

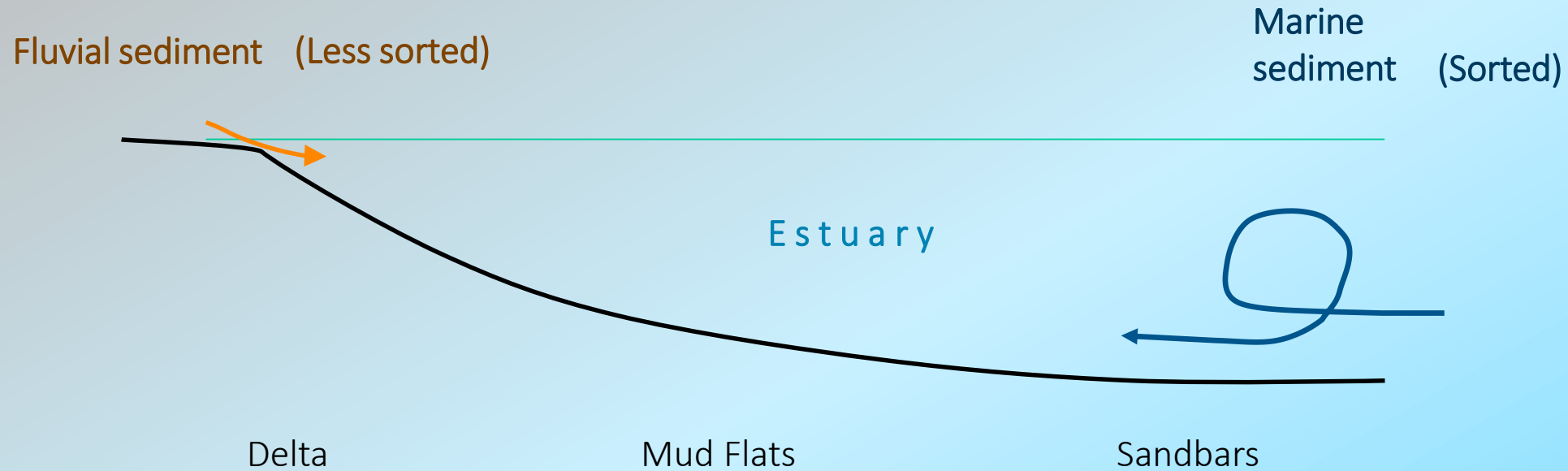
Estuarine Sedimentation

Andy Killick
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Gavin Lawson

Estuarine Sedimentation



Sedimentation controlled by;

- ☐ Sediment supply (2 main sources)
- ☐ Bottom morphology
- ☐ Hydrodynamics

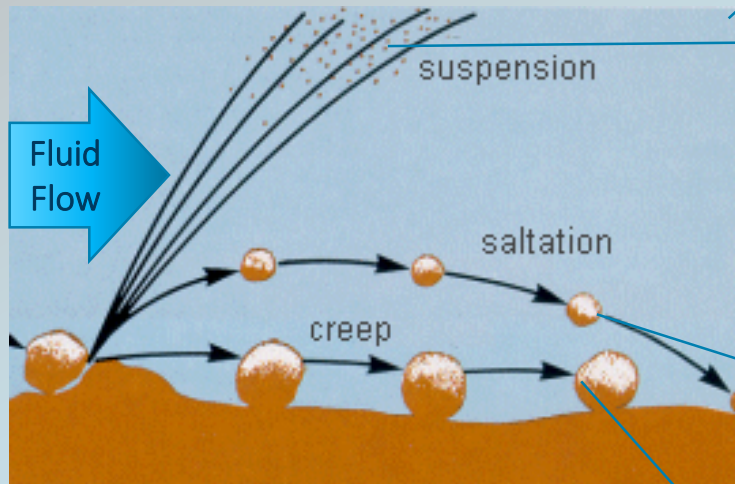
Basics: Sediment Grain Size

Zandvlei



Fragment	Size (Intermediate Diameter)
Clay	< 4 μm
	0.004 mm (4 μm)
Silt	Medium (0.016-0.03 mm)
	0.062 mm (62 μm)
Sand	Medium (0.25-0.50 mm)
	2 mm
Granule	Very Fine Pebble
	4 mm
Pebble	Medium (8-16 mm)
	64 mm
Cobble	
	256 mm
Boulder	> 25.6 cm

Basics: Sediment Transport



Solution – ionic species in water (dissolved load) irrespective of fluid flow. Comprises much of the pollutants or nutrients.

