SHORELINE STRUCTURES

Why Should We Care?

Seawalls, groins, jetties and other shoreline stabilization structures have had tremendous impacts on our nation's beaches. Shoreline structures are built to alter the effects of ocean waves, currents and sand movement. They are usually built to "protect" buildings that were built on a beach that is losing sand. Sometimes they are built to redirect rivers and streams. Other times they are constructed to shelter boats in calm water. In many cases, seawalls, jetties, breakwaters and groins have caused down-coast erosion problems with associated costs that have greatly exceeded the construction cost of the structure.

Every surfrider knows that there are groins and jetties that have incidentally improved wave riding. However, in many other areas shoreline construction has ruined wildlife habitat, destroyed surfing waves and caused beaches to erode. As beach lovers and environmentalists, we need to understand the consequences of shoreline structures so that we may be able to effectively influence decisions on the impacts, placement or necessity of these structures. As an environmental group committed to maintaining the natural shoreline and beach equilibrium, we are usually opposed to construction that will disrupt the balance of forces that shape our coastline.

THE BASICS

Erosion: Where Has All The Sand Gone?

Every winter, the newspapers show pictures of oceanfront buildings falling into giant surf. Beaches are not static piles of sand. Ocean currents cause beaches to move constantly. Beach sand is primarily a product of the weathering of the land. Sand can also come from ocean organisms such as coral. Sand can come from the erosion of coastal bluffs. However, most of the sand along the world's beaches comes from rivers and streams. When natural processes are interfered with, the natural supply of sand is interrupted and the beach changes shape or can disappear completely. Sand production stops when coral reefs die from pollution, when coastal bluffs are "armored" by sea walls and when rivers are dammed upstream for flood control and reservoir construction. The sand that collects behind upstream dams and reservoirs is often "mined" and sold for concrete production. *It then never makes it to the beach.* A public resource is sold for private profit.

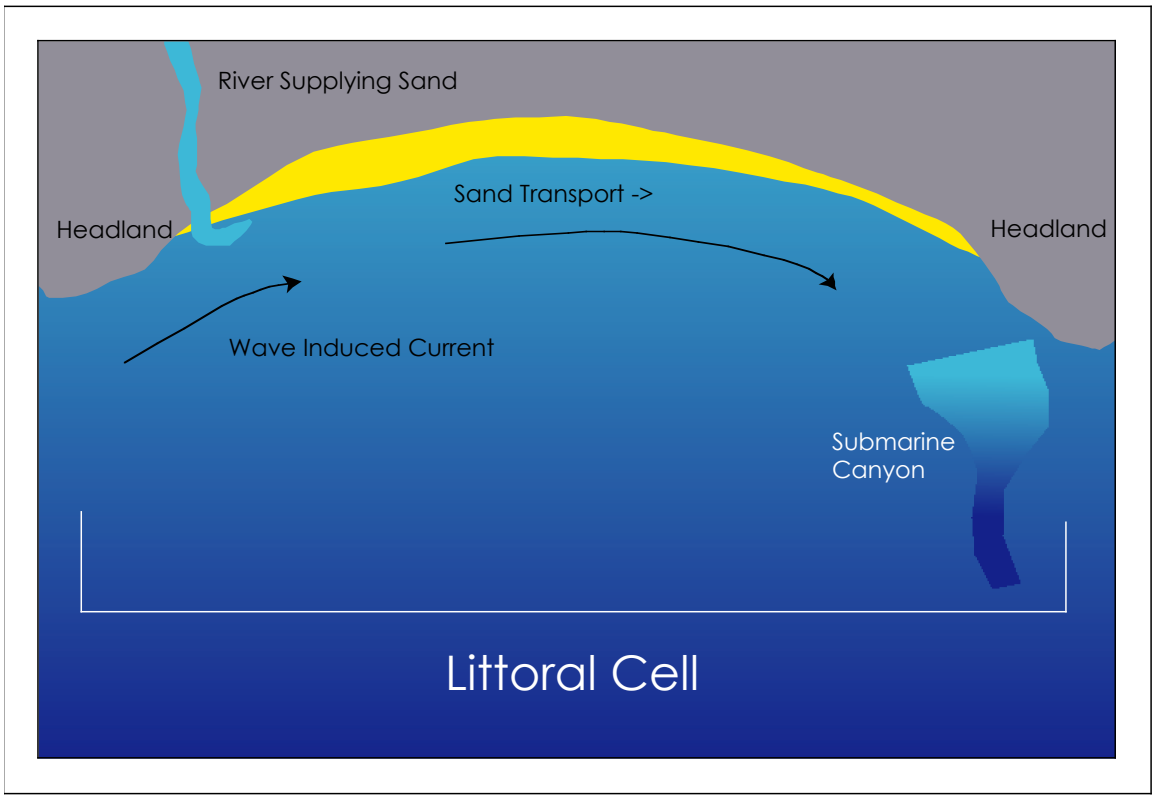
In the face of eroding beaches, owners of beachfront property will often try to use their political influence to demand that "something be done." The intelligent action would be to move the building away from the ocean. Unfortunately, what has often been done in the past has been to armor the coastline with rocks, concrete and steel. This does not protect or maintain the beach—it only protects the buildings.

