Shore Stewards News

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How Bluffs Nourish Beaches

Much of our shoreline consists of bluffs, which may erode due to soil, slope or water conditions, or because of wave and tidal activity. On the upland side, slope failures may occur as a result of water buildup in the soil. This can happen naturally, or as a result of development activities, clearing of vegetation, and modification of site drainage. On the water side, mechanical (wave) energy and fluctuating high water levels due to tides can undercut the toe of the bluff and cause collapse. In both cases, bluff erosion is due to a combination of water and gravity. When a bluff erodes, depositing sand and gravel onto the beach, it is sometimes referred to as a *feeder bluff* .

Incoming waves often come ashore in a diagonal direction, with the backwash of the waves flowing perpendicular to the beach. This flow carries sediment in a zigzag pattern along the beach, which is known as *littoral drift* or *shore drift* . This movement of sediment can take rock and sand from landslides, rivers, streams and eroding bluffs in one location and drop them off miles up the beach. This drift can be interrupted by gravity, or by running into inlets, bends in the contour of the shore, or other formations. This segment of shoreline is what we call a *drift cell* , where sediment is picked up at a source, such as an eroding bluff, and dropped off in what is called a *sink* , or drop-off location. These sinks can be seen in the form of a beach, spit, hook, bar, or tideflat, and are sometimes referred to as *accretion shoreforms.* These are areas where sediment was deposited in the past, or is doing so currently, and are usually noted by their broad backshores. These can also include large accumulations of drift logs, and marsh or dune grass vegetation communities.

Courtesy of King County Department of Natural Resources

Washington Dept. of Ecology

Specific compositions of sand and gravel along a beach are important to many species of marine life. Surf smelt, a forage fish, lay their eggs in the high intertidal zone, in a fine gravel and sand substrate. Sand lance, or candlefish, another important forage fish, spawn in shallow water at high tide on sand-gravel beaches, or sometimes on sand beaches. Forage fish are important food sources for salmon.

Sand and mud beaches support eelgrass beds, which are important habitats for forage fish and other marine organisms. Pacific herring, an important forage fish, deposit their eggs on eelgrass blades. Larger fish like salmon depend on healthy eelgrass beds for their survival, as do Dungeness crabs and several other marine species.

Shoreline Armoring and Hardening

Bulkheads. Seawalls. Riprap revetments. These are all words that describe man-made structures meant to hold back the erosion caused by waves, wind and tides, and all contribute to the *armoring* or *hardening* of the shorelines of Puget Sound. It is estimated that as much as one third of Puget Sound shorelines are currently armored. (Armoring can also include boat ramps, piers, docks, and any other structure on the beach.) Though the main reason given for armoring a property is to halt the forces of erosion, long term erosion rates are generally quite slow, averaging one foot per decade, though some locations of Puget Sound that experience more dynamic wave action have a higher erosion rate. If this erosion occurred at a constant rate it would not be as much of a concern to property owners, as they could easily gauge the rate at which their property is eroding. The erosion usually does not occur at a given constant rate, however, and one can experience little erosion of their property until a landslide removes a large piece of their bluff at one time. Sometimes these landslides are not caused by erosion from wave action, but due to heavy rains, as happened around the region in the holiday of 1996/97. Information on these can be found at: http://www.ecy.wa.gov/programs/sea/landslides/about/shallow.html

Left : riprap armoring at a coastal community in Island County.

Right: riprap installed on both sides of a boat same ramp community.

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While this armoring may serve to protect the bluff against erosion, the energy of the wave activity may be diverted elsewhere. In some instances this energy is directed towards the bottom of the bulkhead, scooping away sand until the bulkhead begins to lean towards the water. We've all seen leaning bulkheads or seawalls and tried to guess how many years it will take until they fall. More often, though, the wave energy is directed back towards the beach, scouring away the sand and small gravel and leaving larger gravel and sometimes bedrock in place of the once sandy beach. . When several homes or a community have hundreds of feet of bulkhead along the beach, this effect may be more dramatic. The finer sand and gravel may end up being moved from in front of the bulkheads to sites at one or the other end of the bulkheads, due to littoral drift. If the now-hardened beach was a location where surf smelt or sand lance deposited their eggs, the change of sand and gravel compositions could cause the beach to no longer be a reliable spawning location for these important forage fish. Likewise, the change in a beach’s characteristics could mean the end of its ability to support the important habitat provided by eelgrass beds. Over the past century there have been significant reductions in the size and number of eelgrass beds in Puget Sound.

