion control measure while longer-term options are developed, CRMC staff offers the following list of stipulations and guidelines that the Council should incorporate into any Council issued assent.

The Town should also consider other options for protecting Matunuck Beach Road, as they have already stated that storm flooding will not be addressed as part of any action taken by property owners to address erosion. The more than 500 residences that will be impacted by a road failure due to shoreline erosion are also at great risk during storm events. If the Town does not impose a mandatory evacuation order before a storm, affected residents may not have an exit out of the community and emergency responders will have very limited access depending on the depth of the flood waters.

During the public workshop, the Town Council and affected property owners stated that they wanted to avoid Army Corps (or any Federal) jurisdiction regarding the installation of shoreline protection measures. Figure 20 below depicts the Army Corps federal jurisdiction. Any structures placed at or below the Mean High Water line will invoke Section 10 jurisdiction. Further, any fill material placed at or below the highest tide line, most likely behind the temporary wooden bulkheads, will invoke Section 404 jurisdiction. If applicants desire to avoid Federal jurisdiction, the installation of temporary shoreline protection structures must be located above the MHW line and not have any fill material placed behind them, otherwise an Army Corps application and authorization will be necessary.

In addition, the Rhode Island State Building (SBC) code applies to any structure installed at or above Mean High Water. The specific section in the Code is Section 1612 Flood Loads.[20] This section also references the standards of other codes that are included through reference, however, ASCE 24-05 "Flood Resistant Design and Construction"[20] is the most pertinent. The Matunuck shoreline is located within a Federal Emergency Management Agency (FEMA)-designated Special Flood Hazard Area (see Figure 22). Thus, construction along this shoreline is subject to the requirements of the State building code for Flood Hazard Area Subject to High Velocity Wave Action and the jurisdiction of the local and state building officials. Temporary Structures as defined in the SBC are limited to less than 180 days and "shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads….during conditions of the design flood." These issues fall under the jurisdiction of the building official and the requirements of the SBC. In accordance with existing CRMC application procedures, it is recommended that the Council require applicants to submit the signed building official form as part of any application package for temporary or long term structures filed with the CRMC.