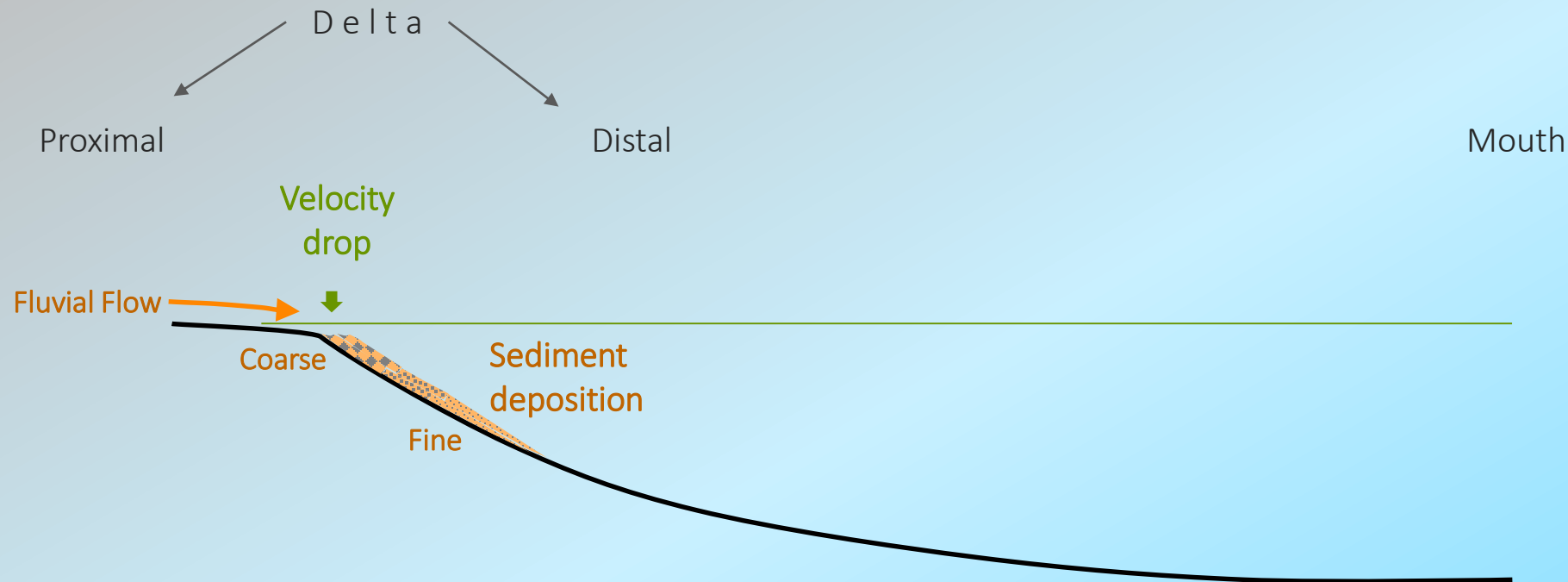
Suspension – turbulence forces continuously exceed gravitational forces on particle. More & coarser grains near boundary with highest turbulence. 90% of river sediment transported in suspension – mostly fine sand & smaller. Includes the wash load.

Saltation – turbulence generates drag & lift forces similar in magnitude to particle weight. Saltation causes erosion and entrainment

Fluid Threshold (Impact)

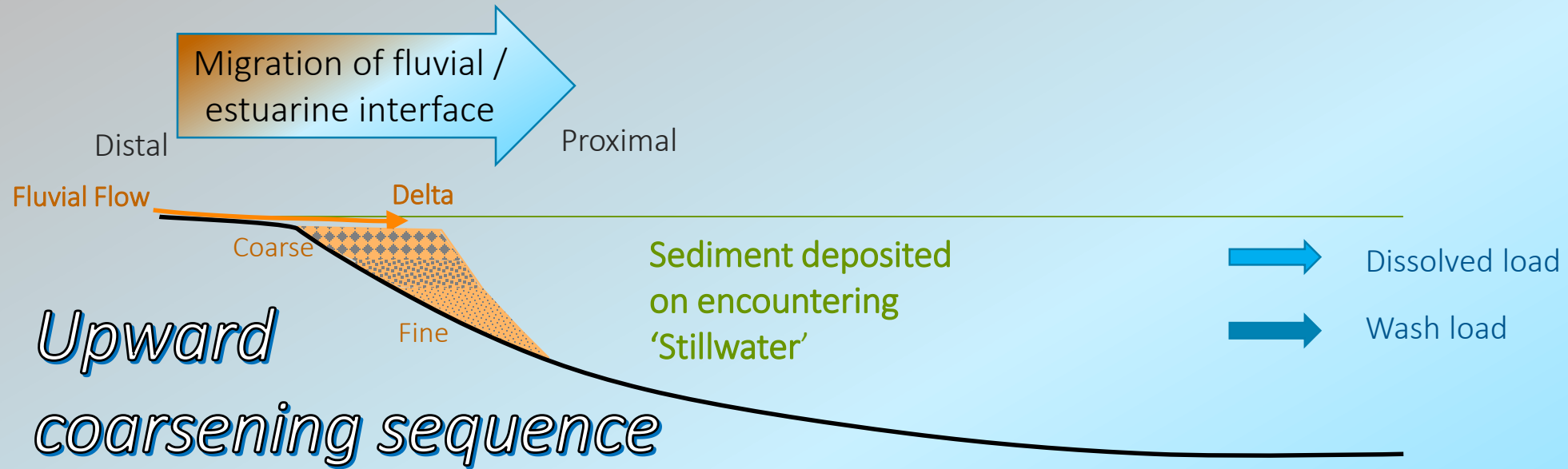
Creep (Reptation) – low fluid velocity, particles roll downstream. Comprises coarser material in transport and is referred to as bedload (<10%). Important geomorphic agent.

Estuarine Sedimentation: Delta



Coarser sediment deposited proximally and finer sediment more distally with respect to the fluvial provenance

