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## Wave-dominated estuaries

**Also known as: barrier estuaries, bar-built estuaries, and intermittently closed and open lakes and lagoons (ICOLL's).**

### Conceptual model diagrams of wave-dominated estuaries



[Physical characteristics](#)  
[Sedimentary environments \(habitats\)](#)  
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### Key features of wave-dominated estuaries

1. A diverse range of both marine and brackish, subtidal, intertidal and supratidal estuarine habitats are supported.
2. Narrow entrance restricts marine flushing, only a small proportion of the estuarine water volume is exchanged each tide.
3. River flow typically high, and flooding may expel marine water and flush material from the estuary.
4. **Turbidity**, in terms of suspended sediment, is naturally low except during extreme wind or fluvial runoff events.
5. Central basin is an efficient 'trap' for terrigenous sediment and pollutants.
6. Long residence time encourages trapping and processing (e.g. **denitrification**) of terrigenous **nitrogen loads**.
7. **'Semi-mature'** in terms of evolution: morphology will rapidly change over time due to infilling, resulting in shallowing of the central basin, and expansion of the fluvial delta.



### Geomorphology

A wave-dominated estuary represents a coastal bedrock embayment that has been partially infilled by sediment derived from both the catchment and marine sources, in which waves are the dominant force shaping the gross geomorphology. In Australia, wave-dominated estuaries are most abundant on the **south-east and south-west coasts**, where they occur on exposed coastlines with a relatively small tidal influence (Roy et al., 2001, Cooper, 2001). Wave-dominated estuaries feature a supra-tidal (or sub-aerial) **barrier** at the mouth that encloses a broad **central basin**. The barrier creates a **constricted entrance** (which can be periodically closed) that allows the exchange of water between the central basin and the sea. Sediment in wave-dominated estuaries ranges from fine to coarse sands in the barrier and **tidal inlet** deposits, fine organic muds and sandy muds in the central basin, to coarse, unsorted gravels, sands and muds (mostly of terrigenous origin) in the **fluvial bayhead delta** (Nichol, 1991). Depending on the degree of sediment infilling, the central basin of wave-dominated estuaries may be irregularly-shaped, following the outline of the drowned bedrock valley (Riggs et al., 1995).

## Tide-dominated estuaries:

Physical characteristics  
Sedimentary environments  
Positive Hydrology  
Negative Hydrology  
Sediment transport  
Nitrogen dynamics

## Tide-dominated deltas:

Physical characteristics  
Sedimentary environments  
Hydrology  
Sediment transport  
Nitrogen dynamics

## Tidal creeks:

Sedimentary environments  
Hydrology  
Sediment transport  
Nitrogen dynamics

## Further information

Evolution  
Geomorphic model development  
Sedimentary environments

## Process models

## Threat models

## Stressor models

## Build your own model

## External links

## References

## Acknowledgements

## Glossary

In the case of wave-dominated estuaries formed in unconsolidated coastal deposits the central basin may be oval-shaped and oriented parallel to the coast (Chapman et al., 1982, Morrisey, 1995). At the head of a wave-dominated estuary is a [fluvial bayhead delta](#) that extends into the central basin and is comprised of vegetated and unvegetated levees, channels, and intertidal areas. The fluvial bayhead delta is constructed from terrigenous material from the catchment being deposited and the mouth of the river (Webster et al., 2002, Pasternack et al., 2002).



**Figure 1.** Examples of wave-dominated estuaries: Tuggerah Lakes (NSW), Broke Inlet (WA), Angurugubira Lake (NT).

## Evolution

The evolution of wave-dominated estuaries is characterised by [infilling \(sedimentation rates\)](#) of the valley, principally the central basin (Roy et al., 1980). As such, wave-dominated estuaries evolve or mature by the simultaneous seaward progradation of the [fluvial bayhead delta](#), and the landward progradation of the [flood tidal delta](#), and also by the expansion of fringing [intertidal flats](#) (Roy, 1984a). Recent studies quantifying the areas of geomorphic and sedimentary environments in Australia's wave-dominated estuaries (e.g., Roy et al., 2001, Heap et al., In Press) have demonstrated that infilling is dominated by the expansion of intertidal environments around the central basin and progradation of the fluvial bayhead delta and alluvial plain, rather than from progradation of the flood tide delta. Given sufficient time and constant sediment supply, wave-dominated estuaries have the potential to evolve into [wave-dominated deltas](#) when the central basin is completely infilled (or is bypassed by the river channel), and terrigenous sediment is exported directly to the ocean rather than being trapped (Heap et al., In Press).

## Habitats and ecology

Wave-dominated estuaries generally contain "true estuarine" (or euryhaline) species, and transient visitors from full marine environments (Paterson et al., 2000, Potter et al., 1994, Rainer et al., 1981b). This is because wave-dominated estuaries provide a diverse range of habitats, such as high-energy [sandy beaches](#) and [channel](#) sands, sheltered deep [muddy basins](#), shallow water habitats, [mangroves](#), [saltmarshes](#), and [intertidal flats](#) (Roy et al. 2001). Depending upon entrance conditions, and latitude, saltmarshes and mangroves can occur around the edges of the central basin, and the high-energy conditions of the inlet produce a sandy substrate and relatively clear shallow waters, that generally support various [seagrasses](#) (Rainer et al., 1981a, Abal et al., 1996, Hannan et al., 1998, Humphries et al., 1992). Central basin muds often support benthic micro- and [macroalgae](#) (Cahoon et al., 1999), and various [invertebrates](#). Wave-dominated estuaries that have undergone slow infilling can contain large areas of [rocky shore](#) and [reef habitats](#) that support a variety of biota (Griffiths, 2001).