Figure 21. Army Corps of Engineers Jurisdiction Limits

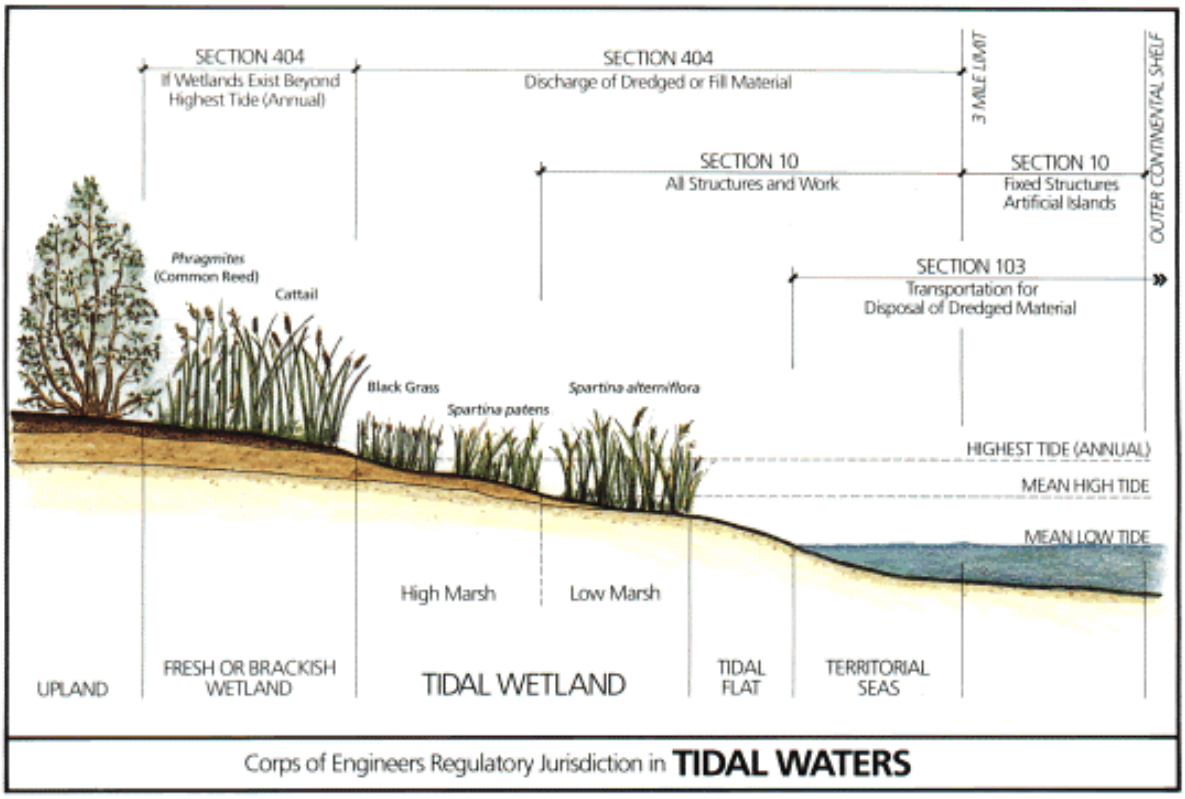
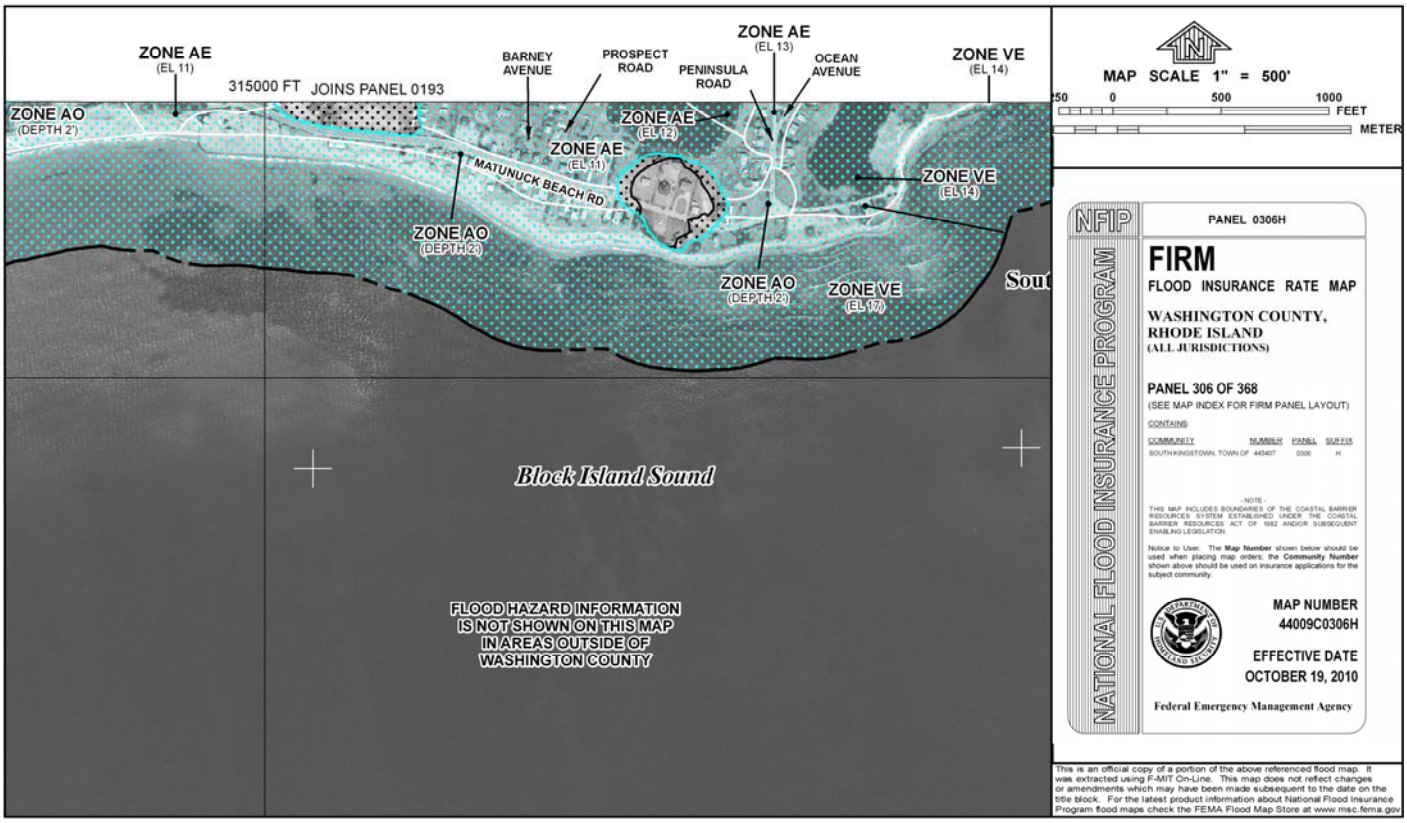