Estuarine Sedimentation: Delta



Bed load – most pebbles & sand deposited in fluvial channels

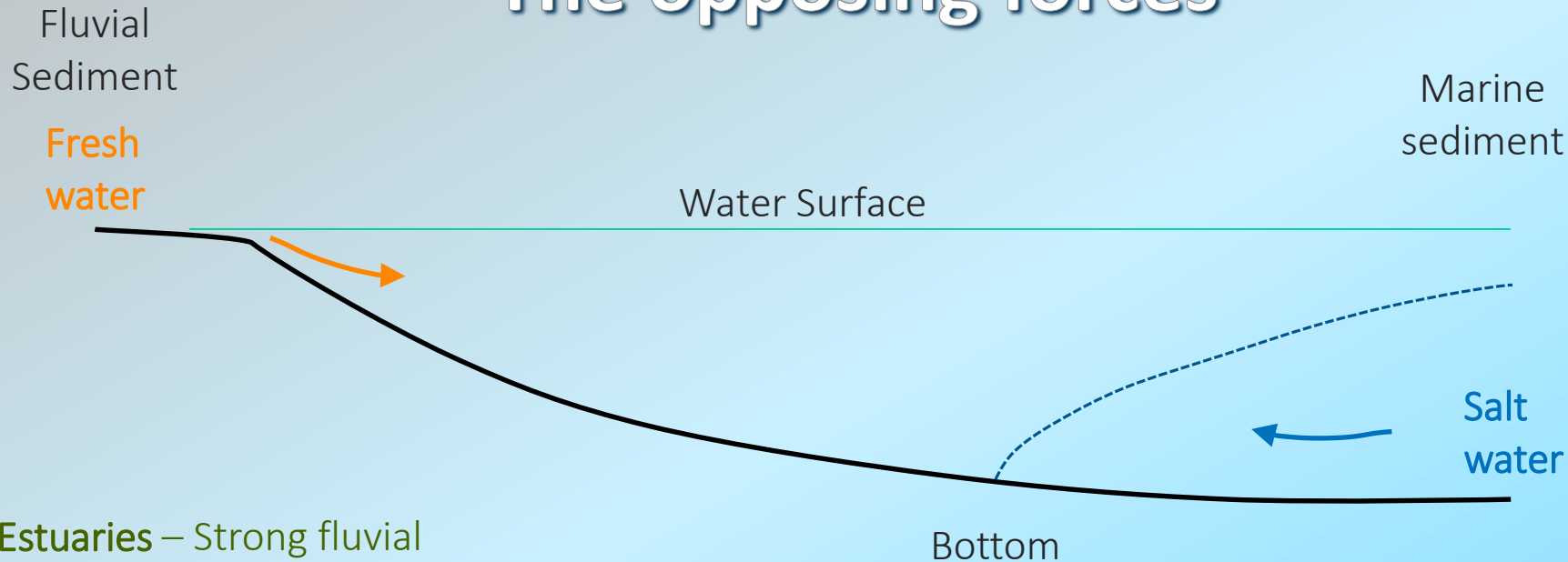
Suspended load – dropped due to reduced velocity on encountering 'stillwater'. Grainsize sorting- coarse material dropped proximally & finer distally

Closed mouth – clay material settles out in low energy parts of estuary. Wash and Dissolved loads may adsorb on particles and flocculates, becoming part of the sediment profile. This could enhance biogenesis – eutrophication

Open mouth – with strong fluvial flow much of the clay (suspended) and wash load will be exported to sea, ultimately being deposited on the shelf.

Tidal Dynamics:

The opposing forces



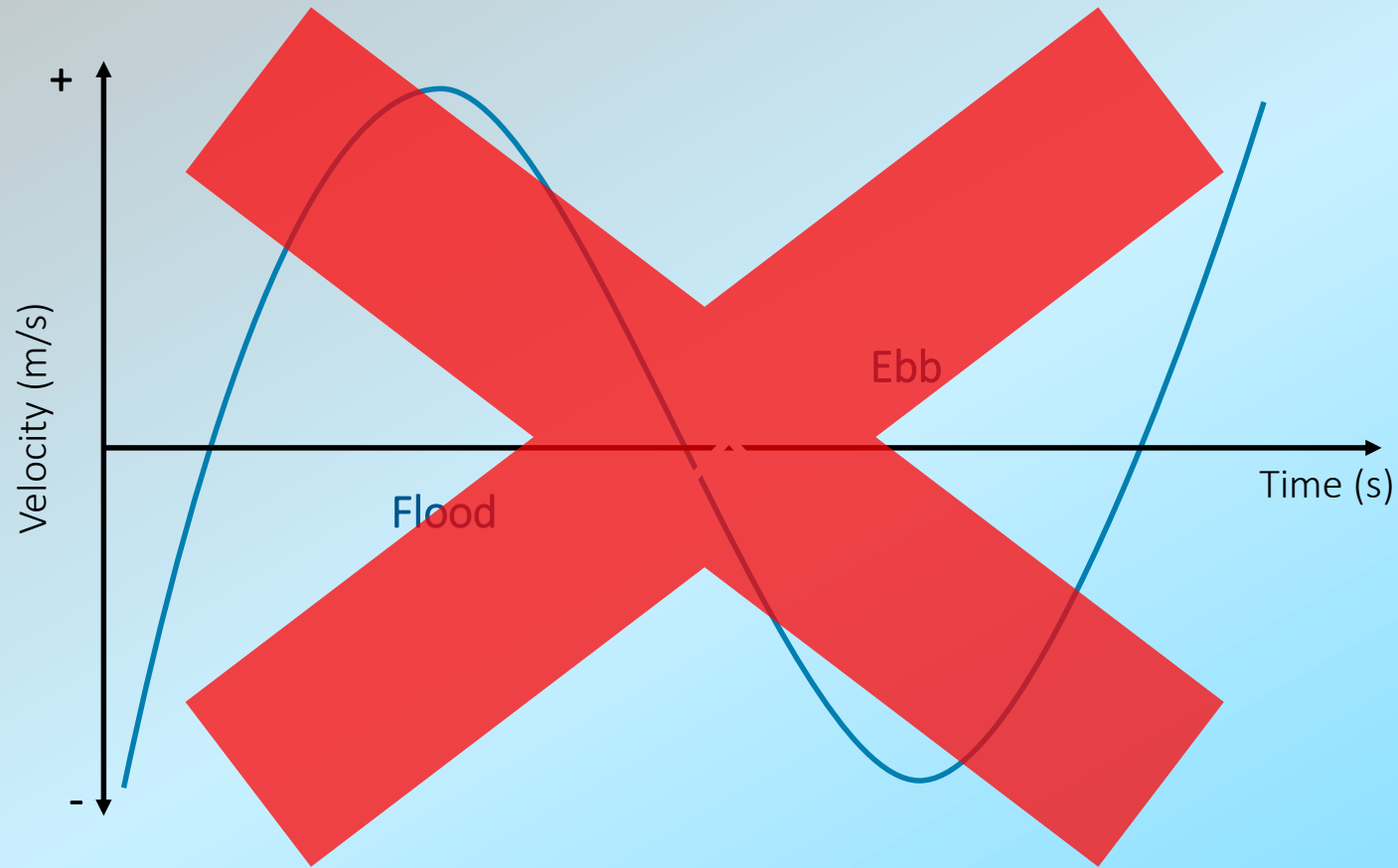
Salt Wedge Estuaries – Strong fluvial Component in deeper estuaries

