StormSmart Properties Fact Sheet 6: Sand Fencing

The coast is a very dynamic environment and coastal shorelines—especially beaches, dunes, and banks—change constantly in response to wind, waves, tides, and other factors such as seasonal variation, sea level rise, and human alterations to the shoreline system. Consequently, many coastal properties are at risk from storm damage, erosion, and flooding. Inappropriate shoreline stabilization methods can actually do more harm than good by exacerbating beach erosion, damaging neighboring properties, impacting marine habitats, and diminishing the capacity of beaches, dunes, and other natural landforms to protect inland areas from storm damage and flooding. StormSmart Properties—part of the Massachusetts Office of Coastal Zone Management's (CZM) StormSmart Coasts Program—provides coastal property owners with important information on a range of shoreline stabilization techniques that can effectively reduce erosion and storm damage while minimizing impacts to shoreline systems. This information is intended to help property owners work with consultants and other design professionals to select the best option for their circumstances.

What Is Sand Fencing?

Sand fencing, also called snow fencing, is designed to help capture sand to build dunes. It is typically made of thin, wooden slats that are connected with twisted wire to wooden or metal stakes. While other fence materials such as plastic, polyethylene, and metal are sometimes used to trap sand, they are not recommended for coastal use because of the impacts they can cause. See Design Considerations below for details on impacts of other materials.

No shoreline stabilization option permanently stops all erosion or storm damage. The level of protection provided depends on the option chosen, project design, and site-specific conditions such as the exposure to storms. All options require maintenance, and many also require steps to address adverse impacts to the shoreline system, called mitigation. Some options, such as seawalls and other hard structures, are only allowed in very limited situations because of their impacts to the shoreline system. When evaluating alternatives, property owners must first determine which options are allowable under state, federal, and local regulations and then evaluate their expected level of protection, predicted lifespan, impacts, and costs of project design, installation, mitigation, and long-term maintenance.

Sand fencing was installed along the base of and perpendicular to this eroded dune to trap windblown sand and help rebuild the dune. **(Photo: CZM)**

How Sand Fencing Reduces Storm Damage

Sand fencing reduces storm damage on coastal properties by helping to build up dunes. As wind blows through the sand fencing, the fencing creates a drag that reduces the wind speed. At lower speeds, the wind can no longer carry sand, which is deposited at the base of or behind the fence. The resulting accumulation of sand and other sediment helps build the dune. Because larger dunes provide greater levels of protection from storm waves and storm surge (the rise in sea level above the average tide level caused by onshore winds), the sediment trapped by sand fencing increases the dune's capacity to protect landward areas. In addition, sand fencing is often used to keep people off the dunes and direct them toward boardwalks and other designated beach access paths to prevent damage to both the dune and erosion-control vegetation.

Sand fencing can be used in conjunction with many other techniques for erosion management. See the following StormSmart Properties fact sheets on related techniques: *Artificial Dunes and Dune Nourishment*, *Planting Vegetation to Reduce Erosion and Storm Damage*, *Bioengineering - Coir Rolls on Coastal Banks*, *Bioengineering - Natural Fiber Blankets on Coastal Banks*, and *Beach Nourishment*.

Relative Benefits and Impacts Compared to Other Options

Under the Massachusetts Wetlands Protection Act, new hard structures are typically prohibited on all beaches and dunes. On coastal banks, hard structures are only allowed when necessary to protect buildings permitted before August 10, 1978, and only if no other alternative is feasible. In many cases, sand fencing projects and other non-structural alternatives are therefore the only options available for reducing erosion and storm damage on coastal properties.

