



Breakwaters & Training Walls

The good, the bad and the ugly

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Across Australia, **breakwaters and training walls** have instigated **fundamental perturbations** to coastal and estuary processes, with **significant consequences**.

Why build breakwaters and training walls?

... to improve hydraulic conveyance of entrance channels to:

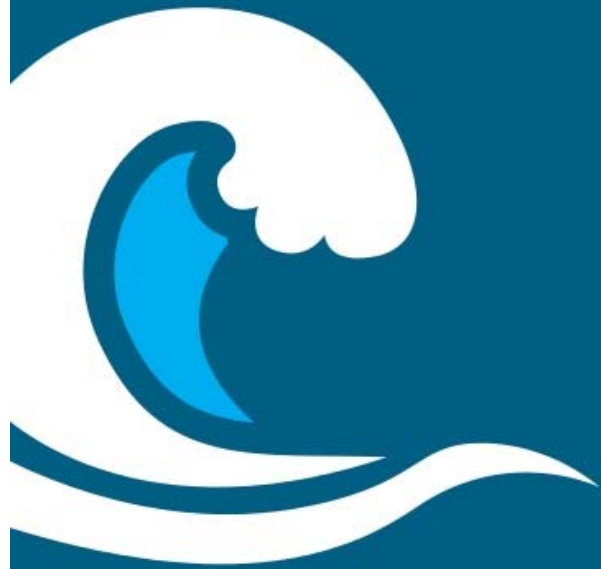
- Increase discharge capacity for major floods
- Assist in minimising nuisance flooding of low lying areas
- Increase estuary/lower river flushing thereby "improving" water quality
- Improve navigability by increasing depths, particularly over entrance bars
- Stabilise entrance location





Impacts on coastal processes

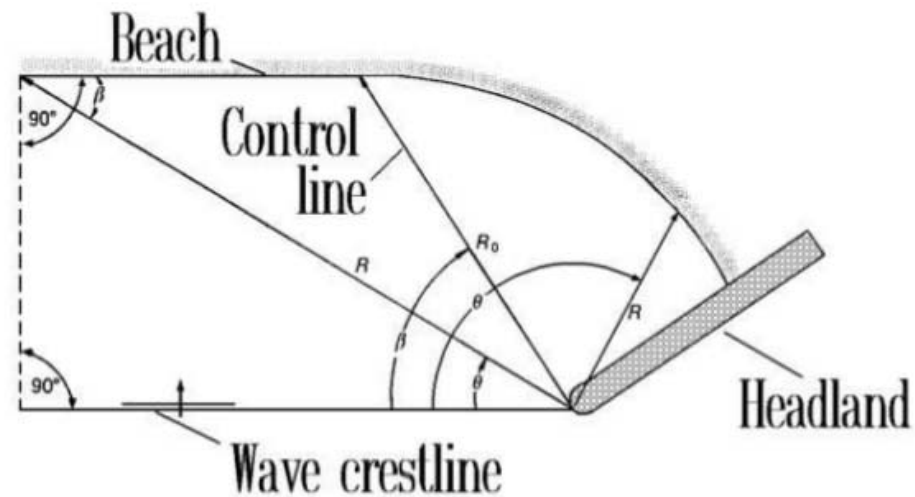
- Trap of littoral drift causing down-drift erosion (e.g. Tweed River breakwaters starving sand to Gold Coast beaches, Coffs Harbour etc.)
- Change in nearshore wave patterns causing coastal re-alignment - a sleeper that occurs somewhat frequently