Millions of taxpayer dollars have been wasted subsidizing beachfront building. Federal flood insurance and expensive Army Corps of Engineer projects have done very little to make oceanfront buildings safe and have hastened beach erosion. In many cases, it would be more cost-effective for taxpayers to have the government buy the coastal property, condemn the buildings and allow the area to act as a buffer between the ocean and the remaining buildings. In urbanized areas with expensive real estate, a more cost effective and environmentally sound alternative to shoreline structures may be to periodically "nourish" the beach with sand.

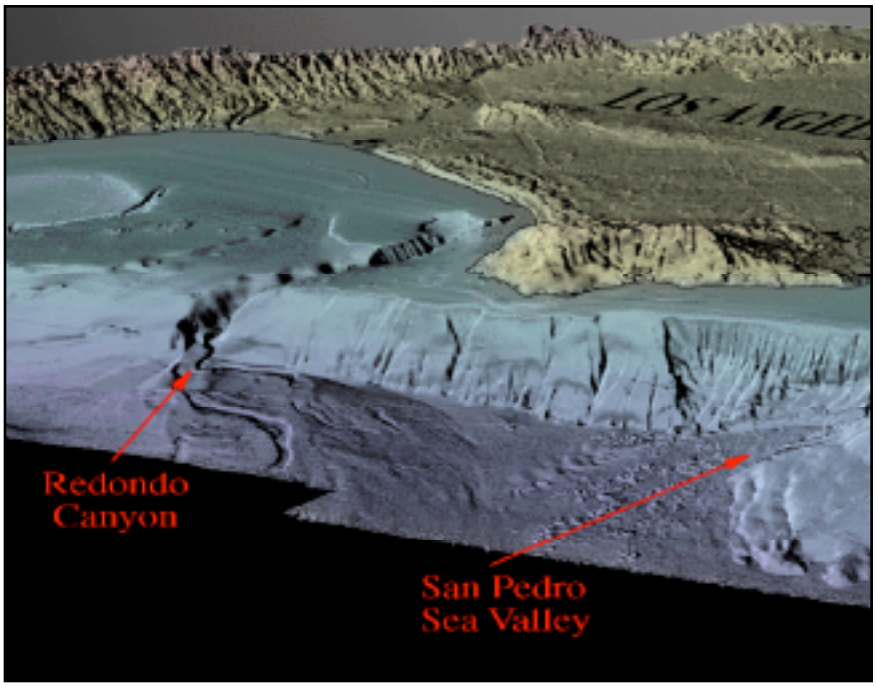
The Littoral Cell

On the West Coast of the U.S., beach sand moves from river mouths to the beach. It then moves along the coast in the direction of prevailing currents and eventually it moves offshore. This sand transport system is called a littoral cell.

When waves break at an angle to the shoreline, part of the wave's energy is directed along the shore. These "longshore currents" flow parallel to the shore. Surfers call this the "drift". This current will move sand along the shore and a beach will be formed. The same current that transports a surfer down the beach from the point of entry will also move beach sand down the shoreline. When this longshore current turns seaward, it is called a rip current.