Sand fencing provides a low-cost, easy-to-install, and effective way to help build up dunes and protect inland areas from storm damage. Unlike seawalls, rock revetments, or other "hard" shoreline stabilization structures, properly designed sand fencing projects do not reflect or redirect waves onto beaches or neighboring properties. The design of a hard structure affects how much wave energy is reflected, for example vertical walls reflect more wave energy than sloping rock revetments. These reflected waves erode beaches in front of and next to a hard structure, eventually undermining and reducing the effectiveness of the structure and leading to costly repairs. This erosion also results in a loss of dry beach at high tide, reducing the beach's value for storm damage protection, recreation, and wildlife habitat. Hard structures also impede the natural flow of sand, which can cause erosion in down-current areas of the beach system. Sand fencing projects, however, increase protection to landward areas while allowing the system's natural process of erosion and accretion to continue.

In general, the impacts of sand fencing projects are relatively minor compared to other options. The most significant factor is the proximity of the fencing to sensitive habitats, particularly nesting habitat for protected shorebird and turtle species (i.e., species that are considered endangered, threatened, or of special concern in Massachusetts). Sand fencing traps lighter, fine-grained sand, creates steeper slopes, and otherwise physically alters the area in a way that impedes shorebird nesting. These birds prefer relatively flat dune areas with coarser sand. The fencing also is a physical barrier that can block unfledged chicks from getting from their nests to their food source, and the posts or stakes can serve as perches for hawks and other predators that feed on the chicks. Another negative impact occurs when fencing destroyed during a storm becomes marine debris. Slats, posts, and wire littered on the beach or floating in the water are not only unsightly, they can harm people and wildlife. For example, wire can entangle wildlife and broken slats can puncture the bare feet of recreational beach users. Certain sand fencing designs and materials, such as sturdy drift fencing and plastic fencing, have additional impacts. See the Design Considerations section for details.

Design Considerations for Sand Fencing Projects

This section covers a variety of factors that should be considered to minimize adverse impacts and ensure successful design, permitting, construction, and maintenance of sand fencing.

Appropriate Locations

Because of its relatively low cost and minor impacts, sand fencing is appropriate at almost any site (except where it may impact protected shorebird and turtle species)—as long as the fencing is not reached by daily high tides and waves from minor storms. Sand fencing can be installed to build up an existing dune, build a dune at the base of an existing bank, or build a dune in low-lying areas where there is blowing sand. Sand fencing can also be strategically placed to direct pedestrian traffic to a designated access point to minimize dune impacts from foot traffic.

Fence Placement

Sand fencing should be installed as far landward as possible, well behind the high tide line, to minimize potential impacts to beachgoers and wildlife and to protect the fencing from storm waves. If waves and tides regularly reach the sand fencing, there will be erosion around the fencing and it will likely be destroyed during a storm. Sand fencing can be installed using a variety of designs, including a single line of fencing parallel to the shoreline, double rows of fencing, a zigzag configuration, and a line of fencing with attached spurs running perpendicular to the dominant wind direction.

In this project, an artificial dune was built at the base of an eroding bank and heavily planted with erosion-control vegetation. Sand fencing was installed to help trap sand to build the artificial dune. **(Photo: CZM)**

Fence Posts

Post material and size should be carefully considered in project design. As for material, only untreated wooden posts are recommended for use on coastal beaches and dunes. Metal posts rust and become a hazard to public safety and marine life, fiberglass posts often shatter when they break and leave dangerous shards on the beach, and wooden posts treated with preservatives do not break down very quickly and remain a marine debris hazard for much longer than untreated wood if lost in a storm. The larger the posts, the more potential for erosion around the base from wind and water, so smaller posts are recommended to minimize scour (i.e., the erosion of sediment around a stationary object). The recommended post size is no larger than 2x4 inches for rectangular posts and 3 inches in diameter for circular posts.

Space Between Slats

Based on a review of available information, sand fencing with 50% open space and 50% slats optimizes sand deposition. If wider slats are used, more erosion is likely to occur around the fencing from wind and waves. Wider gaps between slats promote scour of the sand rather than sand deposition.