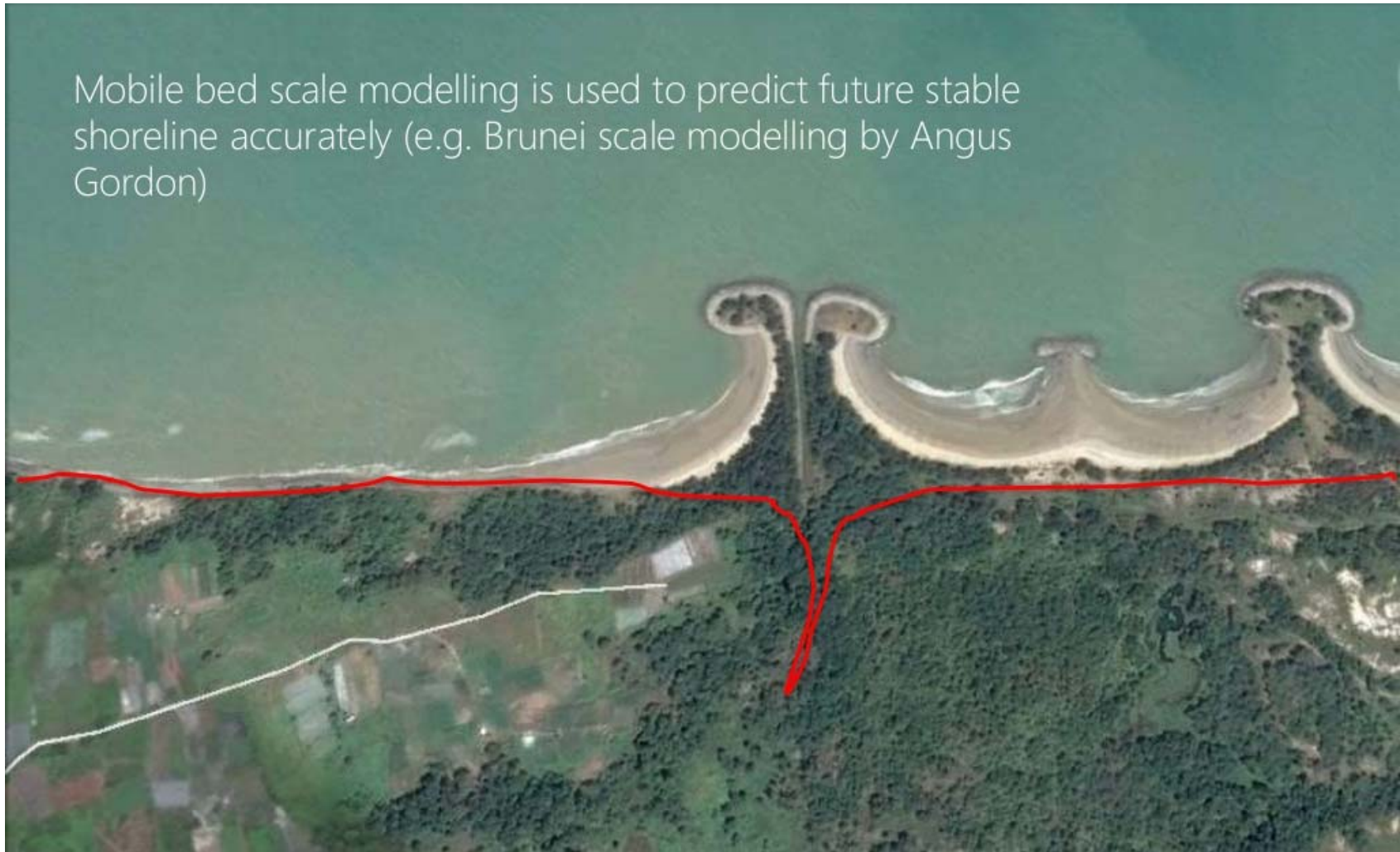
Mobile bed scale modelling has demonstrated conclusively that **breakwaters can change beach alignments** by creating artificial headlands forming crenulated bays on what previously were linear shorelines.

