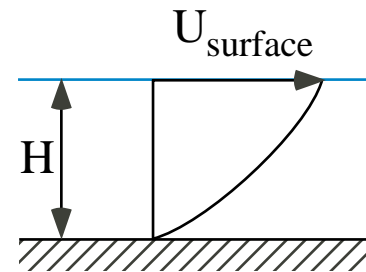
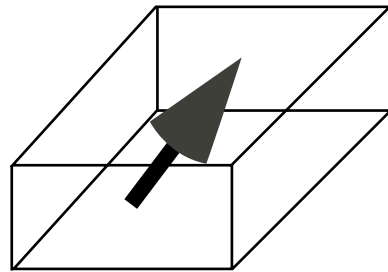


Shear stress

Shear stress is the primary variable that regulates sediment transport.

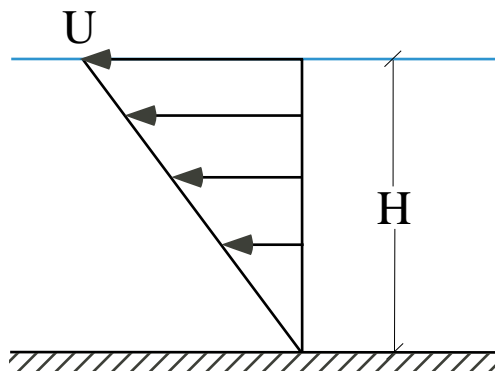
Shear stress τ is the force exerted per area on the bed.



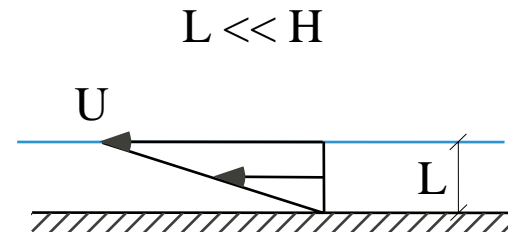
It is usually expressed as the product of the fluid viscosity μ and the velocity gradient (in the simplest case: U_{surface}/H). That is,

$$\tau = \frac{\mu U_{\text{surface}}}{H}$$

This means that transport rates are not entirely dependent on the speed the water flowing above it. The distance over which the speed varies also matters.



Low/small shear
(tidal currents)



more turbulence,
more transport

Large/high shear
(surf zone)

Near shore, when wave motions start to be felt at the bottom, the flow depth is small and the speed at which the flowing water changes direction is fast (i.e., the period of the waves is short).

These two effects combine to create a situation where the shear stress is large and dominated by wave motions, even though the absolute speed of the wave motions may be comparable to or less than surface tidal currents.

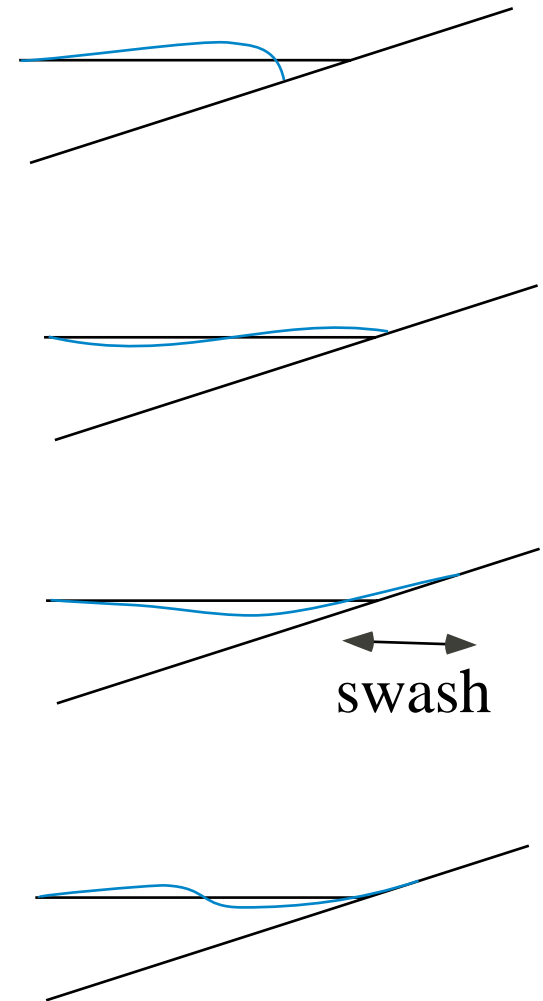
Swash

Swash is the area of the beach where the water surface meets the shoreline.

