There are times when the desire to protect upland property conflicts with the ecosystem services provided by natural landforms. The key to responsible erosion control is to increase the resilience of the property while not negatively affecting the coastal resource areas.

The
Spectrum
of Erosion Control

Lowest potential negative impacts are at the top of the spectrum, with highest potential negative impacts at the bottom.

How To Use This Spectrum

Under the Massachusetts Wetlands Protection Act (GL Ch 131, s.40) a Notice of Intent (NOI) must be filed for any activity in a natural resource area subject to protection (e.g., coastal banks, dunes, beaches, etc.). A NOI for shoreline stabilization should demonstrate that no other feasible method exists for protecting the building that would be less damaging to resource areas. (Note that it is the building that may be protected—not the lawn, pool, patio, etc.)

At a minimum, an alternatives analysis looks at the difference between doing nothing and the proposed action. The alternatives analysis within an NOI can be greatly enhanced by considering the various options, including those found within the spectrum (see reverse). By starting at the top of the spectrum and addressing each method until a feasible alternative is reached, the applicant can show full diligence that all other options that have lower potential impact have been examined. A good alternatives analysis should discuss each method in terms of feasibility, environmental effect, and impact on adjacent and downdrift properties.

Things To Keep In Mind

This is not a complete list. There are more methods, and many variations of the methods found on the reverse of this brochure. Additionally, new methods are frequently being invented and/or modified. Additionally, some techniques may harden a soft method to the point of being considered a Coastal Engineering Structure (CES) (e.g., wire or plastic wrapped fiber rolls).

Very few projects employ only one method. When we are determining a project's effect on coastal resource areas (as well as if it is a CES) the "hardest" aspect of the project should be considered. The images below show vegetation (very low potential impact) combined with fiber rolls and fencing (higher potential impact), therefore the entire proposed project should likely be considered as the component with the highest potential impact. If the cover of sand and vegetation erodes during a storm then the fiber rolls will be interacting with the environment.

What is a Coastal Engineering Structure (CES)?

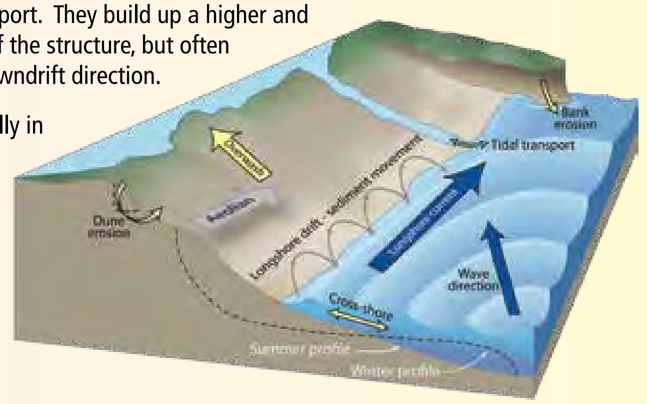
According to the Wetlands Protection Act, a CES "means, but is not limited to, any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, rip-rap or any other structure that is designed to alter wave, tidal or sediment transport processes in order to protect inland or upland structures from the effects of such processes." Some town bylaws may have a more stringent definition. Basically, if a shoreline structure alters a wave's ability to erode sediment (perpendicular to beach) or transport sediment (parallel to beach) it likely qualifies as a CES. Typically biodegradable materials and methods that work to enhance natural land form stability are not considered a CES. It is ultimately a local Conservation Commission or MA DEP that makes this determination.

CES's are never allowed on dunes as they can impede the important function of the resource and damage the beach as well as adjacent properties. For coastal banks (i.e. glacial deposit), a building constructed before August 10, 1978 may be considered "grandfathered," so if there is no other way to protect the building a CES may be permitted.

CES's affect shore parallel and/or perpendicular transport

CES's can be classified as affecting sediment transport in two ways. CES's affecting perpendicular transport (e.g., gabions, revetments, seawalls, etc.) are designed to slow the shoreline retreat by stopping a coastal bank from eroding. However by stopping this source of sediment beaches are often deprived of material. CES's affecting parallel transport (e.g., groins and jetties) are designed to slow longshore sediment transport. They build up a higher and wider beach on the updrift side of the structure, but often reduce sediment supply in the downdrift direction.

