National Flood Insurance Program
Community Rating System

Coastal Erosion Hazards

A Special Flood-related Hazards Supplement to the *CRS Coordinator's Manual*

2015

FEMA

On the cover:
Coastal erosion has left an East Hampton, New York, home standing, but inaccessible.

Photo courtesy Wesley Shaw

A community interested in more information on obtaining flood insurance premium discounts through the Community Rating System (CRS) should have a copy of the 2013 *CRS Coordinators Manual*. This and other publications on the CRS are available at no cost from

Flood Publications
NFIP/CRS
P.O. Box 501016
Indianapolis, IN 46250-1016
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They can also be viewed and downloaded from www.CRSresources.org.

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INTRODUCTION

The Community Rating System (CRS) rewards communities that are doing more than meeting the minimum requirements of the National Flood Insurance Program (NFIP) to help their citizens prevent or reduce flood losses. The CRS also provides an incentive for communities to initiate new flood risk reduction activities.

The CRS includes 19 creditable activities, organized under four categories:

300—Public Information Activities

400—Mapping and Regulations

500—Flood Damage Reduction

600—Flood Warning and Response.

Credit points are based on the extent to which an activity advances the three goals of the CRS. Communities are invited to propose alternative approaches to these activities in their applications.

The Federal Emergency Management Agency (FEMA) and many communities in the United States have long recognized that the mapping and regulatory standards of the NFIP do not adequately address all of the flood problems in the country. In particular, a number of "special" flood hazards deserve attention. They include

- Ice jam flooding,
- Flooding adjacent to closed basin lakes,
- Mudflow hazards,
- Flooding affected by land subsidence,
- Uncertain flow path flood hazards,
- Coastal erosion, and
- Tsunamis.

This publication discusses the credits provided by the CRS for mapping and management of coastal erosion hazards. Other hazards are addressed in two separate publications:

Tsunami Hazards: A Special Flood-related Hazards Supplement to the CRS Coordinator's Manual, and

Inland Hazards: A Special Flood-related Hazards Supplement to the CRS Coordinator's Manual.

Both may be downloaded from www.CRSresources.org.

BACKGROUND ON SPECIAL FLOOD-RELATED COASTAL EROSION HAZARDS

Coastal populations, development, and infrastructure in the United States have increased dramatically since World War II. In 2010, 39% of the U.S. population lived in coastal counties. These 123.3 million people inhabited less than 10% of the nation's total land area (excluding Alaska). Within this limited space, population density far exceeded that of the nation as a whole (it is over six times greater than that of inland counties), and this trend is expected to continue into the future. It is anticipated that the population of coastal counties will increase by another 10 million by 2020 (National Oceanic and Atmospheric Administration, 2013, pp. 3–5).

As growth continues and density increases, so does the risk for major disasters resulting from the combined effects of wind, flooding, and erosion. The potential for major losses exists along all of the nation's major shorelines, including the Atlantic, Pacific, Gulf, Great Lakes, Bering Sea, and the Arctic.

As of 2011, the NFIP covered some $527 billion in assets in coastal floodplains around the nation. The program has paid out $24 billion in losses in coastal areas: 2012's Superstorm/Hurricane Sandy will almost certainly add billions of dollars to these figures.

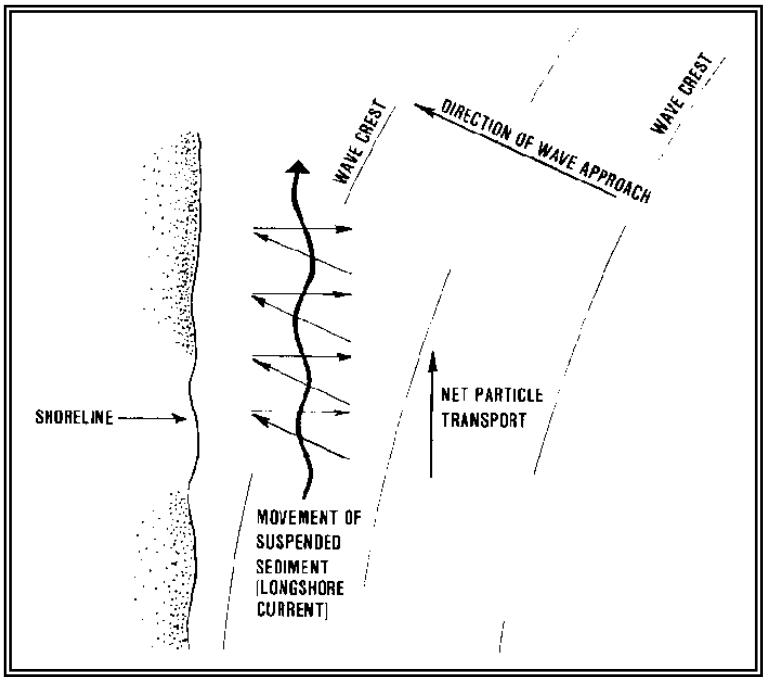
Causes of Coastal Erosion

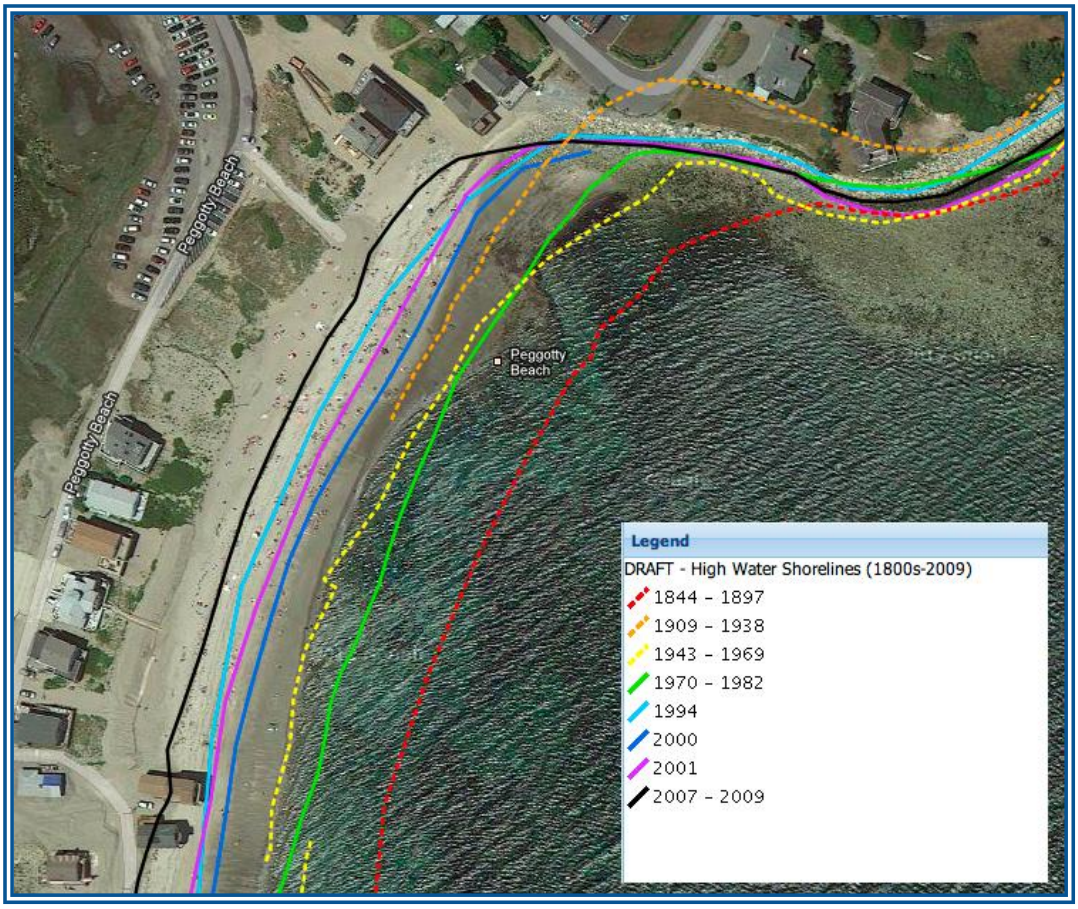
Coastal erosion is a complex physical process shaped by both natural processes and human intervention. Natural factors that influence the erosion process include the geologic characteristics of the shore; the effects of waves, currents, tides, and wind; sediment supply; changes in sea and lake levels; and the bathymetry of the near- and offshore sea bottom.