Partially Stratified Estuaries – typical of shallower wider estuaries. Turbulence on interfaces partially mixes the column

Vertically Homogeneous Estuaries – typical of estuaries with large Width/Depth ratio. Bottom shear mixes the column. Tend to be tide dominated.

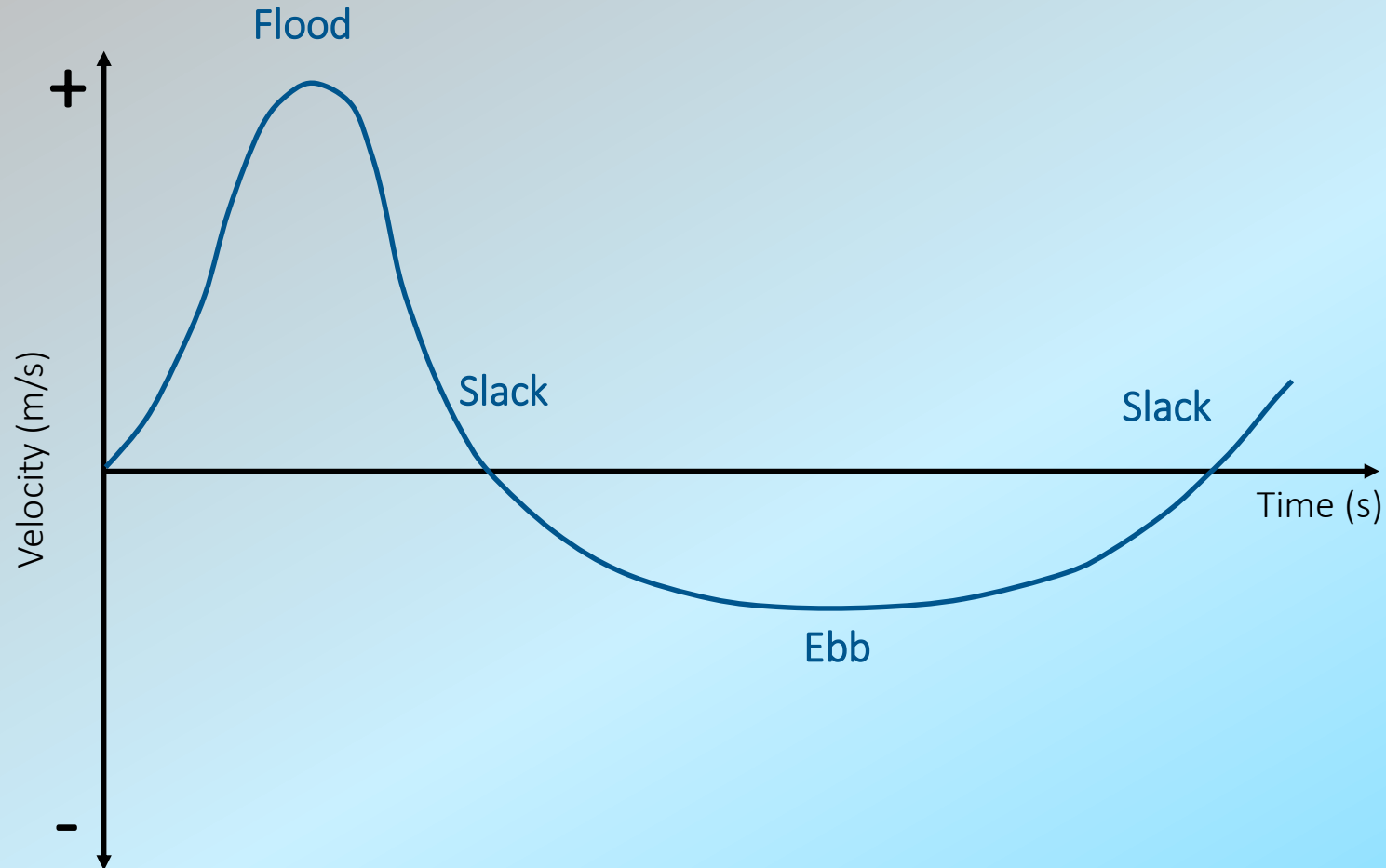
Tidal Prism = volume of water leaving estuary on ebb, or mean difference in high and low). If the prism is a significant part of the estuary volume (i.e. in shallow, small estuaries) then much of the pollutants and sediment is removed