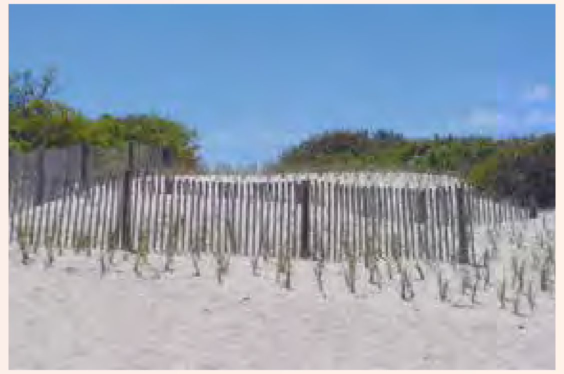
Beaches that are stable are actually in a state of dynamic equilibrium, which means there is as much sand entering the area as leaving the area. Erosion occurs when more sand is moving out of the area than is coming in.



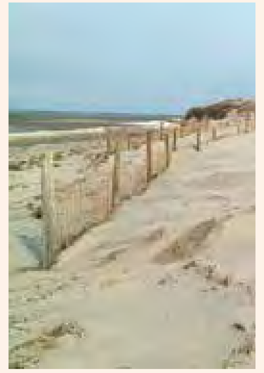
Types of Sand Fence

There are many different types of fencing used for erosion control. Slat fencing, installed with small posts, has 50% porosity which slows down the wind causing sand to accumulate near the fence. It does not survive long when exposed to waves but, if installed landward of the reach of high tide, has relatively low potential negative impacts. Drift Fencing is typically composed of 2x3s installed with 12" pilings. This type of fencing can withstand some waves, but cannot be installed seasonally like slat fencing and has a higher potential for reflecting wave energy. Some projects have used 12" pilings spaced 1" apart. The spacing (8% porosity) allows for some exchange of sediment and water, however not as much as the slat or drift (required 50% porosity) fence. There is also a much greater chance for enhanced beach erosion due to wave reflection in addition to altering the wave environment and sediment transport processes. As porosity is reduced the structure begins to look and act more like a bulkhead than a fence. For these reasons multiple state agencies have classified this type of piling configuration as a CES.

Native Vegetation & Fiber Rolls



Native Vegetation & Sand Fence



Slat Fencing

Drift Fencing

Pile Wall

Additional Information

Massachusetts Office of Coastal Zone Management, StormSmart Properties Fact Sheets Project:
http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-properties/

MassDEP:
http://www.mass.gov/eea/agencies/massdep/water/watersheds/wetlands-protection.html

Woods Hole Sea Grant
www.whoi.edu/seagrant

Cape Cod Cooperative Extension
www.capecodextension.org/marine-programs/coastal-processes-2/

Local Officials
Call the local town hall. Conservation departments are a good place to start.

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Dealing with Coastal Erosion

The Spectrum of Erosion Control Methods

Woods Hole Sea Grant

Cape Cod Cooperative Extension

Start at the top and work your way down until you can safely protect the building.

Note that more detail on most of these methods is available at:

www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-properties/


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May 2013

Coastal shorelines are dynamic; if the building is far enough away from the water then "**Do Nothing**" may be an option, which will allow natural processes to continue. Structural erosion control may only be permitted if the Conservation Commission finds it is required to protect a building. Rapid erosion due to storms can be followed by rapid beach recovery. The images to the left show an area that accumulated over 5' vertically of sand in less than 2 months.

Do Nothing

Managed Retreat

If there is room on the parcel, **retreating** from an eroding shoreline can significantly lengthen the usable lifespan of property. If flooding is more of a concern than erosion elevating the building in place (e.g., on pilings) can reduce flood damage.


Native vegetation

Native vegetation can take up water, break the impact of rain, waves, and wind as well as slow down runoff. Live roots stabilize sediment. Controlling foot-traffic and removing invasive species while restoring with native plants will serve to stabilize the landforms.



Remove invasive species

Vegetation

Beach Nourishment

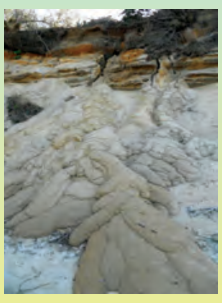
Beach nourishment can be accomplished by trucking from upland sources, or by dredging. This has the benefit of adding new material to the system instead of depriving downdrift beaches like most other methods. If combined with plantings beach nourishment can lead to dune creation. Nourishment sand, as opposed to dune creation, is typically considered "sacrificial" as it is placed to erode instead of what it's protecting. The placed material should be compatible with the beach.


Sand fencing slows wind, causing sand to drop out and accumulate. More details on the back of this brochure. Some materials are not suitable for the coast.

Sand Fencing

Regrade

If a slope is too steep it may prevent vegetation from stabilizing the landform. Stormwater runoff from above can rapidly destabilize the landform (left). **Regrading** a coastal bank landward to a more gentle slope, followed by extensive planting, can allow for faster stabilization.