Littoral transport is the movement of material in the nearshore zone by waves and currents—the mechanism that moves beaches. The movement of sediment may be parallel to the shore, onshore, or offshore. Waves and currents are the primary agents of littoral transport. It is the energy of the waves that picks up the sand and moves it along the shoreline. Most waves strike the shore at an angle setting up a *longshore current*, where sand moves along the beach in a series of zig-zag patterns as successive waves strike the shoreline (see the illustration on the next page). *Downdrift* is the term that refers to the predominant direction of the littoral transport.

From a development standpoint, littoral transport causes problems by removing material from where people would like to have it—on the beach—and placing it where they do not want it, often in navigation channels or offshore. Littoral transport is a natural process, but human activities can alter and accelerate it.

When waves move sediment onto the beach at an angle, the sediment washes back off the beach in a direction parallel to the backwash of the wave (following gravity downhill). This zig-zag movement results in a net longshore current in the direction of the prevailing waves (U.S. Army Corps of Engineers, 1981, p. 7).





Coastal shorelines are dynamic by nature. This image shows the historical location of the high water line of a Massachusetts community (from Massachusetts Shoreline Change Project website, http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/shoreline-change/).

Sea Level Rise

Although sediment supply and coastal storms are important factors affecting shoreline erosion, sea level rise is perhaps the dominant process driving the rate of shoreline movement and position (Zhang et al., 1997). According to the U.S. Environmental Protection Agency, for the past century, *global* sea levels have been rising at about 1.2–2.2 mm per year. There is evidence that this rate is increasing—between1993 and 2003 average global rates were estimated to be nearly 3 mm per year (Bindoff et al., 2007)—but local conditions can make the *relative* rate of sea level rise much smaller or larger. On Louisiana's Grand Isle, for example, where land is subsiding, sea levels are rising at 9.24 mm per year—over three times the global average. Conversely, in Skagway, Alaska, where land is rising after being depressed by glaciers that are now retreating, relative sea level is *falling* at a rate of 17.12 mm per year.

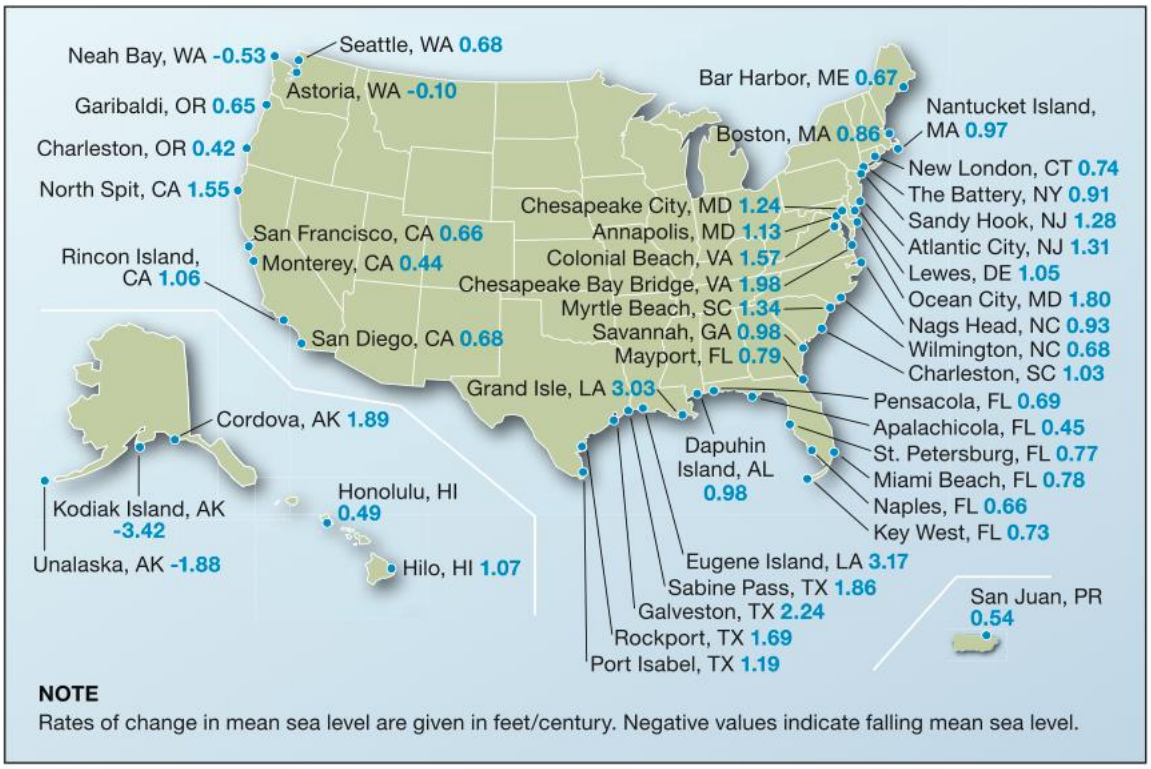


Figure 3-13.
Observations of rates of change in mean sea level in the United States in feet per century
DATA SOURCE: NOAA CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES (http://tidesandcurrents.noaa.gov/sltrends/sltrends.html)

Sea levels are changing at different rates (and even different directions) in different parts of the country. Communities should use the most specific data they can get when planning (Federal Emergency Management Agency, 2011, p. 3-21).

Erosion Rates

Erosion rates vary significantly across regions and shoreline types, influenced by both natural and human factors. Historically, the nation's shorelines have been receding at an average rate of slightly more than 1 foot per year (Leatherman, 1993), but local rates vary tremendously. Erosion rates of 25 feet per year are not uncommon on some barrier islands along the southeast Atlantic coast, and a section of the Washington coast has been eroding at an average of over 100 feet per year for the last century.

Erosion can also be very episodic and geographically targeted: a major storm can erode a stretch of coastline 100 feet or more in a day, only to be followed by accretion over the next decade. Meanwhile, only 100 feet up or down the coast there may be no shoreline change at all.

Protective Functions of Dunes and Beaches

Coastal dunes and beaches provide protection to inland development by breaking waves and dissipating the effects of storms. Their preservation is important to protect property from damage and destruction.

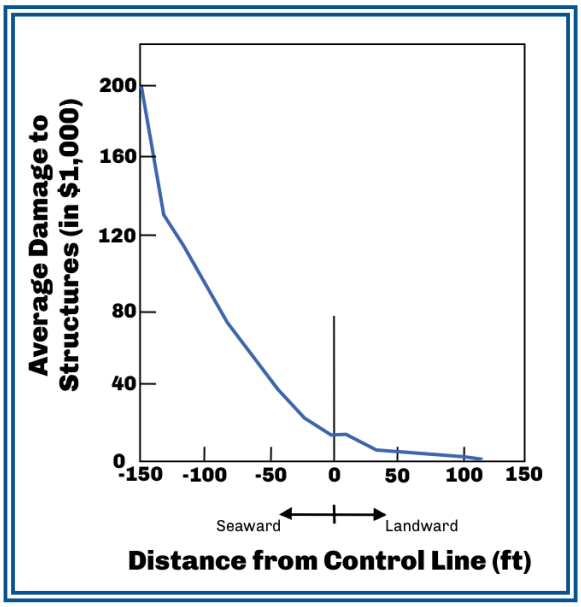
The photographs on the next page were taken at North Topsail Beach, North Carolina, before and after Hurricane Fran. They show an area where there was wave runup on the dune system and significant dune retreat. The volume of sand along the beach and dune system, along with the building setback, resulted in lower flood losses for these homes.