Crenulate shaped bays

- Crenulate shaped bays have been used to stabilize coasts (Richard Silvester, Siew-Koon Ho)
- Crenulate shaped bays exist between headlands
- They have been scale modelled successfully to predict future shorelines accurately



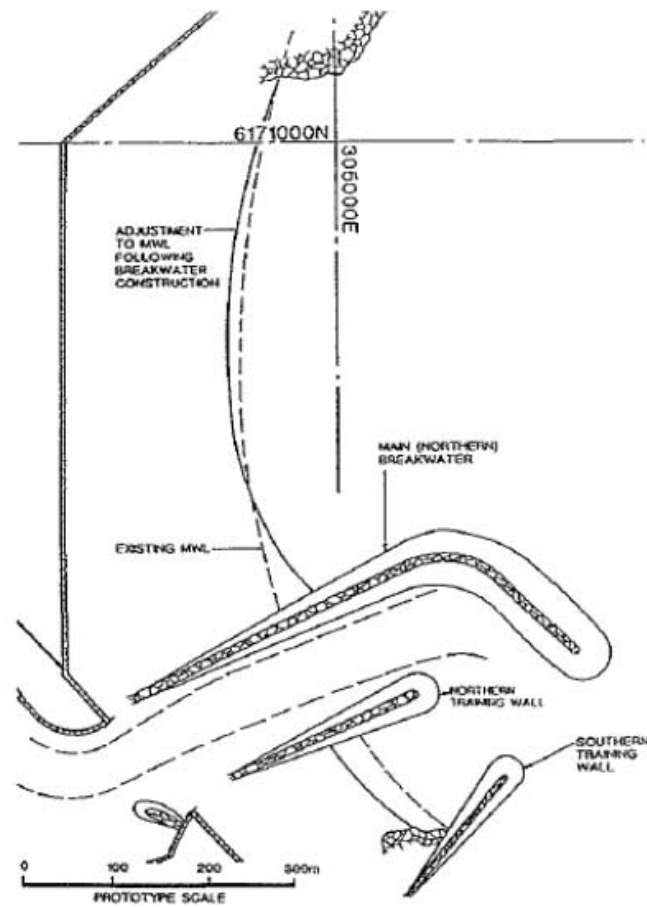
Mobile bed scale modelling is used to predict future stable shoreline accurately (e.g. Brunei scale modelling by Angus Gordon)



The red line shows the coastline before artificial breakwater headlands were developed for the river, and an artificial headland and reef to the right.

Coastal re-alignments

Mobile bed scale models study the impact of breakwaters on beach alignment



Coastal re-alignments

Computer model study of Stockton Beach Newcastle

The northern Hunter River breakwater had a significant impact on the shoreline at Stockton:

- Cut off the flood tide channel that had run along the beach and into the entrance - removing the entrance bar and accretion of sand
- Induced erosion to the north as the shoreline responded to the changed tidal flow and wave conditions



Coastal re-alignments

Similar could occur if breakwater are constructed at The Entrance on the NSW Central Coast



Impacts on estuary processes

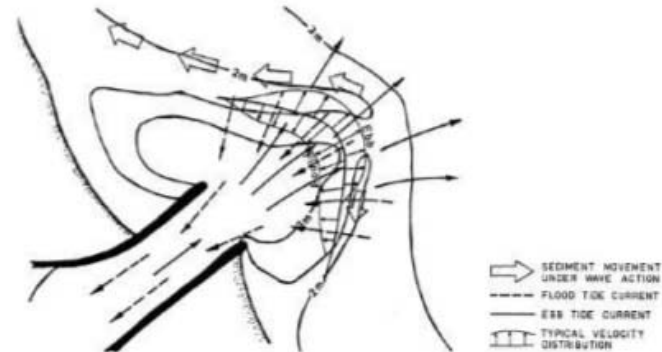
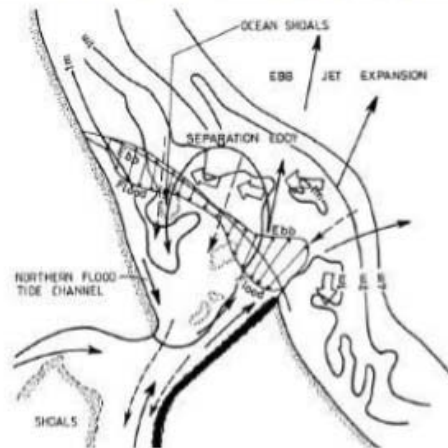
Breakwaters enhance hydraulic efficiency and tidal conveyance