Some areas have underwater canyons near the beach. These submarine canyons were prehistoric river mouths. Sometimes the longshore current will be interrupted by one of these canyons. In this case, the sand is lost from the beach in water too deep to be returned to shore. The littoral cell system, from the river mouth to the underwater canyon, will always lose beach sand. If the sand supply from the river is cut off, the beach will lose sand causing the beach to become narrower.



Submarine Canyon in Santa Monica Bay and San Pedro
(image from Dartnell, and Gardner, 1999, U.S. Geological Survey Digital Data Series DDS-55 (CD-ROM)

On the East Coast of the U.S., the shore formed differently. Sand comes from the erosion of headlands, bluffs and cliffs. The underwater coast (continental shelf) of the east is broad and flat. East Coast beaches are generally wider. Barrier islands run along the coast. In contrast to the West Coast, submarine canyons are rarely near the beach and seldom act as conduits for sand loss. A notable exception is the Hudson Canyon at the southwest end of Long Island, New York. Sand that moves south here is lost down the canyon. On the East Coast, sand "loss" is primarily from the movement of barrier islands. Barrier islands naturally migrate landward due to sea level rise, but this migration is accelerated during storm events. Powerful hurricanes deposit sand inland by washing it over the dunes. Sometimes these storms will create strong currents that take sand too far offshore for it to return to the beach. The depth where sand is moved so far offshore that it cannot return is known as the “closure depth”. The precise depth is under scientific debate and varies with time, wave and weather conditions. When humans try to interfere with the natural migration of barrier islands, it is usually at their long-term peril.

Erosion is a process, not a problem. Beaches are dynamic and natural. Buildings, bridges and roads are static. The problem occurs when there is a static structure built on a dynamic, moving beach. If buildings and roads were not built close to the shore, we would not have to worry about shoreline structures or sand erosion.

RESPONSES TO EROSION

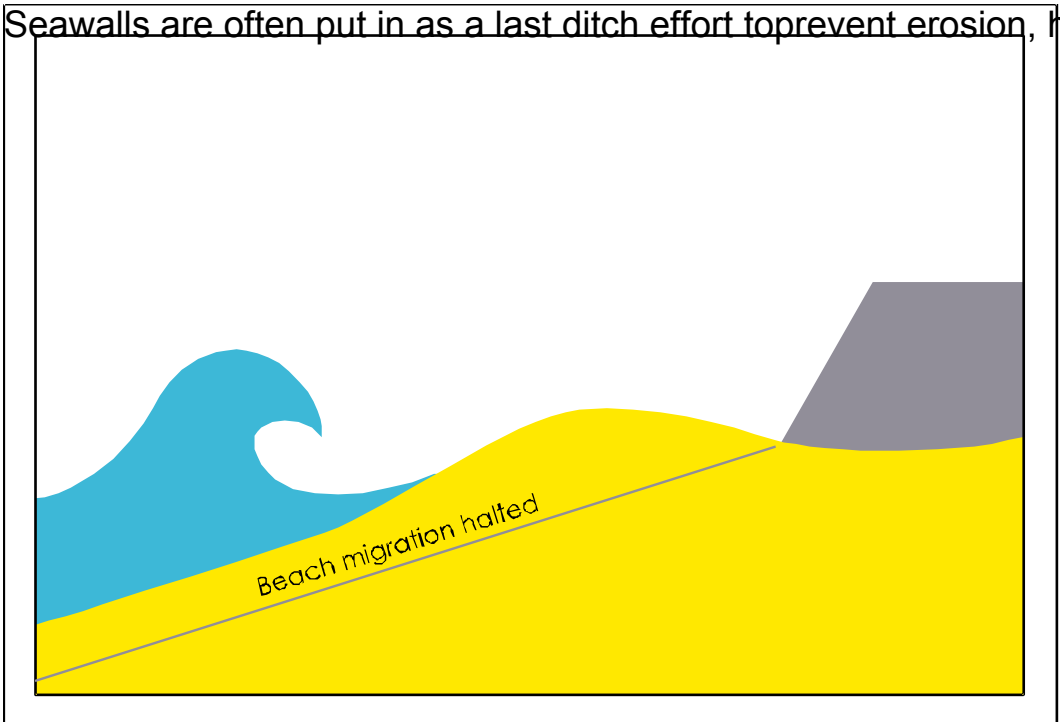
Seawalls

When coastal buildings or roads are threatened, usually the first suggestion is to "harden" the coast with a seawall. Seawalls are structures built of concrete, wood, steel or boulders that run parallel to the beach at the land/water interface. They may also be called bulkheads or revetments. They are designed to protect structures by stopping the natural movement of sand by the waves. If the walls are maintained they may hold back the ocean temporarily. The construction of a seawall usually displaces the open beach that it is built upon. They also prevent the natural landward migration of an eroding beach.