Figure 22. Flood Insurance Rate Map for Matunuck shoreline (FEMA map panel 44009C0306H)



*Superscript numbers reference corresponding Appendix sections

Potential Stipulations/Guidelines for Council consideration

- Temporary shoreline protection facilities shall be designed as temporary measures and shall be removed once a permanent shoreline protection solution is installed, or in accordance with a Council order.
- Temporary shoreline protection shall be installed in a tiered approach with "soft" solutions utilized first and then if they are not effective progressively "harder" solutions up to a temporary timber bulkhead. All applicants for temporary shoreline protection up to and including temporary timber walls understand that these structures provide limited protection from significant storm and wave events and that they will not prevent natural coastal processes and that the best one can expect from these structures is the slowing of natural erosion during typical coastal weather.
- Upon the Chairman authorizing the Executive Director, pursuant to RICRMP Section 180 (Emergency Assents), all temporary shoreline protection structures shall be administratively approved for a period of twelve (12) months. At least 30-days prior to the expiration of the initial approval, the applicant may apply for an extension of six months. The applicant must demonstrate that: a long term solution is being actively pursued; there have been no impacts on public littoral and lateral access; and, the adjacent properties have not had erosion accelerated by the temporary structure. Actively pursued shall mean that actual work is being performed by the applicants and the Town to obtain long term permits.
- All temporary structures shall be installed above the Mean High Water (MHW) Line. The MHW line can be determined from a known tidal benchmark, the CRMC "short term tidal method" or any other accepted engineering or surveying method using the NAVD 88 datum reference point.
- All temporary structures shall be constructed of timber. There shall not be any creosote on any portion of the structure. The wall shall be cantilevered and there shall not be a tie-back system as part of a temporary wall. It is preferred that the material used be untreated as it is temporary in nature.
- All temporary erosion control must be tied into adjacent temporary measures or return into the natural grade. The temporary structure must be coordinated with adjacent properties to avoid end scour.
- The applicant shall detail the location of the temporary wall on the property from two (2) fixed known points on the upland area behind the wall; detail the materials and method of construction including access for equipment, material storage, excess material removal and maintenance access; and obtain local building official approval for timber erosion control structures as required by Local regulations.
- Applicants must provide a public access plan for all new structural shoreline protection projects, where appropriate, to ensure the continued use and access of the public along the shoreline on the project parcel. The public access plan must address both immediate and long-term site conditions.
- Applicants must include current photographs of the construction site, including the two adjoining property boundaries, as viewed from the water toward land.
- The proposed structure shall be located as close as practicable to the shoreline feature or structure it is designed to protect.
- The proposed structure height shall not exceed the height of the existing coastal shoreline feature.
- In the event of a catastrophic storm event, the CRMC may review any approved temporary structural shoreline protection structures on individual lots and may require reapplication.

Long-term Solutions

As detailed above and in great detail in the appendices, this is an existing erosion problem with very limited solutions that will prove satisfactory in the long run. It is a problem that is occurring across the country with greater frequency. Mr. Rick Murray who is a professor of earth science from Boston University and a Scituate, MA selectman said it best recently in the Boston Globe "Not everything we love can be saved". See Boston Globe April 3, 2011.[3] Coastal defense structures are very expensive, require constant maintenance, and significantly degrade the beach, public access, and benthic resources in the vicinity. Soft solutions are expensive and require significant amounts of maintenance. Beach nourishment projects are expensive and require a steady supply of compatible dredge projects. These dredge projects may have adverse impacts at the dredge location. Retreat is expensive, unacceptable to many waterfront owners and in many cases not practical. The common node here is that all of the solutions are expensive and don't protect fully against storm surge and damage from a hurricane. This issue must be carefully debated at the state and local level as to how much should we pay for coastal shoreline defenses, particularly when the benefits are very local, and more importantly who should pay.

Further CRMC staff recommendations

1. The Town of South Kingstown should coordinate with the Towns of Charlestown, Narragansett, Westerly, North Kingstown and the CRMC on maintenance dredging and using the sediment for beach replenishment in the Matunuck Business District.
2. The Town of South Kingstown should work with Economic Development Corporation to look at opportunities for relocating the businesses threatened by erosion.
3. The Town of South Kingstown should develop a plan with assistance from the RI Department of Transportation to relocate Matunuck Beach Road farther inland.
4. The Town of South Kingstown should develop a post-storm debris removal and restoration plan.

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

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