Fence Installation

The number of fence posts should be limited as much as possible to avoid excessive erosion from scour. Posts should be spaced at least 4 feet apart and should be buried several feet into the sediment to withstand erosion and waves. A minimum depth of 4 feet below the surface is optimal.

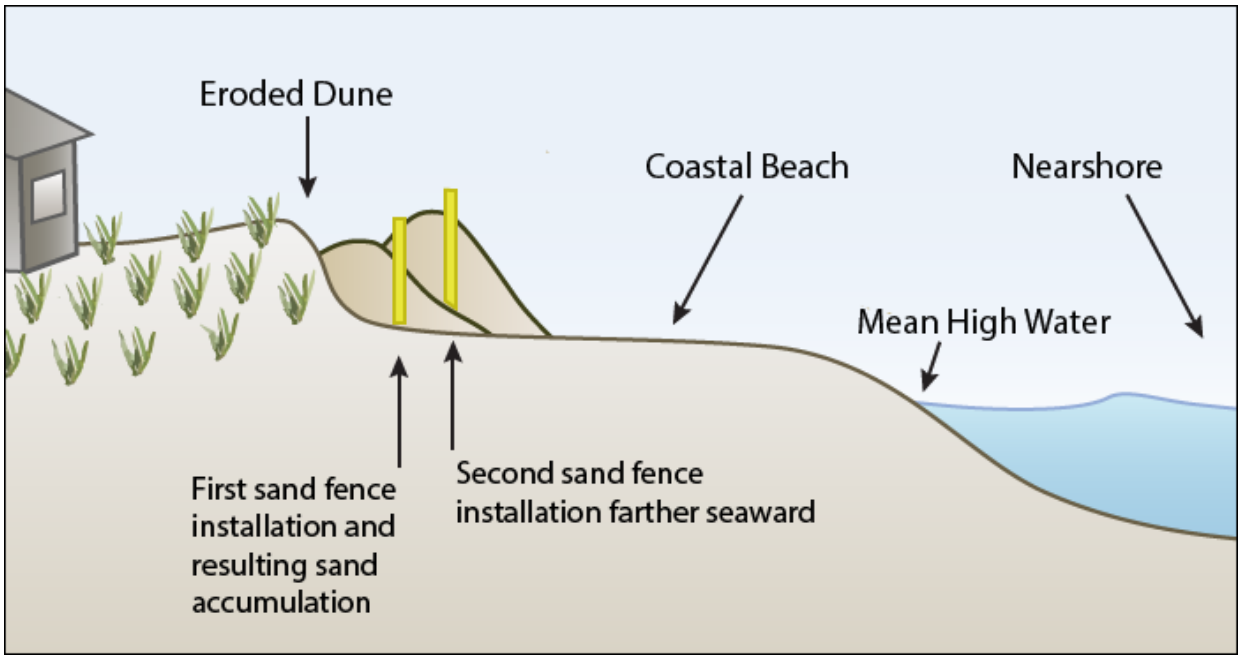
If waves and tides are routinely damaging the sand fencing, it has likely been installed too close to the high tide line. If there is no room at the site to move the fencing landward, additional or alternative shoreline stabilization strategies are likely warranted. Dune nourishment, construction of artificial dunes, and beach nourishment are often combined with sand fencing and vegetation to provide a wider beach and greater level of storm damage protection (see the following StormSmart Properties fact sheets: *Artificial Dunes and Dune Nourishment*, *Planting Vegetation to Reduce Erosion and Storm Damage*, and *Beach Nourishment*).

Vegetation

Whenever possible, native plants that are salt-tolerant and have extensive root systems should be planted as part of a sand fencing project, generally on the landward side of the fencing. These plants are extremely effective at holding sediments in place and help to stabilize windblown sand accumulated by sand fencing. For more information, see *StormSmart Properties Fact Sheet 3: Planting Vegetation to Reduce Erosion and Storm Damage*. Please note that planting may be restricted in nesting habitat for protected shorebird species and only live vegetation should be used. Christmas trees are not recommended for trapping sand because a large section of the dune is disturbed when they are removed by waves, increasing dune erosion. Putting brush and other dead plant material on banks or dunes can prevent living plants from becoming established, further destabilizing the area. Christmas trees and brush can also degrade nesting habitat for protected shorebird species by physically occupying otherwise suitable nesting habitat and impeding chick movement.