When waves hit a smooth, solid seawall, the wave is reflected back towards the ocean. This can make matters worse. The reflected wave (the backwash) takes beach sand with it. Both the beach and the surf may disappear.

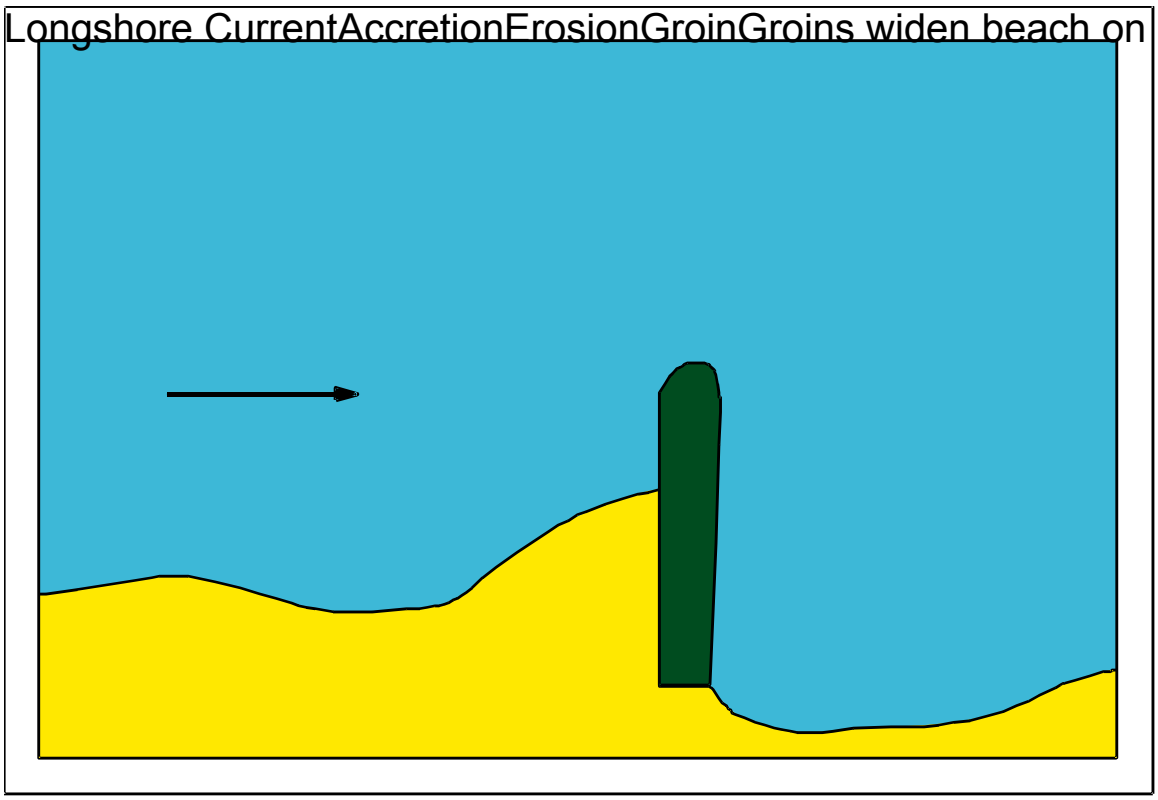
Seawalls can cause increased erosion in adjacent areas of the beach that do not have seawalls. This so-called "flanking erosion" takes place at the ends of seawalls. Wave energy can be reflected from a seawall sideways along the shore, causing coastal bluffs without protection to erode faster. When it is necessary to build a seawall, it should have a sloped (not vertical) face. Seawalls should also have pockets and grooves in them that will use up the energy of the waves instead of reflecting it.

