SHORE STEWARDS NEWS

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Beaches and Bluffs

When walking along the beach, have you ever wondered where the gravel and sand come from, why it changes in appearance and texture as you walk along, and why the profile of the beach may change over time? This issue of the Shore Stewards News is a simple primer on where the beach sediment comes from, where it goes to, and how development and human interactions can impact our beaches. Please check the bibliography, which has several excellent sources and links where you can find materials to help you understand the dynamics of how our beaches are formed.

Feeder Bluffs

Much of the shoreline of Puget Sound is rimmed by steep bluffs that range from fifty to several hundred feet high. Looking at the bluff faces, you can see many layers of sand, silt, gravel and clay, which were deposited during the glacial and interglacial periods. These are easy to spot, as they are often of different colors and shades. As these bluffs erode, they provide the building materials that make up our beaches. If you are walking along a gravelly beach, for instance, look at the bluff face, and you are likely to see layers of gravel. As the bluff erodes, whether from slide activity or wave action, the sediment drops to the face of the bluffs, where it is carried along the shoreline by wave and wind action. These primary sediment input areas can feed miles of beaches, creating shore forms such as spits and barrier beaches.

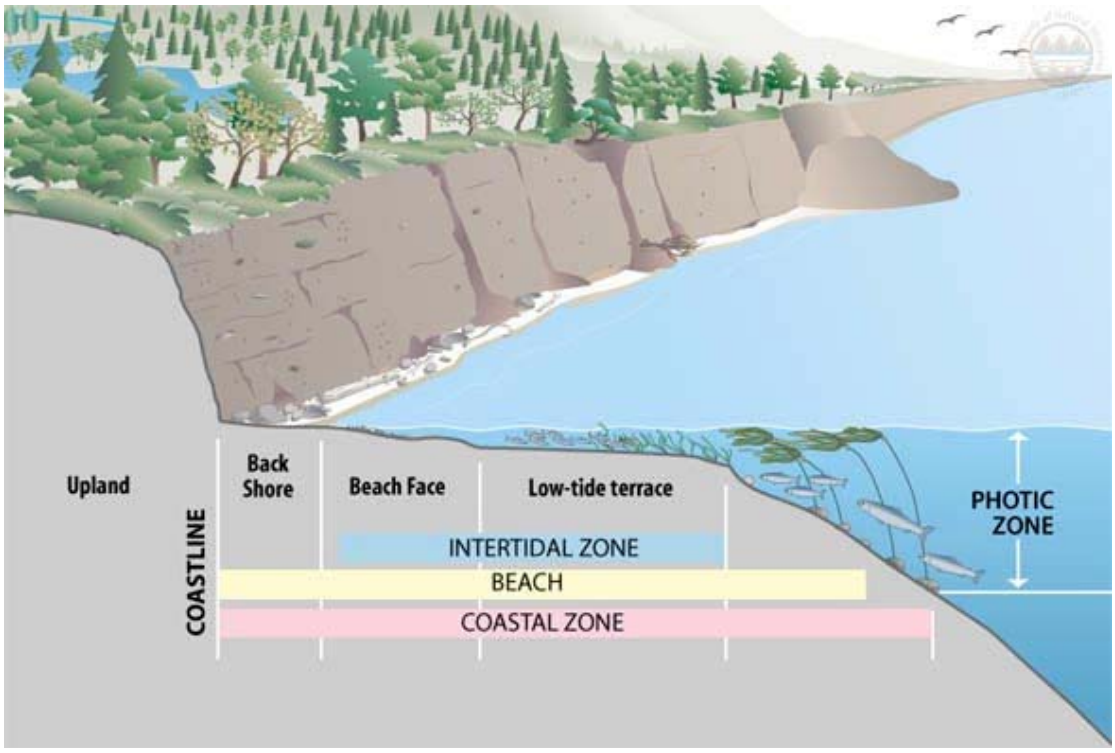
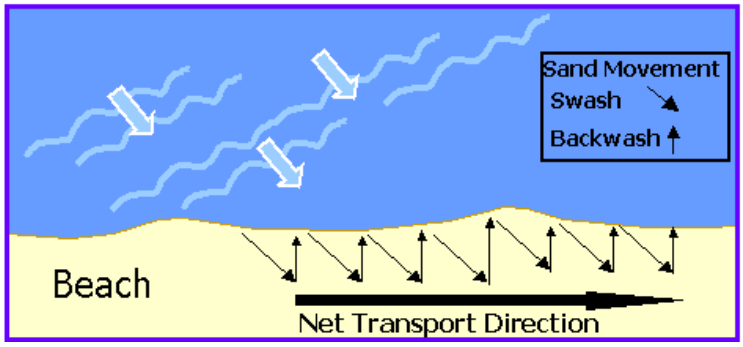


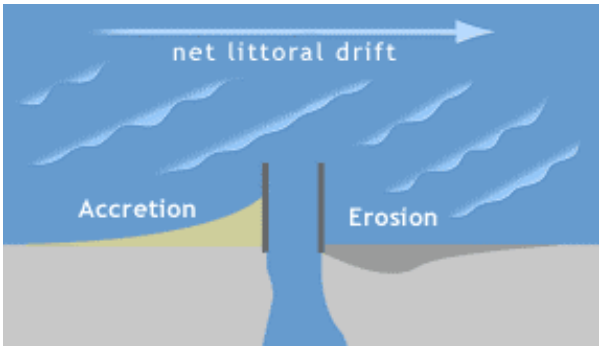
Illustration shows bluff erosion before development. Courtesy of Metro King County Natural Resources and Parks, Water and Land Resources Division.