Additional Rows of Fencing

As shown in the figure below, when sand builds up and buries the fencing (i.e., when the fence is approximately two-thirds buried by sand), an additional row of sand fencing may be installed to continue to help the dune grow (if there is sufficient space available above the high tide line).



This diagram shows where a second row of sand fencing was installed to trap sand after the initial row became partially buried.

Wildlife Protection

Sand fencing may be prohibited in or adjacent to nesting habitat for protected bird and turtle species. At some sites, the location, linear extent, size of the openings, time of year for construction, and other design details may need to be modified so that birds can successfully nest. The Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife can provide information on the species listed as endangered,

threatened, and of special concern in Massachusetts, including their location and any special design or permitting requirements under state regulations.

Marine Debris

To minimize impacts if fencing is washed out in a storm and becomes marine debris, only fencing made of thin slats of untreated wood connected with twisted wire should be used in coastal areas. These materials break down relatively quickly in the marine environment and consequently have fewer impacts than plastic fencing or other fencing made of non-degradable materials. The posts/stakes, slats, and other fencing materials can be labeled to facilitate identification, recovery, and disposal of any components that are damaged and washed off site in a storm.

Heavy Equipment Use

Access for heavy equipment to deliver fence components, vegetation, or sediment to the site must be carefully planned to avoid destruction of existing vegetation; creation of ruts; destabilization of banks, beaches, or other landforms; impacts to wildlife, particularly protected species; and related impacts. When mechanical equipment is being used, contractors should keep hazardous material spill containment kits on-site at all times in case there is a release of oil, gasoline, or other toxic substances.

Sturdy Drift Fencing

This sturdy drift fencing is constructed in a zigzag pattern parallel to the shoreline with 2x3-inch vertical and horizontal cross-members attached to 6- to 8-inch posts. As described above, this type of fencing is not recommended because of its adverse impacts. **(Photo: CZM)**

Sturdy drift fencing is a type of sand fencing constructed with more robust structural elements than standard wire and slat fencing (see photograph below). The components are nailed together and the fence is constructed in a zigzag pattern. Typically used in areas subject to strong waves, this fencing option is intended to break some of the wave energy before it reaches the bank or dune landward of it, rather than to capture blowing sand. This type of structural fencing can increase erosion issues because: 1) the larger the posts used in a sand fencing project, the greater the level of erosion around the posts; 2) the fence acts as a physical barrier that interferes with the natural flow of sediment along the shoreline, particularly when this fencing is installed on narrow beaches and/or in close proximity to the water; and 3) the fence can cause a wind-tunnel effect, increasing erosion of non-vegetated sediments landward of the fence. Sturdy drift fencing also uses significantly more wood and nails than traditional sand fencing, and the wood is thicker and takes longer to break down in the marine environment. This fencing therefore increases marine debris impacts and threatens public safety when significant numbers of nails are left on the beach after the fencing is damaged during storms. Like traditional sand fencing, sturdy drift fencing negatively impacts nesting areas for protected shorebird and turtle species. In most cases, therefore, thin wooden slat and twisted wire sand fencing is recommended over sturdy drift fence to trap sand. If the fence will be reached by daily high tides and waves from minor storms, additional alternative shoreline stabilization strategies are likely warranted. Dune nourishment, construction of artificial dunes, and beach nourishment are often combined with sand fencing and vegetation to provide a wider beach and greater level of storm damage protection (see the following StormSmart Properties fact sheets: *Artificial Dunes and Dune Nourishment*, *Planting Vegetation to Reduce Erosion and Storm Damage*, and *Beach Nourishment*).