Usually the most cost-effective, environmental solution is to move the building away from danger. Building seawalls will buy time against natural processes, but it will not "solve the problem" of erosion by waves.



Groins

Groins are another example of a hard shoreline structure designed as so-called "permanent solution" to beach erosion. A groin is a shoreline structure that is perpendicular to the beach. It is usually made of large boulders, but it can be made of concrete, steel or wood. It is designed to interrupt and trap the longshore flow of sand. Sand builds up on one side of the groin (updrift accretion) at the expense of the other side (downdrift erosion). If the current direction is constant all year long, a groin "steals" sand that would normally be deposited on the downdrift end of the beach. The amount of sand on the beach stays the same. A groin merely transfers erosion from one place to another further down the beach.



Groins occasionally improve the shape of surfing waves by creating a rip current next to the rocks. The rip can be a hazard to swimmers. The rip can also divert beach sand onto offshore sand bars, thereby accelerating erosion. Groins can also ruin the surf. If the waves are reflected off the rocks, the waves may lose their shape and "close-out."

As soon as one groin is built, property owners downdrift of it may start clamoring for the government to build groins to save "their" beach. Eventually, the beach may become lined with groins. Since no new sand is added to the system, groins simply "steal" sand from one part of the beach so that it will build up on another part. There will always be beach erosion downdrift of the last groin.

Breakwaters

A breakwater is a large pile of rocks built parallel to the shore. It is designed to block the waves and the surf. Some breakwaters are below the water's surface (a submerged breakwater). Breakwaters are usually built to provide calm waters for harbors and artificial marinas. Submerged breakwaters are built to reduce beach erosion. These may also be referred to as artificial "reefs."

A breakwater can be offshore, underwater or connected to the land. As with groins and jetties, when the longshore current is interrupted, a breakwater will dramatically change the profile of the beach. Over time, sand will accumulate towards a breakwater. Downdrift sand will erode. A breakwater can cause millions of dollars in beach erosion in the decades after it is built.

Beach Nourishment

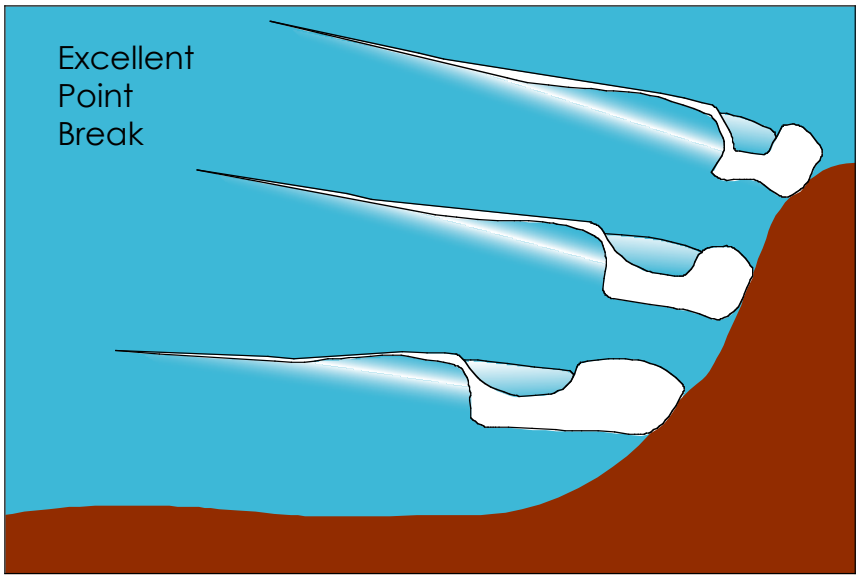
In recent years, the hard structures described above have fallen somewhat out of favor by communities due to the negative impacts we have discussed. Beach nourishment is becoming the favored “soft” alternative. Beach nourishment is simply depositing sand on the beach in order to widen it. Although paid for by all taxpayers, it is frequently undertaken to protect private oceanfront buildings. Occasionally the taxpaying public is refused access to beaches that they have paid to protect. Sand nourishment is a costly, temporary solution. The projects are not intended to have a long life span and must be renourished on a regular basis, creating a cycle that will go on until the money runs out or shorefront buildings are relocated.