Shore or Littoral Drift

Look at the waves as they move onto the beach. They usually come ashore obliquely, at an angle other than 90 degrees, often determined by the direction of the wind. When these waves strike the shore at an angle, they cause the wave swash (water that washes up on shore after an incoming wave has broken) to move up the beach at an angle. This swash moves the sediment sand and gravel up the beach at an angle. The backwash (the water that rolls back down a beach after a wave has broken) then leaves the shore at 90 degrees, solely under the influence of gravity, taking the sediment with it. This causes a gradual zigzag movement of the particles along the shore, which can increase with storms, tides, and seasons.



This sand and gravel constantly flows along Puget Sound beaches. This *littoral drift* can move sediment and other materials from bluff erosion and stream deposits to beaches that are several miles in distance. In locations where jetties or man-made structures block this flow of the sediment, sand and gravel can build up on one side of the blockage (accretion) and erode away from the other side. *See illustration below, courtesy of Washington State Department of Ecology.*



Puget Sound beaches do not run in a straight line, of course, and the shore drift is interrupted by inlets, headlands, and bends in the shore contours. The shoreline around our islands is divided into several sectors which are often referred to as "drift cells." Each of these cells contains a *source*, where sediment and other debris are picked up, and a *sink*, where the sediment is dropped off. In the long term, a single direction of net shore drift may be seen within each cell or sector. These drift cells are generally independent of one another. Looking at littoral drift as the primary way in which beaches are created and changed, one can see that there are two main feature types. We find *bluff-backed beaches*, which are the sources of eroded materials, and *spit or barrier beaches*, where these materials are typically deposited.

Effects of Human Development

It is estimated that there are over 800 miles of bulkheads, seawalls, boat ramps, marinas, docks, and other hardened structures around Puget Sound, equal to about 1/3 of the entire shoreline. Hardened structures can prevent materials from entering the sediment stream, causing erosion downdrift from those structures. This in turn can cause erosion and loss of beach habitat.

A bulkhead does not prevent the beach itself from eroding. The waves reflecting off the bulkheads, particularly those made of concrete, can scour away sediments at the base of the bulkhead. This can undercut the sediment that holds it upright, causing it to lean towards the waves, and possible future failure. This can also cause erosion on nearby beaches. If the bulkhead interrupts the zigzag activity of the littoral drift and halts the transportation of sand up the beach, a sandy beach can be changed into one that only contains cobbles or gravel. In some cases, the beach can be scoured down to bedrock or a hard clay surface. This process may take several years or even decades, but the damage is long-term. This erosion can degrade the nearshore spawning habitats for surf smelt, sand lance, and herring, and ultimately the food sources for salmon and other benthic feeding fish.

There are alternatives to bulkheads, however, such as soft shore armoring. Such alternatives may involve anchoring of large logs parallel to the shoreline, planting of salt-tolerant vegetation, and/or bringing in fill in the form of sand or gravel. Information on these methods can be found in the bibliography. If you are interested in installing soft shore armoring, it is best to consult a professional to assess your situation, as well as performing the design and installation work. This approach does not work in all locations, however, so be sure to investigate your situation to the fullest possible extent.

Bibliography and Links

1. *Puget Sound Notes (issue on management by drift cells*) Tells about the inner workings of sediment transport along the shoreline, how drift cells can be combined into logical management units, and how human alteration of the shoreline interrupts natural processes over the scale of a drift cell. http://www.psat.wa.gov/Publications/psnotes_pdf/ps_notes_47.pdf

2. *Puget Sound Nearshore Environments, Eroding Bluffs, and Development*, Metro King County Natural Resources and Parks, Water and Land Resources Division. http://splash.metrokc.gov/wlr/watersheds/puget/nearshore/BluffC.htm

3. *Glossary of Terms.* This is an excellent glossary that was produced for the City of Bainbridge Island in 2002 as part of their nearshore assessment. This was compiled from several other sources. www.ci.bainbridge-isl.wa.us/documents/GlossaryAppendix%20%5BDRAFT%209-12-02%5D.pdf

4. *Alternative Bank Protection Methods for Puget Sound Shorelines*, Ian Zelo, Hugh Shipman, and Jim Brennan, Washington State Department of Ecology, May 2000. www.ecy.wa.gov/pubs/0006012a.pdf

5. *The Geomorphology of Puget Sound Beaches*, David Finlayson, University of Washington, 2006. http://www.pugetsoundnearshore.org/techical_papers/geomorphology.pdf

Bibliography and Links (continued)

6. *Soft Shore Protection as an Alternative to Bulkheads – Projects and Monitoring*, Jim

Johannessen. www.padillabay.gov/pdfs/SoftShore.pdf

7. *Soft Shore Restoration Blueprint for San Juan County*, 2006, Friends of the San Juans, http://www.sanjuans.org/ShorelineRestoration.htm

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Website: www.shorestewards.wsu.edu