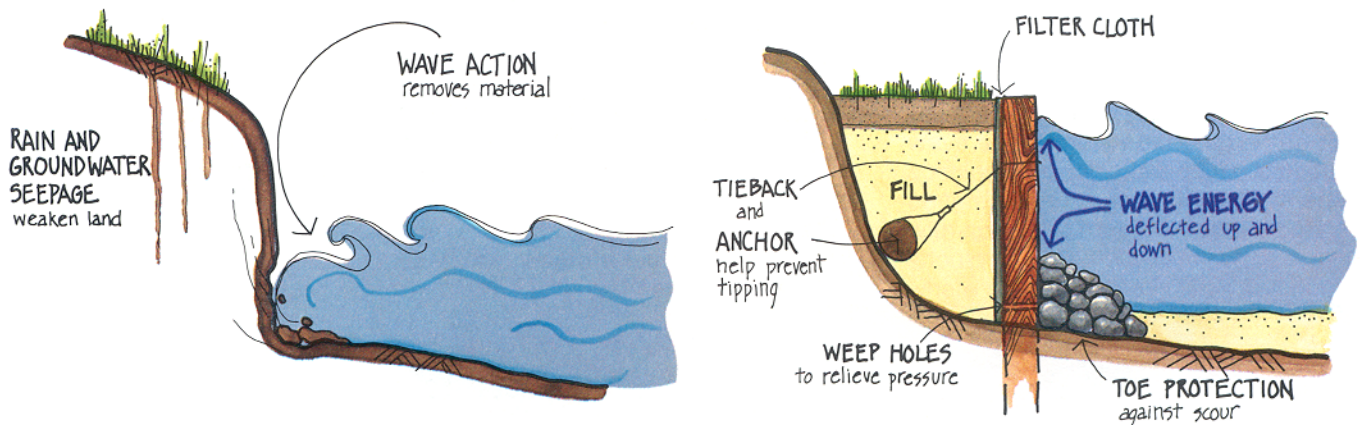


# Bulkheads and Seawalls



Bulkheads and seawalls protect banks and bluffs by completely separating land from water. Bulkheads act as retaining walls, keeping the earth or sand behind them from crumbling or slumping. Seawalls are primarily used to resist wave action. Design considerations for these types of structures are similar. The illustrations on this page show the action of water on an unprotected bluff and demonstrate how bulkheads and seawalls help prevent erosion of the land behind them.

These structures do not protect the shore in front of them, however. In fact, when bulkheads and seawalls are used in areas where there is significant wave action, they may actually accelerate beach erosion. This happens because much of the energy of waves breaking on the structure is redirected downward, to the toe where the wall meets the soft

sand or earth. The shore on this side of the bulkhead or seawall is thus subjected to much more of the force of the waves than if there were no wall, and it erodes quickly.

Bulkheads and seawalls are most appropriate where fishing and boating are the primary uses of the shore, and gently sloping areas for sunbathing or shallow-water swimming are not essential.

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## Design Considerations

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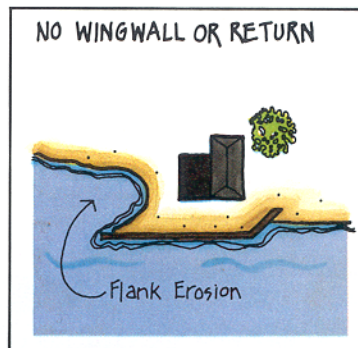
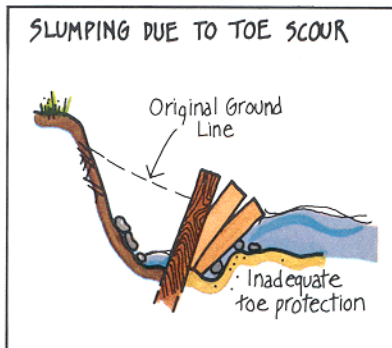
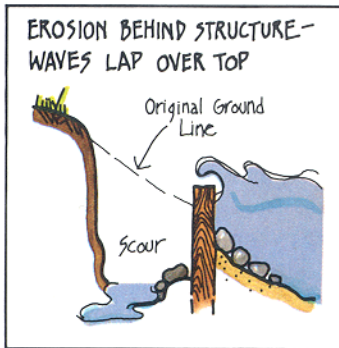
Bulkheads and seawalls can be built in three basic types of design. They may consist of thin, interlocking sheet piles driven deeply into the ground; individual piles used to support an above-ground structure; or a massive gravity construction resting on the shore bottom or embedded slightly in it, supported by its own weight rather than by piling.

Bulkheads and seawalls must be protected against the action of water, both in front of the wall and behind it. Waves that lap over the top could erode the land behind the structure as if the wall were not there, so the structure must be built high enough to prevent such overtopping. Groundwater and rain percolating through the soil may build up pressure behind the wall, eventually pushing it over. Weep holes regularly spaced along the bottom of the structure and equipped with filters to keep them clear relieve this pressure so that the bulkhead or seawall will remain upright.

To be protected against the water's action on its face, a bulkhead

or seawall must be made of materials strong enough to withstand battering by waves and by wave-carried debris. Scour at the toe could eventually undermine the structure and tip it over. An apron of stones or other heavy material can be piled at the base of the wall to absorb the wave energy and protect the underlying soft earth or sand from being carried away.

Water flowing around the sides of the seawall or bulkhead can also cause severe erosion damage, so the structure must cover the entire surface that could be eroded. It should be well anchored to the bluff with wingwalls or returns to resist flank erosion.