Tidal Dynamics: Marine

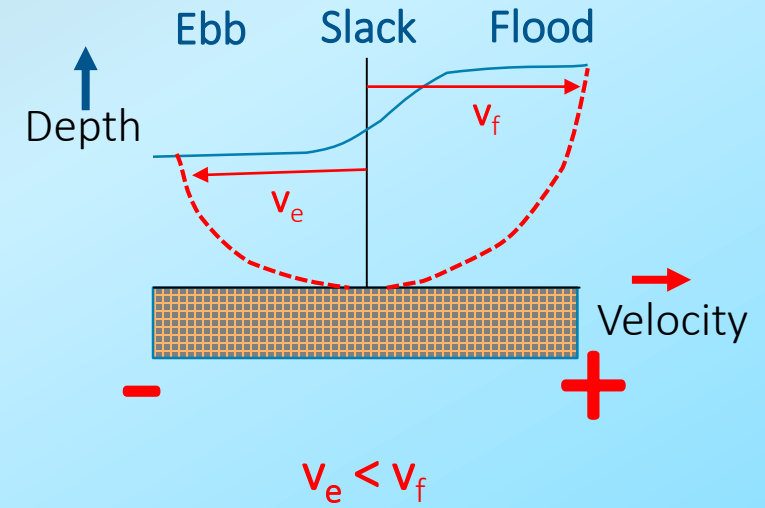


The more symmetrical tidal cycle of the marine environment does not apply in most estuaries

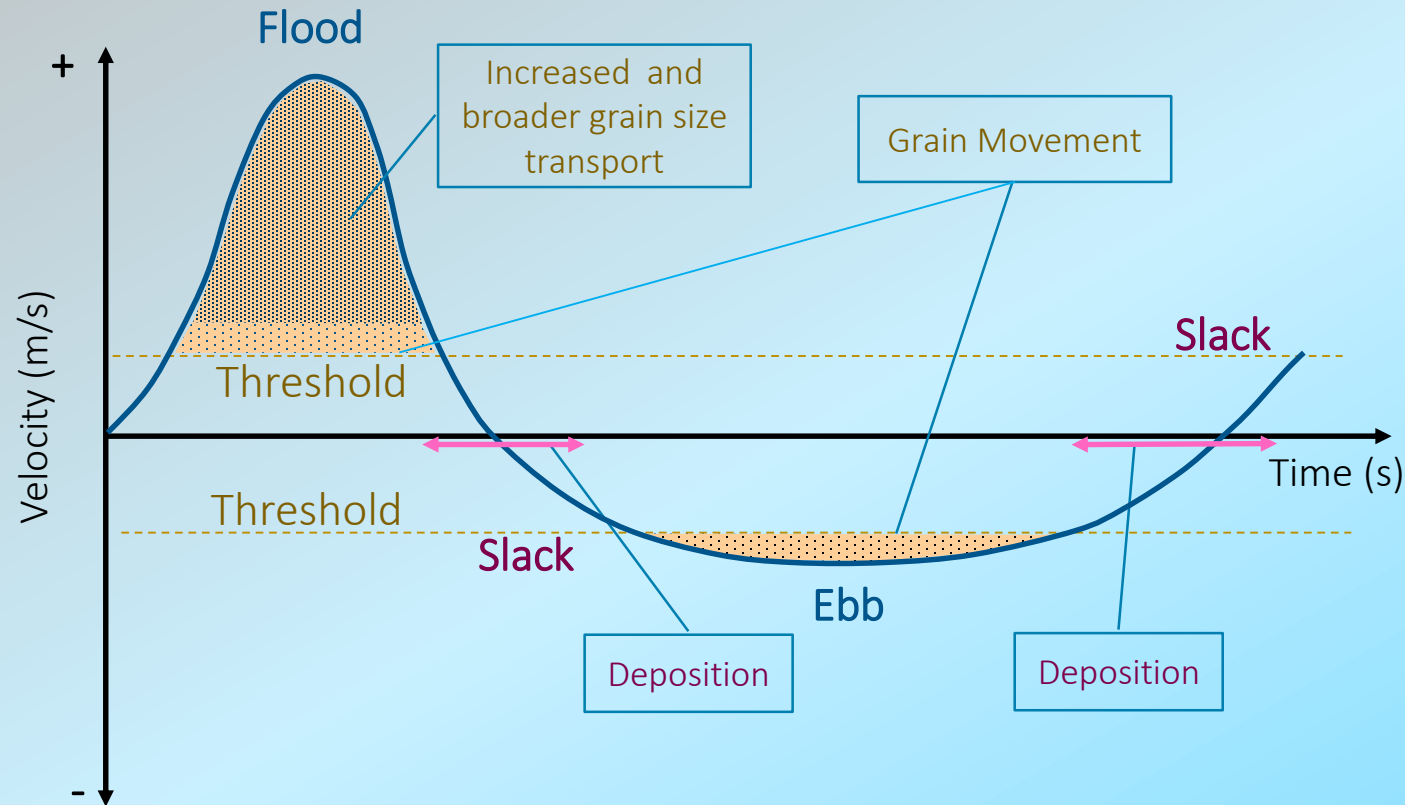
Tidal Dynamics: Estuarine



(Modified from Brown & Davies, 2007)