If sturdy drift fencing is used, ways to reduce the potential impacts and increase the longevity and effectiveness of the project include: 1) installing the fencing far enough landward so that it will not be reached by tides or typical storm waves (i.e., these projects will be affected by severe storms but should not be impacted by regularly occurring storms); 2) adding sediment with a similar or slightly coarser grain size to the existing beach and/or dune (called beach and dune nourishment) when the fencing is installed to minimize impacts to natural sediment flow and enhance the longevity of the fencing; 3) periodically adding additional sediment to "renourish" the beach system; 4) labeling fence components and actively retrieving any debris generated by storm damage; 5) cutting notches in the boards at the bottom of the fence for animal access; and 6) avoiding use in nesting habitat for protected shorebirds and turtles.

Other Types of Fencing Are Not Recommended in Dunes

Sand fencing is the only type of fencing that should be used in dunes. In some cases, rows of closely spaced posts have been installed as anchors for sand bags or as part of a shoreline stabilization project. Although these closely spaced posts have been referred to as fencing, they act as a solid wall, reflecting wave energy and increasing erosion of the beach. Because of their adverse impacts, rows of posts are strongly discouraged.

There are many other types of fencing that have been inappropriately used in dunes, including chain link and solid privacy fences. Chain link fences rust and become a marine debris and public safety hazard when damaged and/or torn out in a storm. Solid privacy fences interfere with the natural movement of the dune and therefore impede the dune's ability to provide storm damage protection. These two types of fencing are typically used for establishing property lines or for stopping sand from blowing onto parking areas. As an alternative, native vegetation can help trap blowing sand and stabilize dunes while serving as a privacy buffer. For more information on the use of vegetation in dunes, see *StormSmart Properties Fact Sheet 3: Planting Vegetation to Reduce Erosion and Storm Damage*.

The row of posts installed at the base of this bank is acting like a solid wall, reflecting wave energy and exacerbating beach erosion and erosion of neighboring properties. **(Photo: Greg Berman, Woods Hole Oceanographic Institution Sea Grant Program)**

A solid fence prevents the natural movement of this dune. **(Photo: CZM)**

Permitting and Regulatory Standards

Most options for addressing coastal erosion, storm damage, and flooding are likely to require a permit under the Massachusetts Wetlands Protection Act through the local Conservation Commission. Permits or approvals may also be required from other state and federal agencies and local departments, depending on the location and the work involved. Generally, regulatory programs are supportive of projects that work to trap windblown sand and build dunes, so permits

are not always required for sand fencing. To obtain a permit, sand fencing projects need to be designed to avoid adverse impacts to habitat for protected species and sited landward of the reach of daily tides and regular storms.

Professional Services Required

Simple fencing projects may be done by the property owner after permits have been obtained if needed. Projects in or adjacent to protected shorebird and turtle habitat and in areas with very narrow dry beach may require professional services. A professional with expertise in designing fencing projects can be consulted to: 1) identify regulatory requirements and ensure the project fully conforms with those requirements; 2) determine the conditions at the site that will affect the project (such as the width of dry beach above high tide, wave exposure, and predicted flood elevations); 3) select plant species and develop a planting and plant maintenance plan; 4) identify the best time of year for installation; 5) prepare plans for permitting; 6) develop an access plan if heavy equipment is needed; and 7) prepare design specifications for construction. The consultant can also oversee permitting, construction, monitoring, and maintenance of the project.

Project Timeline

It may take as little as two to three months to complete a sand fencing project, assuming that only a Massachusetts Wetlands Protection Act permit is required, but it can take longer depending on the factors involved. Factors that affect how long it takes to design, permit, and install a sand fencing project include the contractor's experience with designing and permitting similar projects, completeness of permit applications, special considerations in the permitting process (such as objections by abutters, sensitive resources to be protected, and availability of access for construction), the need for special timing to avoid impacts (e.g., restrictions on construction during nesting season for protected species), and/or weather conditions during construction. Often, Conservation Commission staff are available to meet with applicants to go over the important factors that need to be considered early in the design process.