Before


After (pre-planting)

Fiber rolls (aka bio logs, coir logs, etc.) are composed of biodegradable coconut (aka coir) fibers surrounded by twine netting. Planting native vegetation in and around the rolls can provide additional longer term stabilization. Fiber rolls should be covered with sediment, as sunlight and wind can cause rapid degradation. Proper height is also important as frequent inundation can also lead to failure. Secure anchoring is essential as if fiber rolls break free during a storm they may damage other properties, however use of other non-biodegradable components (e.g., filter fabric) should be avoided.

Fiber Roll

Coir Envelope

Coir Envelopes consist of coir fabric that is filled with appropriate sediment, then sewn closed. The coir should biodegrade over time (otherwise it would be considered a CES) and if the coir rips only sediment should be released onto the beach. While typically much larger than fiber rolls coir envelopes can also be planted with vegetation, and survive longer if covered. Use of non-biodegradable components (e.g., filter fabric) should be avoided.

Once an erosion control structure has enough impact on coastal resource areas it is classified as a **Coastal Engineering Structure (CES)**, with major implications for permitting. Depending on how some of the above methods are designed and installed (e.g., coir envelopes, fiber rolls, fencing) they can approach being classified as being a CES. Only certain properties are allowed to have a CES. See reverse side for details.

IS NOT A CES

IS A CES

Geotextile sand bags are very similar to coir envelopes except that instead of coir, a plastic geotextile is used to contain the sediment, which may end up as marine debris. The geotextile does not biodegrade and over time the structure can become very hard, reflecting wave energy on the beach. In addition to bags, long geotubes (can be >10' diameter and hundreds of feet long) are also used in this fashion.

Geotextile Sand bag/Geotube

Gabion

Gabions are wire mesh baskets filled with rocks. They have the benefit of allowing some dissipation of wave energy and if covered with sediment, vegetation may reduce some of the negative impacts associated with a CES. Coated wire last longer than bare, but are not intended for high wave energy. Regular maintenance is important as rusty metal and freed rocks may degrade the environment.

Breakwaters (not typical for a homeowner) are rock structures, built offshore and parallel to the shore, that reduce wave energy reaching the shoreline. Sills are similar to breakwaters however they are designed to be under water during portions of the tide. The reduction in wave energy can build the beach seaward towards the structure, however it may also slow or block the flow of sediment to downdrift coastal areas.

A **groin** (not typical for a homeowner) is designed to slow sediment transport thereby building a higher/wider beach on the updrift side. Eventually the sediment should overtop or go around the groin to allow longshore sediment transport. In many areas there is not enough sediment supply to the beach system to minimize adverse impacts from the groin. There is often erosion on the downdrift side of the groin where the beach is deprived of sediment.

Breakwater

Groin

Seawalls are cement structures that are typically vertical and therefore highly reflective of wave energy. The increased turbulence at the base of the seawall tends to erode the sediment, leading to a beach that narrows and lowers in height over time. (New seawalls are generally not permissible since they fail to minimize adverse effects).

Revetment

Seawall

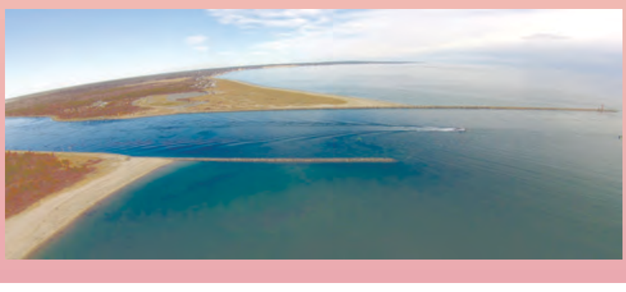
Revetments are comprised of large boulders that start at the bottom (aka toe) of a coastal bank and should only extend as far up the bank as needed to protect the building. Above that salt-tolerant vegetation can help control erosion. More gentle slopes and rough face tend to dissipate more wave energy. Without a proper return end scour can damage the bank.

Jetties stabilize navigation channels that connect bodies of water. A jetty is similar to a groin in that it affects longshore sediment transport, however while a groin is intended to allow sediment to pass a jetty is intended to completely stop sediment. As sediment can no longer naturally bypass the inlet, it will need to be manually bypassed or the updrift side will allow sediment to flow over and around the jetty and the downdrift side will experience severe erosion.

Bulkheads are vertical wooden (sometimes steel or vinyl) structures and therefore reflect wave energy and often lead to a lowering of beach height. Unlike a seawall, bulkheads are typically found in bays and rivers that do not experience frequent strong waves.

Bulkhead

Jetty



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