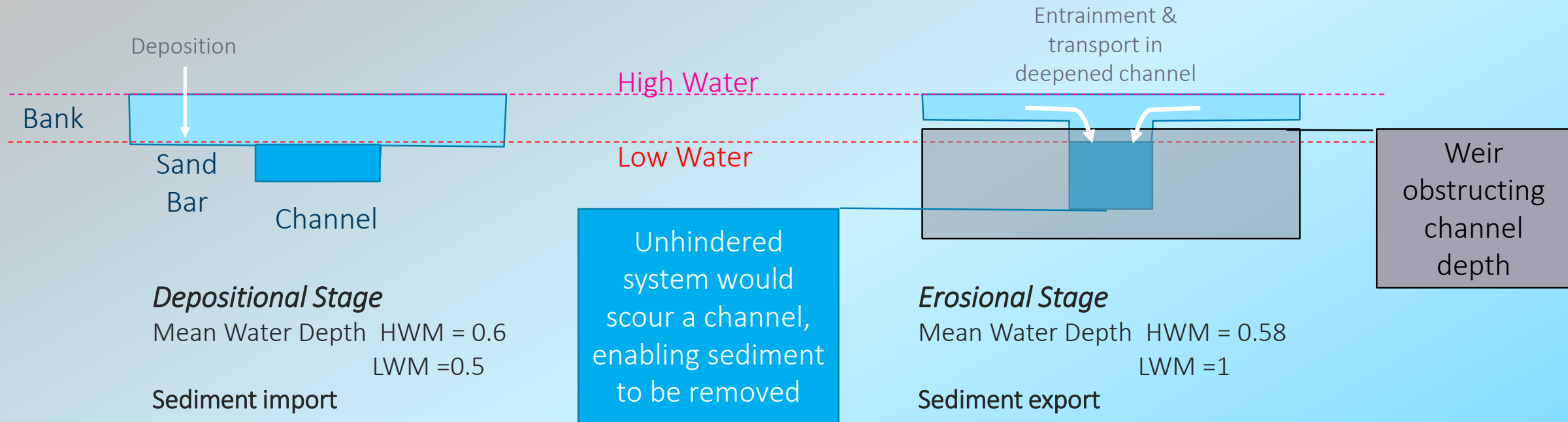


Tidal Dynamics: Estuarine



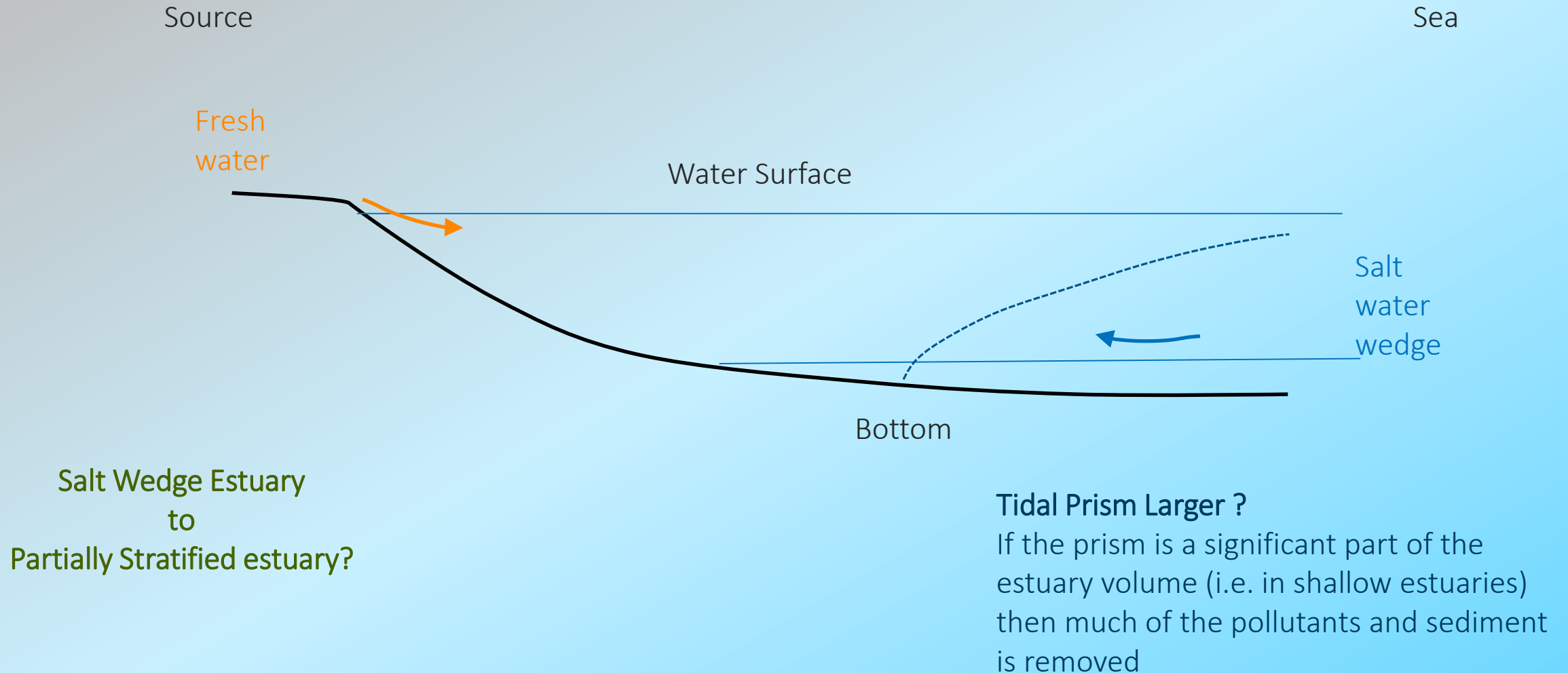
Variation in amount of sediment and grain size as function of current velocity