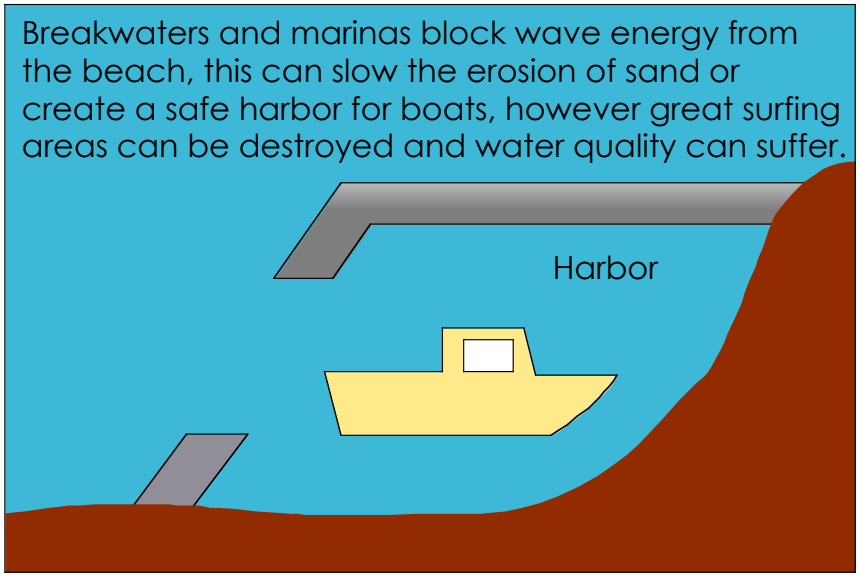
There are many considerations that must addressed when designing a nourishment project. If the grains of sand are not exactly the same size as that of the natural beach, the newly nourished beach may erode faster than the natural beach was eroding. Beach nourishment can cause bottom organisms and habitats to be smothered by "turbid" water that has sand and mud suspended in it. The shoreline is moved seaward into deeper water, causing the beach to drop off quickly, posing a hazard to swimmers. This may also impact the surf for a period of time, causing the waves to break as shore break, until the beach and sandbars can reestablish a level of equilibrium.

NAVIGATION STRUCTURES

Harbors, Natural and Artificial

On the West Coast of the U.S., artificial harbors have been constructed by building a series of breakwaters and jetties. When an artificial harbor is built in an area that is subject to high-energy wave action, it will invariably interrupt the longshore flow of sand. This will cause serious downdrift erosion. Some harbor designs force the longshore current to make a 90-degree turn towards the ocean. This causes a large rip current that may carry sand offshore that might otherwise remain in the surf zone. This will have the effect of completely changing the shape of the ocean bottom. An artificial





harbor mouth can act as a trap for the longshore sand transport causing it to clog up with sand, which makes costly periodic dredging projects necessary.

Natural harbors, like San Francisco Bay, are protected from the ocean's fury but are still subject to tidal and wave energy. This causes water mixing and circulation. Stagnant artificial harbors are easily polluted by boating activities: paint, oil, grease, garbage and illegally dumped sewage. These wastes can poison the living creatures that swim in these waters. When the harbor is dredged, the sand and contaminated sediments cannot be returned to the beaches and must be disposed of in a safe place. Often, the sediments are dumped in deeper waters, poisoning the marine life food web.

Some harbors have been built by dredging wetland areas. Wetlands are habitat for birds and marine life. They can also provide water storage capacity to prevent coastal flooding during rains. Wetlands are natural water filters that purify land run-off before it enters the ocean. **Dredging a wetland to build a boat harbor should never be done**. We have lost over half the wetlands in the U.S. to human development. In California, we have lost over 94% of our wetlands.