Damaged dunes from Tropical Depression Ida show that both dune volume and height are keys to determining the level of protection a dune provides (photo from FEMA library, Elissa Jun/FEMA.)

Before Hurricane Fran, July 1996. After Hurricane Fran, September 1996.
(Photos from USGS.)

Coastal erosion and flooding are related processes that can increase the risk of damage to structures. Once the coastline has shifted inland, flood elevations for the same magnitude storm will be higher farther inland and thus can cause additional damage. With erosion, buildings constructed in lower-risk A Zones with less stringent building codes may be subjected to waves of V-Zone intensity as the shoreline moves inland. The site on which a structure originally built in compliance with A-Zone standards at a base flood elevation of 13 feet might, after a period of erosion, be remapped accurately as being in a V Zone with a base flood elevation of 15 feet. With the new, heightened exposure caused by erosion, waves and storm surge can be of sufficient magnitude to destroy a house that might otherwise have survived had it been constructed to meet the stricter V-Zone standards.

The importance of a wide beach in reducing the damage to structures from hurricanes and tropical storms is widely recognized. After Hurricane Eloise struck Florida in 1975, a survey to quantify the benefit of beach width on storm damage reduction was undertaken in Bay County, Florida. As part of the study, 540 buildings were evaluated to determine the extent of damage and the relative position of each to a jurisdictional control line, generally parallel to the shoreline (Shows, 1978). The survey results illustrated in the graph show the structural damage caused by Eloise as a function of the proximity of structures to the jurisdictional control line.



Damage to structures is based on their relationship to the jurisdictional control line (Shows, 1978, p. 159).

A similar study in North Carolina after Hurricane Floyd found that buildings that were set back more than 100 feet from the shoreline suffered one-third of the damage of those buildings set back less than 30 feet (Hazard Mitigation Technical Assistance Partnership, Inc., 2000, p. 35).

Present-day beach and dune topography alone should not be used to determine the storm risk for an existing or proposed building. Instead, the most landward shoreline and beach/dune profile expected over the lifetime of a building or development should be calculated and used as the basis for decisions. The most landward shoreline should be based on long-term erosion and observed shoreline fluctuations at the site and, where possible, predicted future sea levels should be considered in projections.

Dune erosion calculations at a site should also take into account the condition of the dunes. A dune that is not covered by well-established vegetation (i.e., vegetation that has been in place for two or more growing seasons) will be more vulnerable to wind and flood damage than one with well-established vegetation. A dune crossed by a road or pedestrian path will offer a weak point that storm waves and flooding will exploit. Post-storm damage inspections frequently show that dunes are breached at these weak points and that the structures landward of them are more vulnerable to erosion and flood damage.

Siting and design should include consideration of multiple storms or hazards within a short period, whose cumulative effects can exceed those of a design-level event (Federal Emergency Management Agency, 2011, p. 11).

CRS CREDIT

The hazards associated with coastal erosion must be dealt with at the community level, using all available floodplain management tools. Under the CRS, these tools are organized under four general series of credited activities:

- Informing the public and specific populations, such as developers and engineers, about the hazards (300 series),
- Mapping and regulating the hazard areas with recognition of the unique problems associated with the hazards (400 series),
- Special structural and nonstructural efforts to solve existing problems (500 series), and
- Special emergency preparedness efforts that recognize the particular problems associated with these hazards (600 series).

This section reviews the proven mitigation measures for the coastal erosion hazards addressed in this publication. In some cases, CRS credit is provided for an activity in the *CRS Coordinator's Manual*. In other cases, particularly in the 400 series, special credit is provided in this publication. For those credits, this document is a supplement to the *Coordinator's Manual* and the same formatting is used. The special hazard credit points calculated with this publication are added to the regular credit points in the *Coordinator's Manual*, although in certain cases maximums may apply.

A community's coastal erosion management program may include activities that are not eligible for CRS credit. For example, local post-disaster recovery and mitigation policies might require that damaged areas be redeveloped with new street patterns to accommodate the clustering of structures away from areas subject to coastal erosion.

300 Public Information Activities

People living on the coast often do not start worrying about erosion until their property or homes are visibly threatened. At that point, their choices are more limited than they would have been had erosion been considered before the building was sited.

Because the flood hazards associated with coastal erosion are different from "normal" flood hazards, there are special needs for public education. Property owners and developers must be made aware of the hazards and the methods for mitigating them.

A sustained public outreach program is needed to inform coastal populations about coastal preparedness and mitigation. Such a program should encourage information that is consistent between local government and the community at risk. (A program for public information (PPI) committee, as outlined in Section 330 of the *Coordinator's Manual*, can help unify a community's message.) Innovative approaches should be encouraged at many different levels.

310 Elevation Certificates

FEMA elevation certificates, which are required for the purchase of NFIP flood insurance, and which must be maintained by CRS communities, MUST be based upon the current Flood

Insurance Rate Map (FIRM) for the community, and they must be completed using the flood information from the FIRM and the corresponding Flood Insurance Study. There is no requirement to maintain elevation certificates outside the Special Flood Hazard Area (SFHA).

This means that if a community has mapped areas with coastal hazards, and it is regulating areas outside the SFHA and/or its regulatory flood elevation is higher than that shown on the FIRM, everyone must still use the data from the FIRM for the purpose of filling out the elevation certificate.

320 Map Information

Many communities provide inquirers with flood information from their Flood Insurance Study, FIRM, and other sources. This is an excellent opportunity to explain the information on the maps (including LiMWAs (limit of moderate wave action), if you have them), local conditions, and regulations, including coastal erosion hazards and erosion management requirements. (Sharing this information is mandatory if the community receives credit for mapping and regulating its coastal erosion hazards.) When relevant, communities should also explain that FIRMs DO NOT INCLUDE consideration of chronic (long-term) erosion.

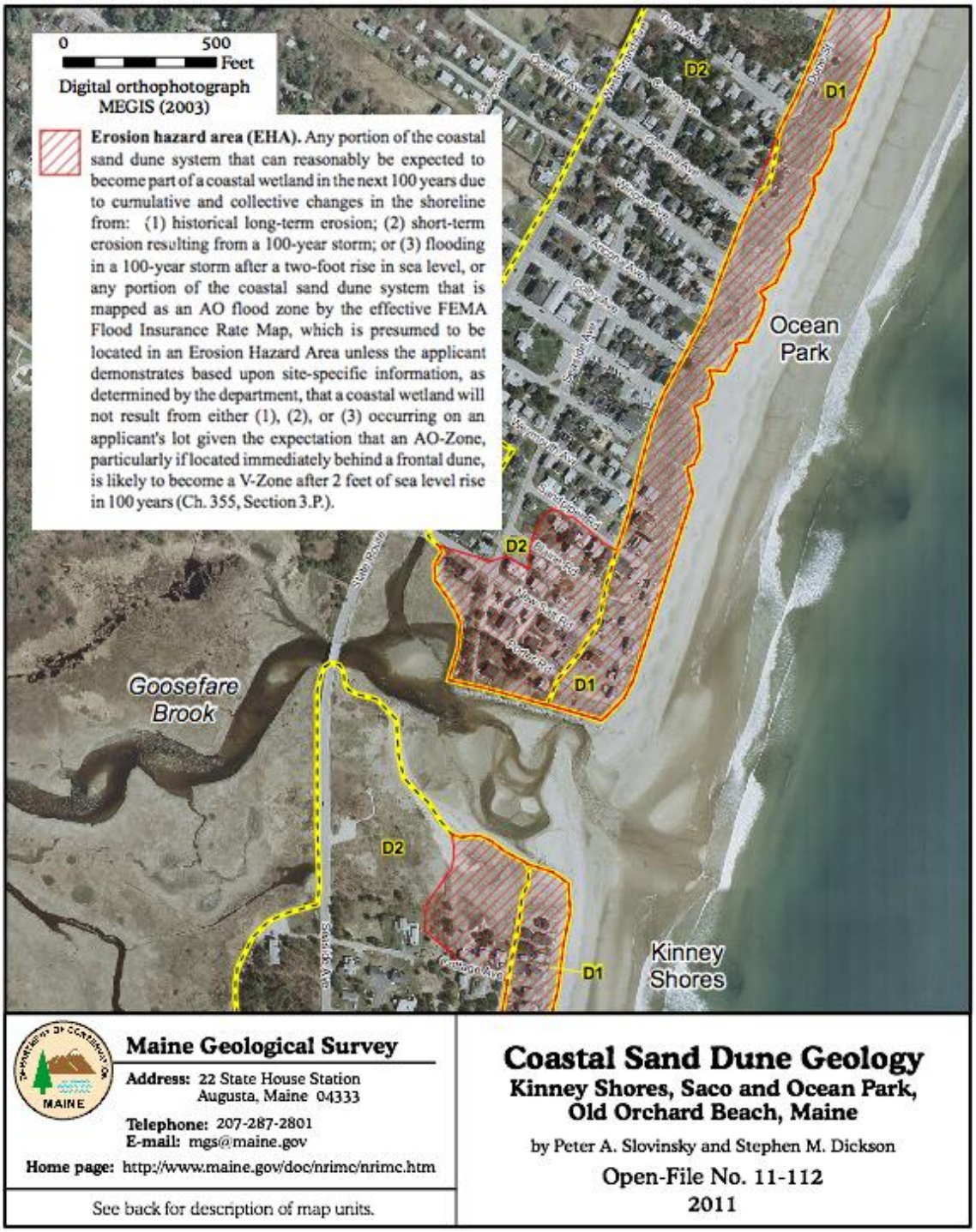
Sharing this type of hazard information provides inquirers with a more complete picture of their risks and the importance of regulations as property protection measures. Notifying people that they are in flood and coastal erosion hazard areas can also motivate them to purchase flood insurance and/or undertake property protection measures.