Tidal Dynamics: Estuarine

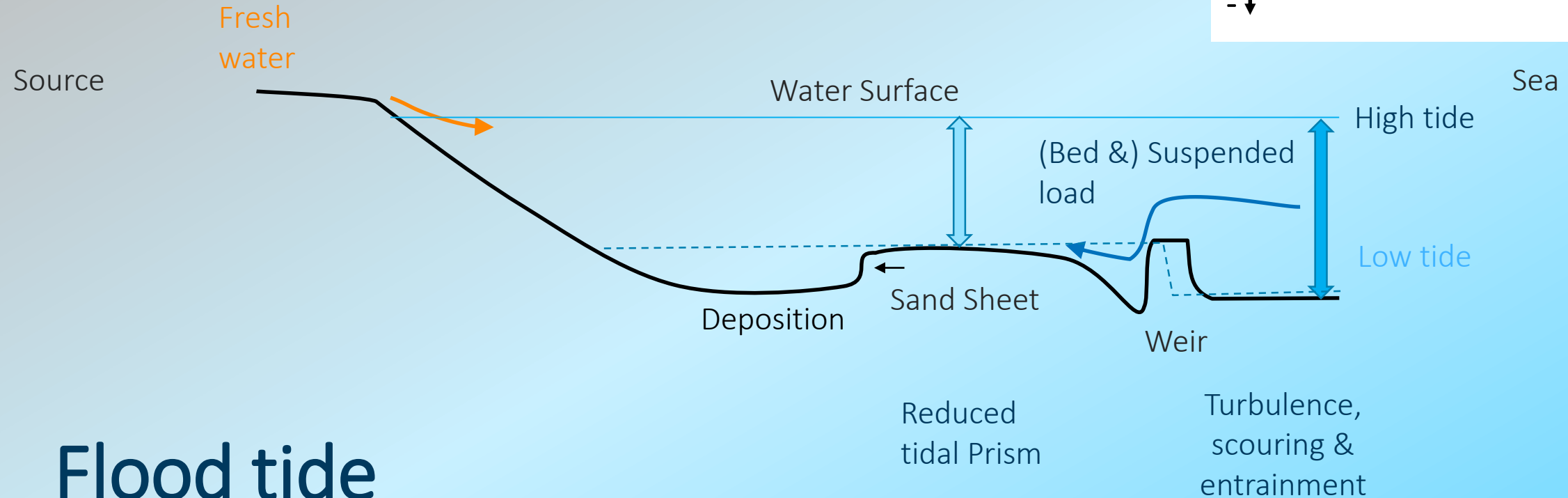
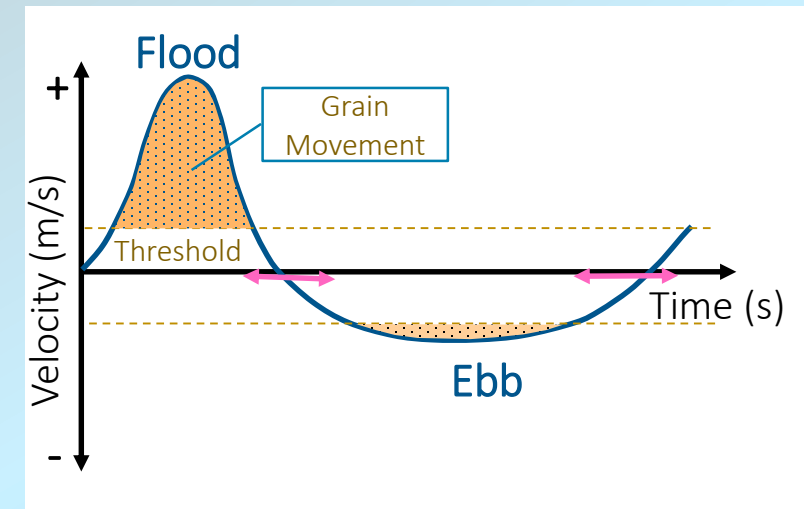


The self-correcting mechanism of a deeper mean water depth on the ebb tide has been thwarted by the introduction of a rock weir/ sewerage pipe

Zandvlei: Before



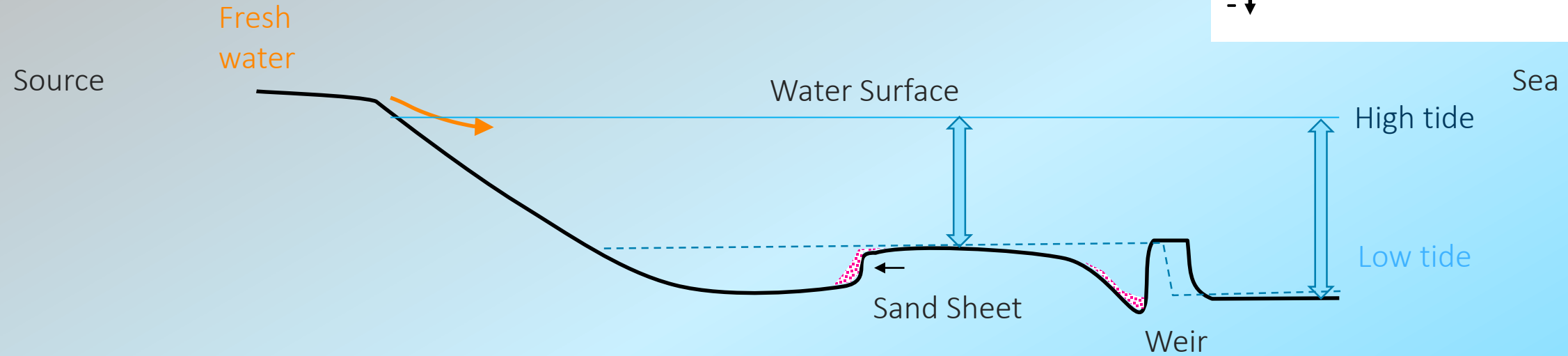
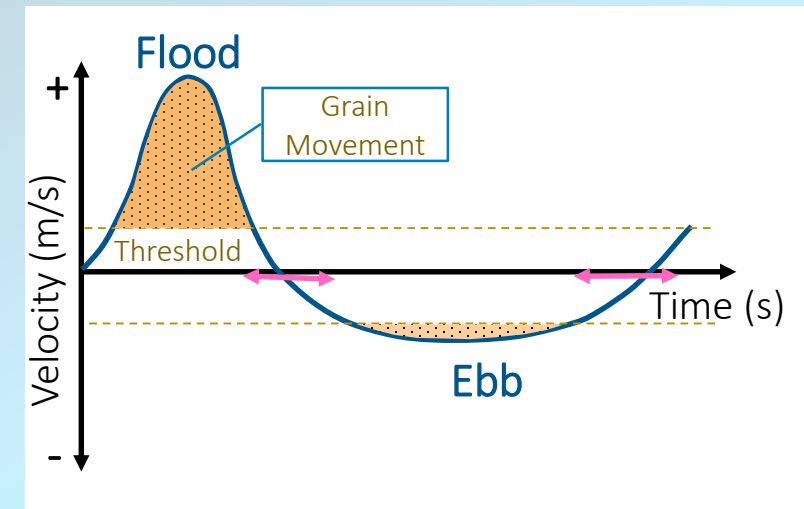
Zandvlei: Now