Left : after storm events, gravel that accumulates along the side of this boat pier at Camano Island State Park is often moved by park staff to a large pile on the upper beach.

example

Right: of concrete seawall, Cama Beach State Park.

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Two examples of shoreline hardening, Cavalero County Park on Camano Island.

1. Wooden bulkhead protects parking lot area from

erosion, and

2. Concrete boat ramp. This down-drift side of the boat ramp has a significant drop, where the gravel and cobble have been carried away by waves and tidal action. The other side of the boat ramp is level with the beach. You will see similar activity in many Puget Sound locations.

Alternatives to Shoreline Hardening

As scientists and researchers have come to understand the significance of the effects of shoreline hardening, they have sought out alternatives to bulkheads. Some of these methods are known as *soft shore protection.* In the Puget Sound region, early efforts in soft shore protection were led by Wolf Bauer, who, since the 1970s, designed many Seattle Parks projects and numerous constructed beaches in Puget Sound and British Columbia.

Jim Johannessen of Coastal Geologic Services, Inc. has been one of the foremost advocates of this approach in the region. In his article *Soft Shore Protection as an Alternative to Bulkheads – Projects and Monitoring,* Johannessen describes several projects that included different soft shore approaches. On Blakely Island, the community of Driftwood Beach was protected by removing non-native materials and debris from the upper berm and backshore area, importing washed, rounded gravel via barge to offload to the upper beach, and planting native vegetation in the backshore area. This established more realistic beach slopes to an area that had been mined of its original gravel in the past. For further information on this and other projects, go to the link in the bibliography.

Elliott Menashe of Greenbelt Consulting worked with Johannessen to create a soft-shore alternative called the Root Wall. Menashe describes the root wall in this way: “A root wall will mimic naturally occurring accumulations of marine driftwood, which protect shorelines and prograde beaches...The root wall employs large tree root masses, trunk and root masses, and other large woody debris (LWD) as primary structural components to provide immediate toe protection and bluff stabilization. LWD to be used as structural components exposed to wave attack would be of durable tree species resistant to rot and abrasion... The planting, establishment, and development of trees and shrubs behind the structure are integral to the root wall system’s design. Incorporating planned vegetation elements in the engineering design provides short term and long term erosion control, as well as long term structural and environmental benefits...” See links below for more information.

Soft shore alternatives are promoted by several agencies and organizations throughout the Puget Sound region. However, as the methods of soft shore protection are relatively new, some are taking a more cautious approach. In 2005, Kathy Taylor, Ph.D. with the Puget Sound Action Team, stated in a paper for the Proceedings of the 14 th Biennial Coastal Zone Conference, “Although there is an interest in using soft shore protections and bioengineering in place of bulkheads, there is a lack of monitoring data on these alternatives. So, it is difficult to promote regulatory implementation. There is also a lack of training for geologists, contractors and engineers who consult and propose solutions to shoreline landowners. The site-specific nature of each problem and solution make it difficult to provide standards or specifications for bioengineering solutions.”

Soft shore protection is not a solution for every property owner. There are complications to consider when contemplating the soft shore alternative. Many who have sought out local contractors who are familiar with soft 3

shore alternatives are left with few choices. Contractors who have traditionally installed bulkheads but are seeking information on how to use soft shore methods have few avenues available to obtain this knowledge. Homeowners who have considered soft shore protection as a way to replace their failing bulkhead have found the cost for an individual to be prohibitive, as the engineering costs for such a system are more affordable for a community-shared project. As more communities install soft shore protection and the method becomes more widely known and understood, the number of contractors who know how to install such systems and engineers who can design a proper soft shore system would likely increase. Until then, you will likely see continued installation of bulkheads and other hardening methods and the resultant problems with such installations.

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