Providing hazard information provides many benefits to residents; businesses; real estate and insurance agents; lenders; and those interested in purchasing, developing, or repairing property. CRS credit is provided for advertising this service and for providing information as described in the *Coordinator's Manual* under Activity 320, with bonus credit for providing information on special hazards (including coastal erosion) under element MI5 (see Section 322.e).

330 Outreach Projects

This activity provides credit for newsletters, mailings, presentations, booths, brochures, and a host of other means of getting the word out to the public or to target audiences, such as builders or school children. Credit for some of the elements is based on covering topics such as "flood hazard," "flood hazard map," "flood safety," and "property protection." These topics should include information on the coastal erosion hazards, in addition to the flood hazard mapped on the FIRM.

One of the elements in Activity 330 provides up to 100 points for developing and implementing a program for public information, or PPI. The community identifies its most important public information needs and identifies the best way to meet those needs. One of the additional designated PPI topics could focus on coastal erosion, if the strategy team determines that that is as important, or even more important, than "normal" flooding. Note that a PPI bonus (see Section 332.c in the *Coordinator's Manual*) may also apply to outreach projects credited under other activities (e.g., Activity 350).



As part of Maine's Coastal Sand Dune Rules, the state maps erosion-prone areas along its sandy beaches. The red-hatched area is expected to become part of a wetland over the next 100 years (Slovinsky and Dickson, 2011).

340 Flood Hazard Disclosure

The CRS provides credit when real estate agents disclose information about a property's flood hazard to prospective buyers. These provisions are based on the rationale that flood hazard information about a particular building or property is relevant to an informed purchase or development. More credit is provided if the disclosure includes other hazards, such as coastal erosion hazards.

State or local mandates that sellers, landlords, or developers disclose these hazards can receive credit if they ensure that those involved in the real estate transaction receive the necessary information in a timely and understandable manner.

Some credit is also available if real estate agents don't actually disclose a property's hazards, but do provide a handout advising potential property buyers about what to look for and what questions to ask.

350 Flood Protection Information

Under Activity 350, communities receive credit for putting flood protection information in their public libraries and on their websites. These materials should cover all known flood-related hazards, including coastal erosion hazards and property protection measures. Points earned here are eligible for the PPI bonus mentioned above.

The community or the librarian should also review the references at the end of this supplement to identify additional documents that would be helpful locally. Some of the websites mentioned in this supplement could also be good links for the community's website coverage of its coastal erosion hazards and ways people can protect themselves and their property.

South Carolina's notification requirement for ocean-related hazard and flooding is established in the state's Coastal Tidelands and Wetlands Act. If a beachfront property is located seaward of the legislated setback line, a contract of sale or transfer of real property must contain a disclosure statement that includes the local erosion rate.

360 Flood Protection Assistance

Floodplain residents are more likely to undertake activities to reduce flood and coastal erosion hazards to their property if reliable assistance is available locally. The CRS provides credit if a local government provides technical advice to interested property owners and publicizes the availability of the service.

370 Flood Insurance Promotion

Floodplain residents are more likely to purchase insurance to cover their potential property losses from coastal erosion if they are aware that it is available and know that reliable information on cost and availability is provided locally. The CRS provides credit for a local government that has a plan for promoting flood insurance, provides technical advice to interested property owners, and implements the plan.

A community that is receiving credit for Activity 370 should have a section of its program addressing coastal erosion.

400 Mapping and Regulatory Activities

FEMA and many communities in the United States have long recognized that the national mapping and/or minimum regulatory standards of the NFIP do not adequately address the problems of coastal erosion. For example, as noted above, FIRMs DO NOT consider long-term erosion trends. Since coastal erosion has the potential to result in extraordinary flood damage, it is important that communities address erosion in ways that go beyond the minimum NFIP standards.

In order for a community to protect new development in areas subject to coastal erosion, it must have maps that adequately define the hazardous areas and ordinance language that deals with the specific hazards of coastal erosion in those areas.

Mapping Coastal Erosion Hazards

Several states and local governments have established shoreline mapping programs to provide a technical basis for permit review and to establish long-term erosion rates to use in conjunction with building setback regulations. These shoreline monitoring programs also serve as a basis for development decisions and assessing the need for beach restoration, nourishment, revegetation, and other beach erosion control projects.

To prepare beach profiles, some agencies use field surveys with the data tied to the same control points from one survey to the next. Light detection and ranging (LiDAR) and other remote sensing technology can be used to conduct hydrographic and topographic surveys over large areas more efficiently than with traditional survey methods.

The identification and mapping of vulnerable areas serves as a necessary guide for managing development. Many states have established their own shoreline mapping programs. For example, Hawaii's coastal erosion maps can be viewed at http://www.soest.hawaii.edu/coasts/erosion/index.php.

410MCE Additional Flood Data for Coastal Erosion Areas

Up to 50 credit points for mapping coastal erosion (MCE) hazard areas or erosion rate analyses for management purposes is provided under this activity. Credit for the regulation of new development in mapped coastal erosion areas is provided in Section 430CE. Areas for which coastal erosion hazards mapping and regulation credit is requested may extend outside of the SFHA.

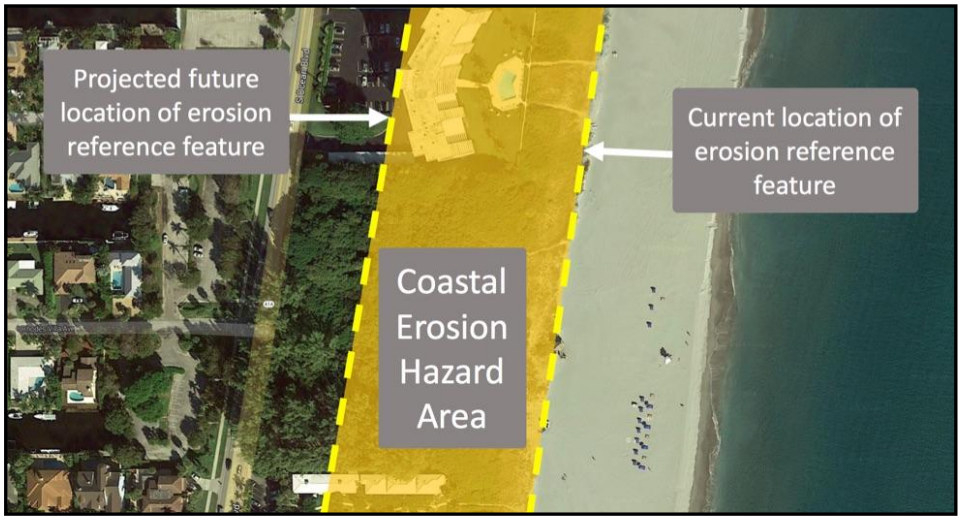
Credit Criteria for MCE

(1) The area mapped must be subject to regulations designed to minimize future exposure to erosion damage. The community must receive at least 20 points (after the impact adjustment) for regulations that are credited under Section 430CER.