Flood tide

Increased water depth = higher velocity
= large sediment import

Zandvlei: Now

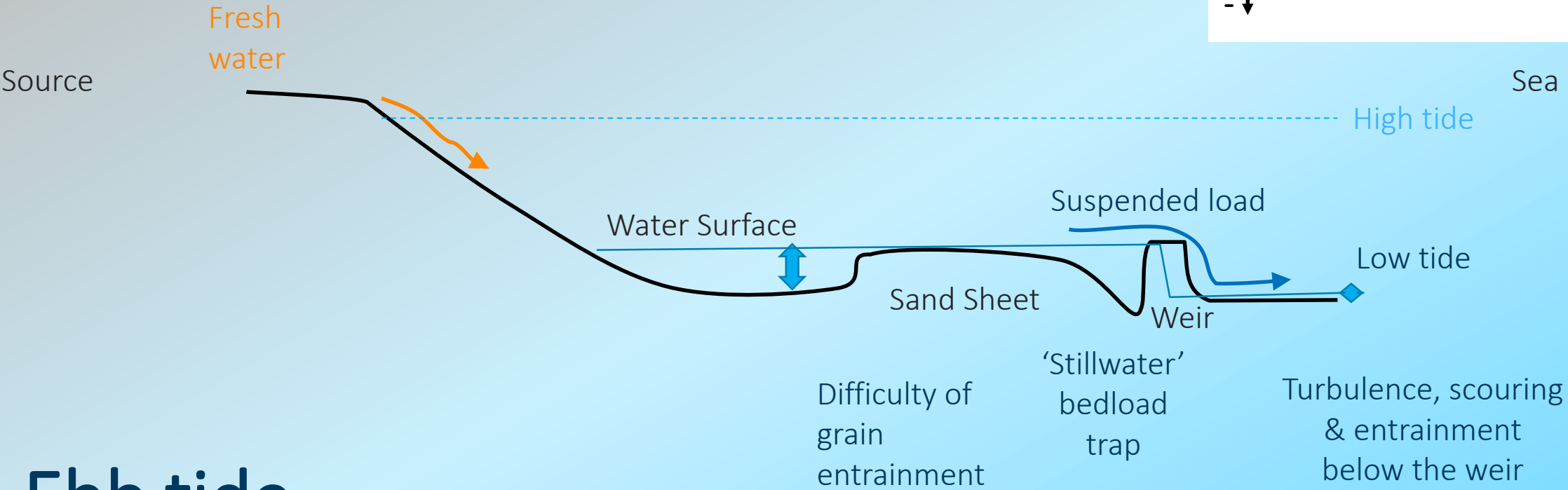
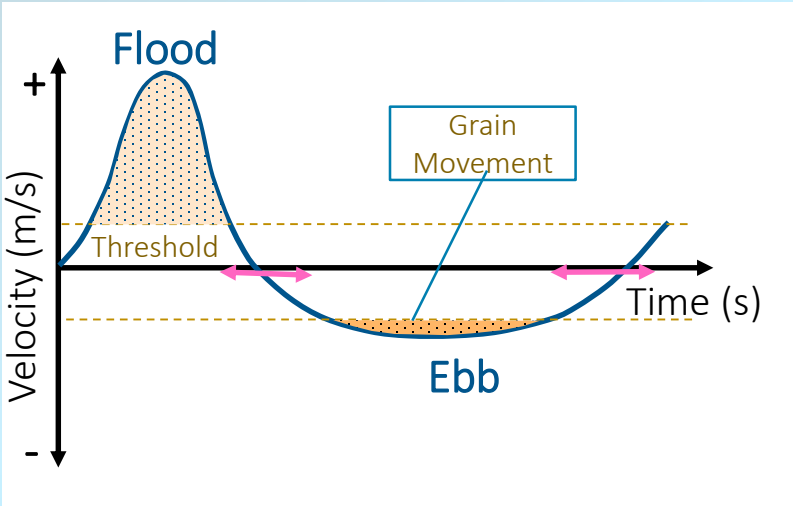


Slack

Intermediate water depth
velocity below threshold = deposition

No creep or saltation.
Some sediment even falls out of suspension

Zandvlei: Now



Ebb tide

- Reducing water depth
- = reduced velocity
- = less and only finer sediment entrained
- = limited sediment export

Zandvlei: Now



The Weir on the ebb tide:
Mostly laminar flow
above and turbulent flow
below

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