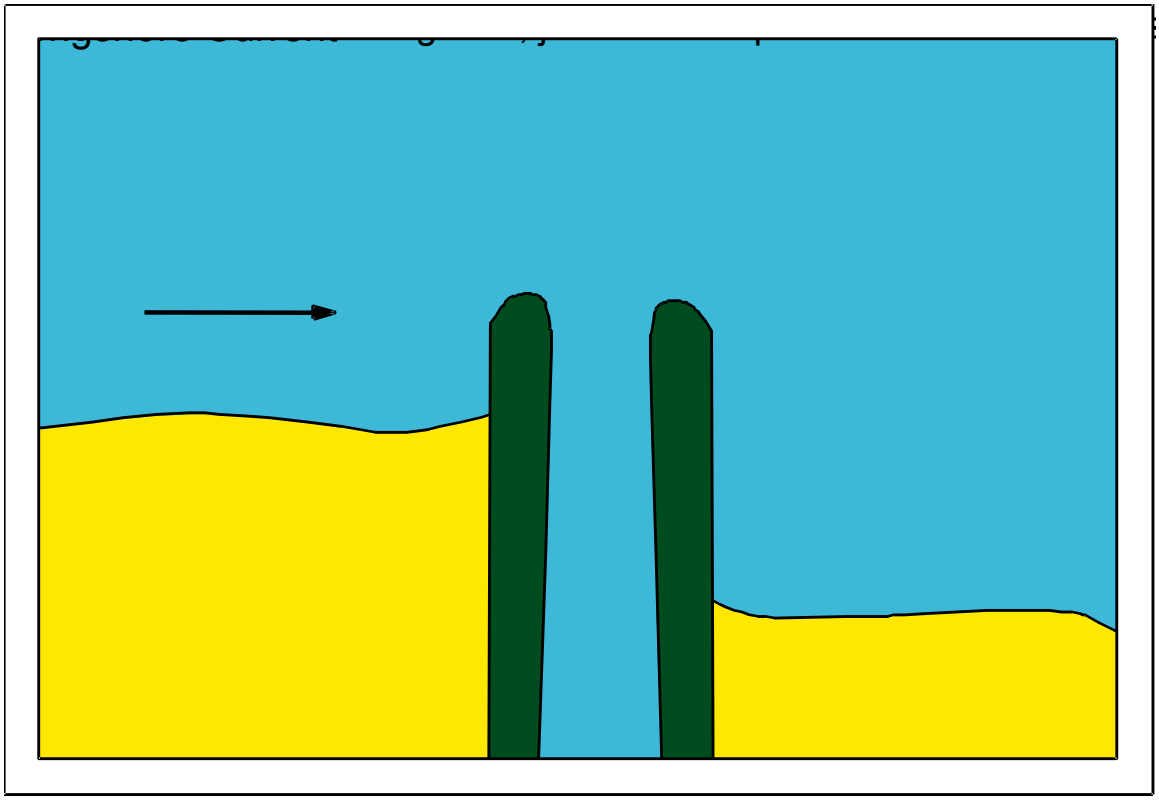
Jetties

Jetties are large, man-made piles of boulders or concrete that are built on either side of a coastal inlet. Whereas groins are built to change the effects of beach erosion, jetties are built so that a channel to the ocean will stay open for navigation purposes. They are also built to prevent rivermouths and streams from meandering naturally.

Jetties completely interrupt or redirect the longshore current. Just as a groin accumulates sand on the updrift side, so do jetties. The major difference is that jetties are usually longer than groins and therefore create larger updrift beaches at the expense of the smaller downdrift beaches.

On East Coast barrier islands, ocean tidal inlets migrate naturally with the longshore current. A jetty system will permanently disrupt the equilibrium of the beach. This may seriously affect the tidal circulation and the health of the wetlands between the barrier islands and the mainland.

Inlets with short jetties that don't quite reach the surf will clog up with sand. The sand must be dredged on a regular basis. A "sand by-passing" system may be built to pump sand around the jetties. The sand pumping may come from within the inlet or from the updrift beach. These methods are expensive and must be maintained indefinitely.



WHAT YOU CAN DO

Environmental Impacts

Before a shoreline structure is built, the local community must be informed of its environmental impacts. The National Environmental Protection Act (NEPA) mandates that an Environmental Impact Statement (EIS) must be prepared to identify environmental impacts of the project. This document must spell out all effects that a new structure will have on the surrounding area**. It is during the scoping of and subsequent public comment period of preparing an EIS that Surfrider Foundation activists can have the greatest impact on the proposed project.**

The EIS process allows activists to educate the public about the project's impacts on the environment. Written comments on the draft EIS are crucial for legal purposes. Oral comments at hearings are even more important because they are picked up in the media, which allows more of the public to become informed.