The "coastal erosion hazard area" must be identified. The coastal erosion hazard area is the area between the current location of the community's erosion reference feature and the projected location of that erosion reference feature 30 to 150 years into the future. Erosion reference features are generally set by states' coastal management programs, and commonly

include first lines of vegetation, crests or toes of dunes, edges of bluffs, or mean high water lines. See the example below.

(2) The coastal erosion hazard area must be identified based on mapping or erosion rates that meet FEMA's minimum mapping standards. In the absence of FEMA standards, the mapping must be consistent with state coastal mapping standards.



Credit Points for MCE

Mapping coastal erosion hazards (MCE) (Maximum credit: 50 points)

1. 50 points, for mapping the annual erosion rates of the community's shoreline subject to erosion
2. 25 points, if the community requires a site-specific erosion rate analysis to be done at the time of application for development permits within 600 feet of a shoreline that is subject to erosion
3. 25 points, if the community adopts a regulatory map delineating the areas expected to be affected by erosion over the next 30–100 years but without showing specific erosion rates

As of the publication date of this supplement, there were no official FEMA mapping standards for coastal erosion. Therefore, communities may use maps or rates prepared by the state. If there are no state erosion maps or rates, the community may use those prepared by the U.S. Army Corps of Engineers, the U.S. Geological Survey, other federal agency, a university, or a research institute, or it may develop its own maps or rates. If there are no state or federal maps or rates, the community must document that the maps or rates it uses are consistent with state standards.

Credit Calculation for MCE

c410MCE = MCE

Documentation for MCE Provided by the Community

(1) At each verification visit,

(a) A map that shows the coastal erosion hazard areas or erosion rates along the ocean or lake shoreline of the community. If only a small area of the community is mapped for coastal erosion, only those areas need be shown on the map; however, the length of the entire shoreline must be identified on the map.

(b) A description of the method used for mapping coastal erosion hazards.

(c) Credit for 410MCE is provided only if the mapping is used for land use regulation to prevent damage from coastal erosion hazards. The documentation required for Section 430CER will meet this requirement.

(d) If credit for mapping on a case-by-case approach is requested, a description of the local government's enforcement procedures.

420CEOS Open Space Preservation

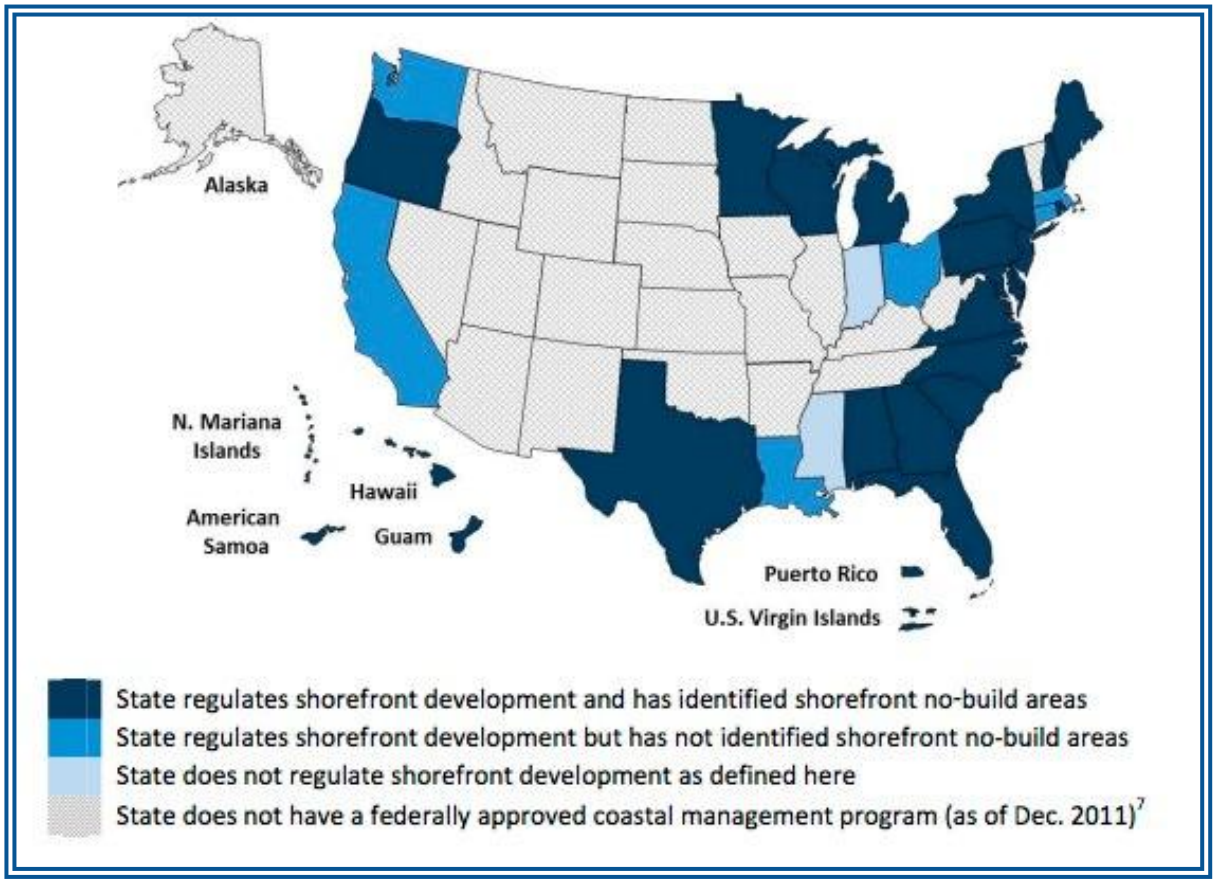
NOTE: *This section is a supplement to Activity 420 (Open Space Preservation) in the* Coordinator's Manual. *Much of the discussion in this section relies on Activity 420. Please read that section before proceeding.*

It is generally accepted that the best use of hazardous coastal areas is to keep them open and free from development altogether. In addition to avoiding harm to property, preserving these hazard areas has public uses and recreation benefits. Protecting the area from development assures the protection of sensitive natural environments and access to areas of natural resources.

Sand dunes are home to many plants and animals. These plants and animals live in a harsh environment of salt spray, shifting and infertile sand, bright sunlight, and storms. Some of the animals that depend on sand dunes include burrow-dwelling beach mice, coach-whip snakes, ghost crabs, nesting sea turtles, least terns, piping and snowy plovers, ground doves, and migrating monarch butterflies.

There are several ways to preserve areas as open space. Although they do not produce all the benefits that public ownership does, regulatory approaches, such as setbacks, can significantly reduce risk from coastal erosion.

Over three-quarters of coastal states employ setbacks or some other type of no-build area along some portion of their shorelines. The associated laws and regulations vary considerably from state to state. For example, the geographic extent of shorefront no-build areas ranges from "beach only" to "beach and natural features," such as dunes and bluffs, to "beach and natural features plus areas beyond" (National Oceanic and Atmospheric Administration, 2012, p. 5).



Most, but not all, states have established some sort of "no-build areas" along their coasts (National Oceanic and Atmospheric Administration, 2012, p.5).

Local governments can acquire full or partial interest in the land, commonly referred to as "fee simple" or "less-than-fee-simple" ownership. Fee simple ownership includes the full bundle of rights and is used in situations where full public use of the property is needed, such as for recreation or public buildings. When full use of the property is not needed, such as limiting development in coastal erosion hazard areas, then local governments may opt to obtain cheaper less-than-fee simple interest.