Due to incoming waves, that interface moves up and down the beach.

Even though the flow velocity isn't very large, the small flow depth makes the shear stress extremely large. As a result, even coarse material can be mobilized by slow-moving swash.

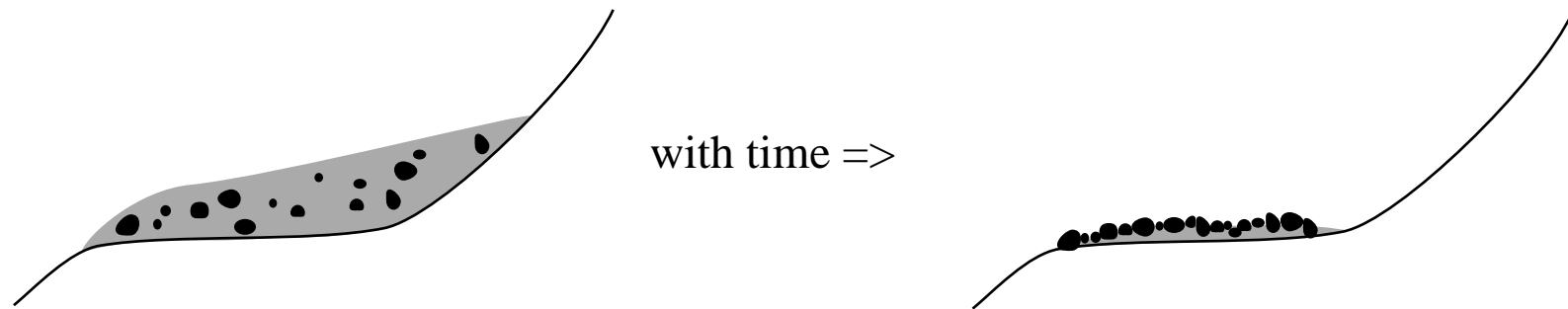
The shear within the swash is also **asymmetric**.



Gravel transport

An interesting effect happens when most of the sediment on bed is gravel (coarser than about 1 cm or 1/4 in). It is called **armor**ing.

Imagine a fresh landslide of till has arrived to the beach...



Clay, silt and sand at the surface are transported away from the site, while only coarse gravel and cobbles cover and protect the remaining deposit.

Bedforms

Bedforms are any feature that forms as a result of an interaction between sediment transport and a flow (e.g., dunes). However, dunes are rare in the Puget Sound. Here, one of the most common bedforms are **beach cusps**.



Mixed-sediment beach in New Zealand

Berms

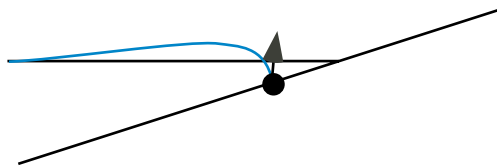


Numerous parallel shelly and woody berms near the point at Cama Beach

Berm formation

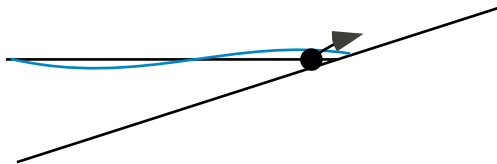
Berms form as a result of preferential shoreward transport within the swash. They are generally preserved (left behind) after a high-water event (stormy high tide, etc.).

1.



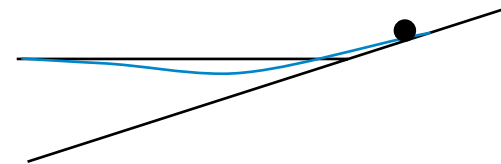
As new wave approaches, it breaks generating considerable turbulent energy.

2.



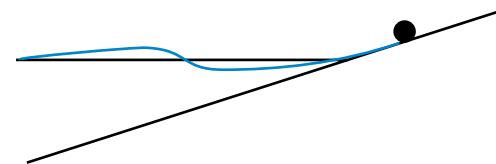
With collapse of wave, water is thrust landward, transporting mobilized sediment.

3.



Maximum height of swash. Motion stops and begins toward the sea; considerable sedimentation.

4.



Energy is lost to friction and some water permeates the beach. In sum, most sediment is deposited. A new wave approaches.

Longshore bars

Bars are an offshore accumulation of material near the point of wave breaking. Though there are many reasons for bar formation, most have to do with a convergence of sediment transport. This convergence maintains itself by fixing the point along the beach at which the waves break.

Bars are most common on sandy, exposed coasts, but they are relatively rare in Puget Sound. Muted bars can occur on the low-tide terrace.