Our goal is to make sure that the long-term effects and the true costs of the project are carefully spelled out for both the public and the decision-makers. If there are environmental impacts, the developer must provide ways to "mitigate" the damage. For

instance, if the project will cause downcoast erosion, the developer may be required to install and maintain a sand replenishment system or promise to post a bond that will pay for periodic sand replenishment as long as the structure exists. This may be impractical. If there is wildlife habitat destroyed, the developer may be required to restore habitat *on site* if feasible.

The Only Permanent Solution: Retreat from the Beach!

"Hard" shoreline structures have severe environmental impacts on the longshore current and the natural processes of beach sand distribution. "Soft" solutions like sand nourishment are expensive and temporary. Marinas should be built in natural harbors away from the energy of the waves. ***Building on our ocean's shore is not a good idea.*** **NATURE WILL ALWAYS PREVAIL**.

Shoreline construction means that taxpayers pay the bills when the ocean behaves as expected. Whether it is fire department rescues, the Public Works Department placing sand bags, the police guarding vacant buildings from looters or the Army Corps of Engineers spending millions to "correct the problem," taxpayers are the ones who pay. Shoreline protection is, often, "welfare for the rich."

Shoreline property owners frequently limit the public's access to the beach by refusing to let the public cross their property to get to the beach.

Shoreline building also means habitat destruction. Birds, plants and animals that call coastal dunes and beaches their homes are slowly becoming extinct.

As humans continue to overpopulate our coastal areas (and the planet) we will have to be more thoughtful about our relationship with the ocean. Surfrider Foundation activists will continue to educate the public about the natural processes that create and maintain our shoreline. Sometimes shoreline structures must be built, but the public must know the impacts. Society will have to continually pay to maintain the structures and correct the environmental damage caused by them. The best solution is to retreat from the beach and allow nature to replenish, maintain and change the beach as she sees fit.

Beach Preservation Policy

Ratified by BOD 4.17.99

Introduction:

The Surfrider Foundation recognizes that beaches are unique coastal environments with ecological, recreational and economic value. The Surfrider Foundation further recognizes that beaches are a public resource and should be held in the public trust. As human activities and development in coastal areas increase, the need for preservation of beaches becomes ever more apparent.

"Hazards" occur when naturally dynamic coastal processes encounter static human development, and when humans interfere with marine and littoral systems. The Surfrider Foundation is working proactively to promote conservation and responsible coastal management that avoid creation of coastal hazards or erosion problems. The Surfrider Foundation supports coastal research and science-based management of coastal resources to promote sustainable, long term planning and preservation of beach environments.

This policy is general in nature; the Surfrider Foundation recognizes that every specific case must be evaluated in the context of its local setting.

Whereas:

> Beaches are often perceived as separate habitats, but in reality are small parts of much larger coastal ecosystems. These systems include watersheds, wetlands, and nearshore marine environments.
>
> Beaches are dynamic in nature and change on multiple temporal and spatial scales. These changes are therefore difficult to predict with certainty.

Therefore:

The Surfrider Foundation hereby advocates actions to promote long term beach preservation for the benefit of the public.

Coastal areas that are free of development should be protected via proactive means that do not interrupt coastal processes. These include:

- Placement of beaches and beachfront lands in public trust
- Establishment of beach setbacks based on current and historical erosional trends
- Restoration of natural sediment transport processes in coastal watersheds

In areas where erosion threatens existing coastal development, the Surfrider Foundation advocates appropriate long-term solutions that maximize public benefit. These include:

- Landward retreat of structures from dynamic shorelines

Where landward retreat is not feasible, beach nourishment[1] projects may be considered, on a case by case basis, as viable alternatives for short-term beach preservation.

Under no circumstances does the Surfrider Foundation support the installation of stabilization or sand retention structures along the coastline. Such structures can protect existing coastline development but have no place in beach preservation.

[1] For the purposes of this policy, 'beach nourishment' is defined as: the placement of clean sand of the appropriate composition and grain size on the beach or within the littoral environment. Under no circumstances is the incorporation of sand retention devices of any form to be construed as included within this definition.