An easement is an example of a less-than-fee simple interest in the land. An affirmative easement is a right to use land, such as when the community purchases an easement for hiking trails or beach access. A negative easement prevents the primary owner from using the land in certain ways, such as when the community purchases a scenic easement to prevent the owner from doing anything that would impair the aesthetic attractiveness of the land. Easements are particularly useful when regulations alone will not meet a community's goals and fee simple acquisition is not necessary, desirable, or cost-effective.

A local government may also obtain full or partial title to land by a bargain sale, dedication, or donation. A bargain sale is part sale and part donation, where the local government obtains title for less than the fair market value. This works when the property owner is willing to sell land to the local government for less than the market value, in exchange for federal and state income tax deductions equal to the difference between the market value and the sales price.

A fee simple donation may also be used to obtain property rights. Local governments usually receive donations when the property owner wants to maintain the land in a certain way or wishes to obtain tax benefits.

Up to 750 points are provided for the preservation of coastal erosion open space (CEOS) within a community's mapped coastal erosion hazard area. Qualifying areas may be publicly owned or privately owned and regulated such that they meet the standards set in Section 422.a of the *Coordinator's Manual*. Designated open space may include areas protected by coastal construction setbacks. Note that creditable setbacks must prohibit all buildings, fill, or other encroachments on flood flows. Regulations merely requiring permits for construction in certain areas are not sufficient for CEOS credit. This credit is in addition to the credit provided for open space (OSP) under Activity 420.

Dune and beach areas preserved in their natural undeveloped state may also qualify for natural functions open space (NFOS) and natural shoreline protection (NSP) credit under Activity 420 (see Sections 420.c and 420.g in the *Coordinator's Manual*).

Credit Criteria for CEOS

For CEOS credit,

(1) The area must meet the credit criteria for open space preservation under Activity 420.

(2) The community must earn at least 25 points for its mapping of coastal erosion under Section 410MCE.

(3) The community must receive at least 10 points for keeping maps updated under Section 440EDM.

(4) The community must receive at least 20 points for its regulations under Section 430CER.

Credit Points for CEOS

Coastal erosion open space (CEOS) (Maximum credit = 750 points)
CEOS = Up to 750 points, based on the amount of the coastal erosion hazard area that is preserved as open space and the range and factors taken into consideration in projecting the future coastal erosion hazard area

Impact Adjustment for CEOS

CEOS credit is adjusted based on the ratio of preserved open space in the community's coastal erosion hazard area (see definition in Section 410MCE (1)b, credit criteria) to the total area of the community's coastal erosion hazard area, the time range of the community's projections, and the degree to which the projections consider future sea levels.

As with other regulatory elements, areas for which open space credit (Activity 420) is requested must be excluded from the area credited for the special regulations.

Section 403 of the *Coordinator's Manual* has additional information on impact adjustments for areas. The areas qualifying for CEOS need to be marked on the OSP impact adjustment map.

$$CEOS = \left(\frac{aCEOS}{aCE}\right) \times \frac{year\ (projected) - year\ (current)}{100} \times CFSL \times 500,$$

where

aCEOS = the size of the area(s) that qualifies for CEOS,

aCE = the size of the community's coastal erosion hazard area,

year (projected) = the year to which the location of the erosion reference feature is projected, and

year (current) = the year credit is requested or verified

CFSL = consideration of future sea level multiplier. The multiplier is as follows:

1.1, for using at least the NOAA or Corps of Engineers "low" projection,

1.2, for using at least the NOAA or Corps of Engineers "intermediate" projection,

1.5, for using at least the NOAA or Corps of Engineers "high" projection.

These projections may be found on the Corps of Engineers' Climate Change Adaptation page at http://www.corpsclimate.us/ccaceslcurves.cfm.

Documentation for CEOS Provided by the Community

(1) At each verification visit,

(a) A map identifying the coastal erosion hazard areas to receive CEOS credit, and the sizes of each.

(b) A brief description of how the coastal erosion hazard area was determined.

(c) Documentation that shows that the area meets the preservation requirements for Activity 420 (Open Space Preservation) in the *Coordinator's Manual*.

(d) Documentation showing the community received at least 25 points under Section 410MCE, 20 points under Section 430CER, and 10 points under Section 440EDM.

430CER Higher Regulatory Standards

NOTE: *This section is a supplement to Activity 430 (Higher Regulatory Standards) in the CRS* Coordinator's Manual. *Much of the discussion in this section relies on Activity 430. Please read that section before proceeding.*

Local governments have used a variety of ordinances to reduce the risk of damage from hurricanes, coastal erosion, tsunamis, and other hazards. Such ordinances include shoreline setbacks; zoning to regulate the use of land and density of development; subdivision regulations to guide the placement of buildings and facilities within a development; and environmental protection ordinances to preserve frontal dunes, wetlands, and other landforms that provide the community with a degree of natural protection. Credit is provided for regulating coastal erosion hazard areas in a manner that recognizes those elements of the hazard not addressed by the NFIP minimum standards for floodplain management.

Credit is provided for regulatory standards that mitigate the effects of erosion within those coastal erosion hazard areas. Up to 370 credit points are provided for coastal erosion regulations (CER) and dune and beach regulations (DBR) that prohibit new building within mapped erosion, dune, and beach areas. Credit is based on the erosion protection level, in years. This is in addition to credit provided for other regulatory standards under Activity 430 in the *Coordinator's Manual* (see, in particular, Section 432.k).

Setback Regulations

Coastal construction standards of the NFIP have emphasized the elevation of structures rather than horizontal displacement of them. The NFIP only requires horizontal displacement in V Zones to the extent that buildings must be "located landward of the reach of mean high tide" and must not alter frontal dunes or mangrove stands (44 *CFR* §60.3(e)). These requirements do not apply in coastal A Zones, despite the possibility that such areas may be experiencing erosion.

Setbacks based on maximizing the distance between the shoreline and the oceanfront side of a structure can be extremely effective in delaying damage from erosion. To minimize damage, the safest approach available in eroding areas is to site the structures in a way that will avoid long-term erosion risks over the anticipated life of the structure.

Some states use a calculated "average annual erosion rate" to establish the minimum setback for new construction. Recognizing that larger structures usually pose a greater economic risk and are more difficult to move, these calculations may include consideration of the size of the proposed building, with larger buildings required to be set back farther than smaller ones. North Carolina, for example, requires a minimum setback of 60 feet or 30 times the annual shoreline erosion rate (whichever is greater) for buildings of less than 5,000 square feet, but 180 feet or 90 times the shoreline erosion rate for structures larger than 100,000 square feet.

Credit Criteria for CER

(1) The regulations must be based on coastal erosion mapping developed in accordance with the criteria of Section 410MCE, and

(2) At a minimum, the regulations must prohibit all parts of all new buildings—including attached porches and similar structures—in the 30-year erosion-prone area. Setback calculations must NOT incorporate beach nourishment projects.

Credit Points for CER

Coastal erosion regulations (CER) (Maximum credit: 370 points)

(1) CER = the total of the following points:

(a) The erosion protection level, in years, where new buildings are prohibited. CER has a range of from 30 to 100. The minimum value for CER is 30, i.e., the regulations meet the prerequisites listed above. The maximum value for CER is 100, i.e., the regulations prohibit all new buildings in at least the 100-year erosion-prone area.

(b) 0.5 x the number of years of erosion protection required by the setback regulations for structures that are substantially improved

(c) 0.5 x the number of years of erosion protection required by the setback regulations for structures that are substantially damaged

(d) 20 points, if large buildings are required to meet a 60-year setback standard

(e) 1 x the number of feet that the community adds as a buffer beyond the calculated erosion setback. If a community requires a 20-foot buffer landward of the 30-year setback, credit would be 20 points.