Maintenance Requirements

Regular maintenance of fencing projects will include retrieving damaged fencing components and replacing deteriorated or storm-damaged fence sections. Maintenance needs will depend, in part, on the proximity of the fencing to the reach of high tide and the frequency and severity of storms. A schedule and plan for replacing fencing should be included in the original permit application so that maintenance can be conducted without additional permitting.

Project Costs

The costs of sand fencing projects are most influenced by the type of fencing and posts selected, the length of the area to be fenced, and the complexity of project design and permitting. In addition, the size and location of the fence will affect construction and maintenance costs, as well as the level of protection provided by the project. Fences that are too close to the high tide line will likely require more frequent maintenance. In comparison with other shoreline stabilization options, sand fencing projects typically have relatively low design and permitting costs, low construction costs, and low maintenance costs. See the StormSmart Properties chart, *Relative Costs of Shoreline Stabilization Options* (PDF, 99 KB), for a full comparison.

Additional Information

Sand fencing can be installed in conjunction with many other techniques for erosion management. See the following CZM StormSmart Properties fact sheets for additional information:

- *StormSmart Properties Fact Sheet 1: Artificial Dunes and Dune Nourishment*
- *StormSmart Properties Fact Sheet 3: Planting Vegetation to Reduce Erosion and Storm Damage*
- *StormSmart Properties Fact Sheet 4: Bioengineering - Coir Rolls on Coastal Banks*

- *StormSmart Properties Fact Sheet 5: Bioengineering - Natural Fiber Blankets on Coastal Banks*
- *StormSmart Properties Fact Sheet 8: Beach Nourishment*

The following publications and websites also provide valuable information:

- CZM's Coastal Landscaping website includes information on landscaping coastal areas with salt-tolerant vegetation to reduce storm damage and erosion.
- CZM's *Landscaping to Protect Your Coastal Property from Storm Damage and Flooding fact sheet* (PDF, 962 KB) gives specific information for homeowners on appropriate plants for erosion control in coastal areas.
- *Coastal Dune Protection and Restoration—Using 'Cape' American Beachgrass and Fencing* (PDF, 3 MB) by the Woods Hole Sea Grant and Cape Cod Cooperative Extension Program includes case studies and tips on dune restoration, along with information on preserving shorebird habitat and understanding the permit process.
- CZM's *Environmental Permitting in Massachusetts* briefly describes major environmental permits required for projects proposed in Massachusetts.
- *Guidelines for Barrier Beach Management in Massachusetts* (PDF, 12 MB), which was produced by the Massachusetts Barrier Beach Task Force in 1994, provides an overview of the Massachusetts Wetlands Protection Act Regulations and resource areas, along with information on various erosion management techniques, their potential impacts, and measures to minimize those impacts.
- *Salisbury Beach Dune Walkover Access Design Standards* (PDF, 14 KB) gives general design standards for walkways over coastal dunes that minimize potential adverse effects. These standards are widely applicable.
- *The Ballston Beach Barrier Dune Restoration Project* (PDF, 1 MB) documents innovative sand fencing techniques used to restore a dune on a barrier beach in Truro.
- Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) cover work in wetland resource areas and buffer zones.
- The Natural Heritage and Endangered Species Program website provides information on protected species in Massachusetts, habitat maps, and regulatory review for projects in or adjacent to these habitats.
- The Massachusetts Ocean Resource Information System, or MORIS, is a web-based mapping tool for interactively viewing coastal data. MORIS data layers, such as endangered species habitat and shellfish, can help identify sensitive resource areas within or near the project site.

www.mass.gov/stormsmart-coasts-program

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