Timber bulkhead

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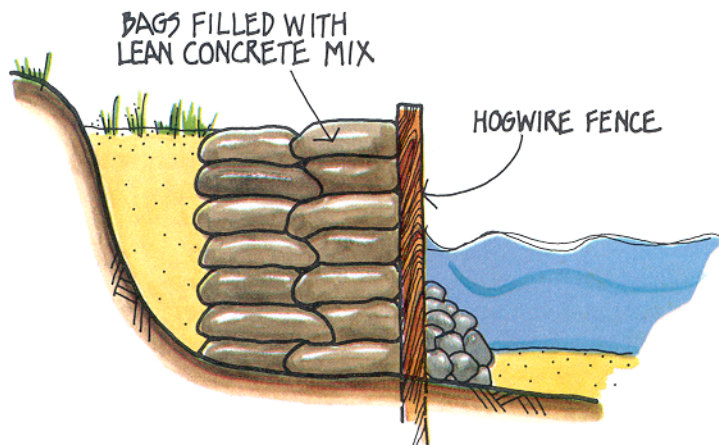
## Site Characteristics

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Erodible bluffs where bulkheads and seawalls are appropriate may rest on rocky, sand, or earth bottoms. The type of bottom influences the choice of bulkhead or seawall design, since none of the three basic designs can be used for all shore bottom types.

With bottoms of sand or earth, interlocking sheet piles can be driven or jettied deeply. Designs using individual piles to support above-ground structures can also be used in these areas. For sites with rocky bottoms, above-ground gravity structures are usually the most economical, but local wave energy or other considerations may make pile-supported structures the most appropriate choice. In soft rock, piles can be driven; bedrock requires drilling holes for the piles and anchoring them firmly with grout or concrete.

Local wave energy also significantly influences bulkhead and seawall design. Because bulkheads and seawalls receive the full force of the waves, strength of materials is vital in areas where waves are especially heavy. Where the cost of materials needed to withstand extremely rough waves (reinforced concrete, for example) is prohibitive, a breakwater or combination of protective structures might be more suitable than a bulkhead or seawall.



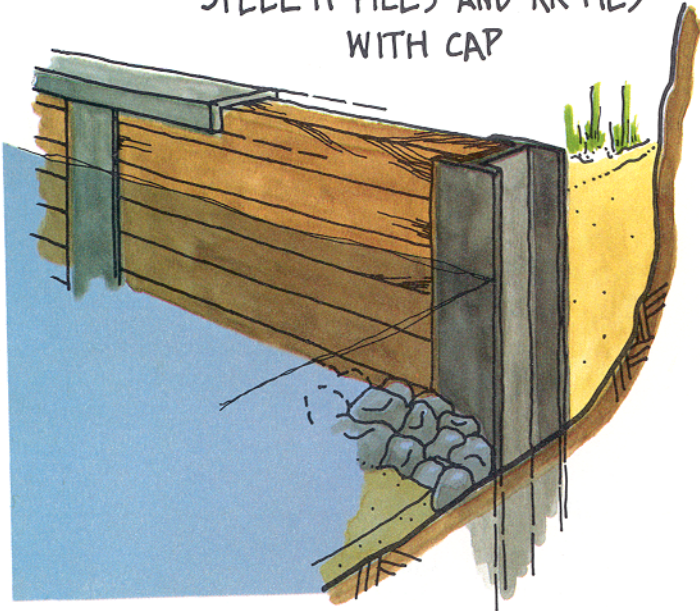
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## Construction Materials

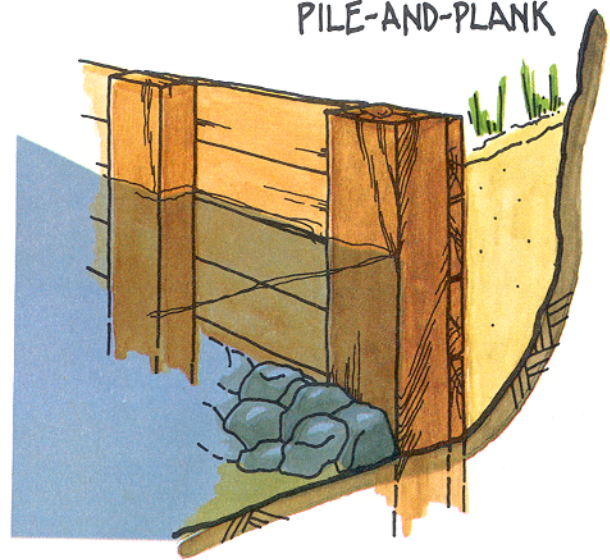
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Treated timber is generally the least expensive of the sturdy materials suitable for low cost seawalls and bulkheads, but it cannot be used in all designs. Timber is most useful in sheet-pile or in pile-and-plank designs. The combination of

STEEL H-PILES AND RTIES  
WITH CAP



PILE-AND-PLANK



timber with steel H-piles is relatively more expensive, and its cost may limit this design to a small number of special applications.

Steel or aluminum may be used in sheet-pile form, the choice of material depending on cost and the nature of the shore bottom (steel can penetrate harder materials than aluminum). With all sheet-pile construction, however, special equipment is needed to drive the piles into the ground. The chief advantage of sheet piling in bulkhead and seawall construction is its neat

appearance and relatively maintenance-free protection.

Bags filled with lean concrete mix and held in place by hogwire fencing are suitable for above-ground construction of gravity structures.

Care should be taken with all materials, both those that are locally abundant and those that are widely available, to conform to the design considerations mentioned earlier. In addition, special modifications may be necessary to adapt designs for use with locally available materials.