(f) 75 points, if erosion-threatened structures must be removed within two years of such designation by the state or local government. The regulation must: (a) require the structure to be moved within two years of receiving the erosion-threatened designation; (b) identify erosion-threatened structures as those where any portion of the foundation sits within a zone of imminent collapse measured from a reference feature such as the first line of natural vegetation, or the normal high tide; and (c) define the landward boundary of the zone as being measured from the reference feature a distance of at least five times the average annual long- term erosion rate for the site, plus 10 feet.

Credit will only be awarded where a state or local government can show that the regulation has been upheld in court.

(g) 100 points, if hardened structures, such as seawalls, revetments, and large sandbags are prohibited along the erodible shoreline.

(h) 25 points, if all new structures must be set back at least 60 feet for the entire shoreline, including areas with accretion.

To receive credit for CER, the regulations must prohibit all new buildings from the area expected to erode over the next 30 years. If that is the only coastal erosion regulation enforced in the community, then CER = 30. Credit is provided for either local or state erosion management regulations as long as they are enforced within the community.

Additional credit is provided where regulations require substantially improved and/or substantially damaged structures to be set back at least 30 times the average annual erosion rate at the building site. The amount of credit is based on the number of years of erosion protection identified in the setback regulation. Credit is calculated by multiplying the number of years of protection by 0.5.

There is additional credit if a community requires all new and substantially improved large buildings (i.e., over 5,000 square feet) to be set back beyond the 60-year erosion protection line.

Communities that require the removal of erosion-threatened structures from the shoreline may receive 75 points. This regulation must specify how erosion-threatened structures will be designated and that upon such designation the property owner must move or demolish the structure within two years. Structures with any portion of the foundation in a zone of imminent collapse are considered to be erosion-threatened structures. The zone of imminent collapse extends landward from a reference feature identified in the regulation, usually the first line of natural vegetation, line of escarpment, or normal high tide line. At a minimum, the landward boundary of the zone must extend from the reference feature a distance of five times the average annual long-term erosion rate for the site plus 10 feet. For example, if the erosion rate is 2 feet per year, the building must be moved if it is located closer to the reference feature than 20 feet [(5 x 2 feet) + 10 feet = 20 feet]. Credit will be awarded only if a state or local government can show that the regulation has been upheld in court.

Permanent shoreline stabilization projects, such as groins, jetties, bulkheads, seawalls, revetments, and large sandbags, may cause the loss of the public beach by increasing erosion of the seaward beach. They may also increase erosion at adjacent properties by interrupting natural sand migration patterns. Communities that prohibit these types of hardened structures receive 100 points for CER.

Dune beach regulations (DBR) (Maximum credit: 30 points)

(2) DBR = the total of the following:

(a) 20 points, for regulations that prohibit vehicular and pedestrian traffic on sand dunes except on appropriate access structures
(b) 10 points, for regulations that prohibit development seaward (or lakeward) of existing buildings on waterfront properties. This includes new buildings,

additions, swimming pools, pavilions, septic tanks, bulkheads, seawalls, and similar structures that can become debris in a storm and damage buildings.

Sand dunes are important in providing protection to buildings along the coast. They act as natural barriers to dissipate waves and protect back-lying areas from flooding and erosion. Pedestrian access between a coastal building and the shoreline is often overlooked when siting decisions and plans are made. Experience shows, however, that uncontrolled pedestrian access can damage coastal vegetation and landforms, providing weak points upon which storm forces act. Dune blowouts and breaches during storms often result, and buildings landward of the weak points can be subject to increased flood, wave, erosion, or overwash effects.

Impact Adjustment for CER

Regulatory credit is adjusted based on the percentage of the shoreline mapped and regulated for the erosion hazard.

Option 1

If development along the entire shoreline is regulated for coastal erosion protection, rCER = 1.0.

If a community has designated and regulates all of its shoreline as an erosion hazard area, it should use Option 1, where rCER = 1.0. In accordance with the impact adjustment map instructions in Section 403 of the *Coordinator's Manual*, when determining the area subject to local coastal erosion regulations, the local government omits areas owned by the state and federal governments or areas in which development is prohibited by the federal government. Note that coastal wetlands are NOT excluded from these calculations unless the state or community has regulations explicitly prohibiting development in these areas. Federal regulations are not sufficient.

Option 2

If development along only a portion of the shoreline is regulated as an erosion hazard, a default value of 0.25 may be used for the impact adjustment ratio (rCER = 0.25).

If Option 2 is used, credit for more than one special hazard will be granted only if the hazards cover different geographic areas.

If the standard is enforced in only some of the community's shoreline, the community must use either Option 2 (the default value) or Option 3. The community may use Option 2 if it results in more points than Options 1 or 3. For example, if more than 75% of the regulatory floodplain is preserved as open space, rCEOS > 0.75 and Option 2 would provide more credit than Option 1.

Option 3

rCER: The size of the area subject to coastal erosion regulations must be determined in order for the credit points to reflect the impact of the regulations. This impact adjustment is the ratio of the shoreline regulated for coastal erosion protection to the length of the entire shoreline.

$$rCER = \frac{\text{Length of shoreline subject to erosion regulation}}{\text{Length of the community's entire shoreline}}$$

If Option 3 is used, each standard for which regulatory credit is requested must be appropriately designated on the impact adjustment map. The area affected by the regulatory standard must exclude areas designated as open space that are receiving OS credit under Activity 420 (Open Space Preservation).

In many communities, these regulatory standards will be applicable throughout the community's coastal erosion area, so a note on the map key will be adequate.

Credit Calculation for CER

$$cCER = (CER \times rCER) + DBR$$

Documentation for CER Provided by the Community

(1) At each verification visit,

(a) Application for credit for Section 410MCE for the coastal erosion hazard.

(b) The state or local law or ordinance language that adopts the regulatory standard. The appropriate acronym (CER or DBR) must be marked in the margin of the sections of the ordinance that apply to this activity.

(c) An explanation of the procedures followed for enforcement of the regulatory standard.

(d) An impact adjustment map showing the erosion rates or areas and the regulations applicable to the shoreline.

(e) Development plans and/or permit records that document how the regulation has been applied. This will vary from state to state. The ISO/CRS Technical Reviewer can clarify precisely what is needed for each state.

A photocopy of the appropriate pages of the ordinance is sufficient and should be attached to the activity worksheet. The Chief Executive Officer's (CEO's) application certification is considered to include a certification that the ordinance or statute has been enacted into law and is being enforced (see Section 212.a in the *Coordinator's Manual*).

If the regulations are enforced throughout the area mapped and credited under Section 410MCE, the map for Section 410MCE can be used as the impact adjustment map.

440EDM Coastal Erosion Data Maintenance

Credit is provided for making the community's floodplain maps more current, useful, or accurate in order to improve local regulations, planning, disclosures, mitigation, and property appraisals.

CRS credit (12 points) is provided for including coastal erosion-related hazard areas in a geographic information system (GIS), in a digitized parcel system, or on an overlay map. This is found in Section 442, AMD3 of the *Coordinator's Manual.*

Credit Criteria for EDM

(1) The community must update the erosion data on at least a five-year cycle.

(2) The community must receive credit for regulating development in erosion-prone areas under Section 430CER.

Credit Points for EDM

Erosion data maintenance (EDM) (Maximum credit: 20 points)

EDM = 20, if a state or local agency maintains reference marks spaced no more than ½ mile apart and records shoreline erosion in relation to those reference marks at least every five years, OR

EDM = 10, if a state or local agency takes new aerial photographs at least every five years to update its shoreline erosion rates.

This credit is for updating erosion data on at least a five-year cycle and adopting the new rates or maps as part of the community's erosion setback and coastal management regulations.

Impact Adjustment for EDM

All of the shoreline must be included in the erosion study; therefore, there is no impact adjustment for this element.

Documentation for EDM Provided by the Community

(1) At each verification visit,

(a) A description of the method used to update mapped erosion rates or regulatory maps.

(b) A certification that the rates or maps are updated and adopted on at least a five-year cycle.

500 Flood Damage Reduction Activities

Coastlines have always been a favored location for human settlements. Unfortunately, erosion risks are often given only a second thought when beachfront property is developed, and coastal communities have continued to construct new housing, maritime facilities, and resort developments in erosion-prone areas. As a result, the destructive force of coastal erosion threatens more people and structures every year.

510 Floodplain Management Planning

Communities are encouraged to prepare and adopt coastal management plans that guide land use development, redevelopment, post-disaster recovery, and mitigation decisions. Credit for preparing, adopting, implementing, evaluating, and updating such a plan could be credited under Activity 510 (Floodplain Management Planning).

Section 512.a, Step 4 (b)(1)d of the *Coordinator's Manual* provides specific extra points for identifying any coastal A Zones while assessing a community's hazards. Related credit is provided elsewhere in Section 512.a, Steps 4 and 5, for flood hazard assessment and problem analysis that address areas likely to flood and flood problems that are likely to get worse in the future, including those arising from climate change or sea level rise.

520 Acquisition and Relocation

Acquisition and relocation may be the most cost-effective way of solving the problem of threatened structures in coastal erosion areas. Recognizing this, the CRS offers a 50% credit bonus for buildings that are removed from these areas.

Buildings threatened by imminent collapse from coastal erosion lose most of their economic value. They have substantially lower tax value and pose a potential public safety hazard if they are destroyed during a storm or abandoned. Relocation, therefore, may be a desirable public goal because the community can thereby avoid the loss of tax revenue and the public cost of clearing the wreckage of abandoned buildings. Relocation is a common practice in some states, including North Carolina and Maine, both of which discourage or prohibit further hardening of their shorelines.

Building being relocated from the erosion hazard area after Hurricane Fran, Figure Eight Island, North Carolina (photo from Berry Williams).

Relocation of existing structures from eroding shorelines can also be an effective method for protecting the private investment in a threatened structure. Structures on deep lots may gain significant protection by being moved landward on the same lot. If sufficient space is not available on the existing lot, an alternate site must be acquired and prepared, substantially increasing the cost of relocation.

The technical feasibility of moving both small and large structures has been demonstrated on several occasions. Relocating readily movable one- and two-story residential buildings has proven particularly cost-effective.

530 Flood Protection

Elevating Buildings

Elevating buildings that are flood prone has proven to be a cost-effective method of property protection. Local governments that consider the future condition of their eroding beaches and dunes may decide to assist property owners who elevate buildings that were built below the base flood elevation. However, as a growing number of communities have learned, people must keep in mind that elevation does not directly address beach erosion, and elevated structures may eventually end up above storm waters but inaccessible if the beach erodes away beneath them and they're left standing in the sea. Activity 530 in the *Coordinator's Manual* provides credit for buildings that are elevated. There is additional credit for elevating structures due to increased flood potential that results from coastal erosion.

Structural Flood Control

The CRS does not provide credit for structural flood control projects that can result in a revision to the community's FIRM, since the benefits of the project are provided in the reduced flood elevations or in properties' being removed from the SFHA. Nor does the CRS provide credit for coastal structural projects that may be installed to affect erosion rates, including seawalls, groins, and beach nourishment.

540EPM Coastal Erosion Protection System Maintenance

This element credits programs that maintain measures that protect buildings from coastal flooding or erosion. These measures may include dune or mangrove preservation, bluff stabilization, and beach nourishment programs. The community must submit a description of the program and identify where it is in effect on a map.

Credit for this element is dependent on the community's having coastal erosion setback regulations. This is provided under Section 430CER. If CER = 0, then EPM = 0.

Up to 100 credit points are provided for coastal erosion protection maintenance (EPM). This credit is to encourage maintenance of erosion protection programs, such as beach nourishment and sand dune restoration. CRS credit is only provided where the projects are not reflected on a FIRM or other map of erosion-prone areas.

Credit Criteria for EPM

(1) The maintenance program must have been designed by a professional expert to ensure that it will be effective and for the purpose of erosion management.

(2) The community must provide documentation of the level of protection provided by the project. This information should be in the design specifications for the project.

(3) The erosion protection program must be an ongoing program with a multi-year implementation plan. The program must have been in effect for at least two years before credit is provided.

(4) The community must receive CER credit for regulating development in erosion-prone areas under Section 430CER.

(5) The community must not use hardened structures, such as seawalls, groins, or large sandbags more than 5 feet wide and 15 feet long when measured flat.

(6) The program must be based on adding more sand to the area. Pushing sand or grading the beach is not adequate for credit.

(7) Environmental compliance (from page 540-5 of the *Coordinator's Manual*).

Credit Points for EPM

Coastal erosion protection system maintenance (EPM)
(Maximum credit: 100 points)

1. EPM= 20, if the maintenance program is for a project providing protection from a storm with a 10-year return frequency

2. EPM= 50, if the maintenance program is for a project providing protection from a storm with a 25-year return frequency

3. EPM= 100, if the maintenance program is for a project providing protection from a storm with a 50-year return frequency

This credit is for ongoing maintenance performed by a public, quasi-public, or non-profit agency, such as a property owners association. It is NOT for

- Regulations that require individuals to maintain a program on their own properties,
- Maintenance of hard structural projects, or
- Implementation of one-time-only projects, such as a beach-bulldozing project.

Impact Adjustment for EPM

Option 1: If the maintained erosion protection measures cover the entire shoreline of the erosion-prone area, rEPM = 1.0

Option 2: If part of the erosion-prone shoreline is protected by one of the maintained programs, the community may use the default value for the impact adjustment ratio, rEPM = 0.20

Option 3: The impact adjustment for maintaining erosion protection programs is the total length of the shoreline protected by those programs divided by the total length of the shoreline in the erosion-prone area. Because these protection programs are linear features, area is not used as the basis for measurement.

$$rEPM = \frac{\text{Length of shoreline protected by the maintenance program}}{\text{Length of shoreline in the erosion-prone area}}$$

Option 3 produces the most accurate impact adjustment figures and, in many cases, the results will be higher than those derived by using Option 2. However, it does require measuring the length of the shoreline affected.

Credit Calculation for EPM

$$cEPM = EPM \times rEPM$$

Documentation for EPM Provided by the Community

(1) The community must submit the following documentation with its application:

(a) A description of the erosion protection maintenance program. The description must show that the program was designed by a professional expert for the purposes of erosion management, and that all permits were obtained.

(b) Documentation that shows how the community calculated the length of shoreline affected by the erosion protection program.

(c) A description of the protection project components and documentation on the level of protection provided by the maintenance project.

(d) A copy of the multi-year maintenance plan.

(e) Completed Certifications of Compliance with Environmental and Historic Preservation Requirements for Drainage System Maintenance (CC-540EHP) from the community and other local, regional, or state agencies. The forms can be found in Appendix F of the *Coordinator's Manual* or downloaded from www.CRSresources.org.

One of the keys for crediting a maintenance program is that a professional expert must have designed it to ensure that it will be effective. Some communities have implemented projects on their beaches or dunes without careful design.

The community must provide documentation of the level of protection provided by the project. This information should be in the design specifications for the project.

Because credit for coastal erosion regulations is a prerequisite for this credit, the community must have a map of the erosion-prone area. That map should be sufficient to show the shoreline subject to erosion and the portion that is covered by the program.

600 Warning and Response

When erosion moves the shoreline inland, water moves closer to nearby houses, businesses, and public facilities. As coastlines are shifted inland, flood elevations for the same magnitude storm will be higher farther inland. These changes can have a significant impact on a community's warning and response efforts. As homes, businesses, and public facilities become more vulnerable they may need earlier warning to take emergency protective measures or to evacuate. Public facilities may need to be closed and may not be able to perform their emergency functions during and after the coastal storm, and primary roads may become flooded and need to be abandoned as evacuation routes.

Changing shoreline conditions and the potential for increased vulnerability of life and safety must be considered and should be incorporated into emergency preparedness plans. Such advanced planning gives the community time to examine storm hazards and formulate workable and effective means of mitigating them. Emergency preparedness planning should be a key component of this process.

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NOTE: *See www.CRSresources.org for additional sources of information about coastal erosion.*

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