Wallis Lake Inlet 1952 (Photograph courtesy NSW Governm



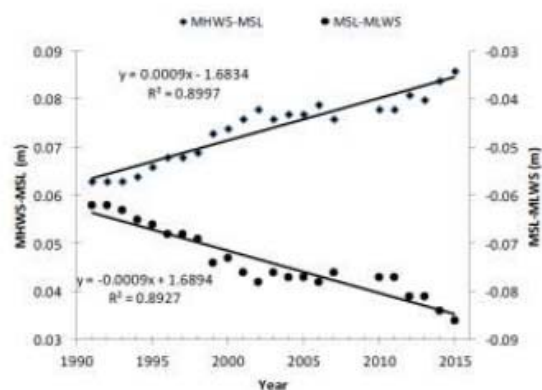
Wallis Lake Inlet 1974 (Photograph courtesy NSW Government)



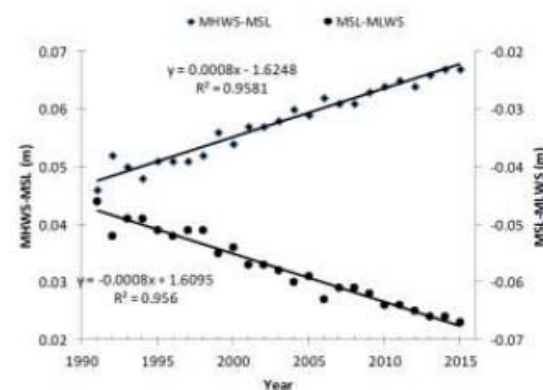
Long-term impacts on tidal planes

The construction of entrance breakwaters on Wallis Lake, Lake Macquarie, Lake Illawarra and Lake Wagonga has triggered unstable scouring modes at these estuary entrance channels.

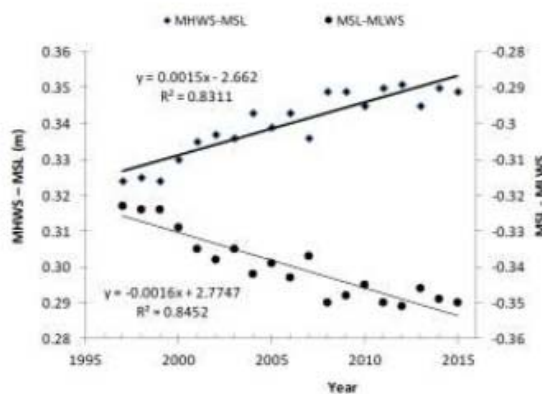
High water levels are increasing while low water levels are decreasing (note various scales).



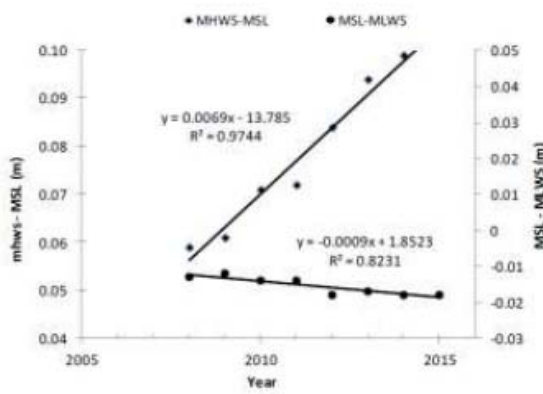
(a) Wallis Lake



(b) Lake Macquarie



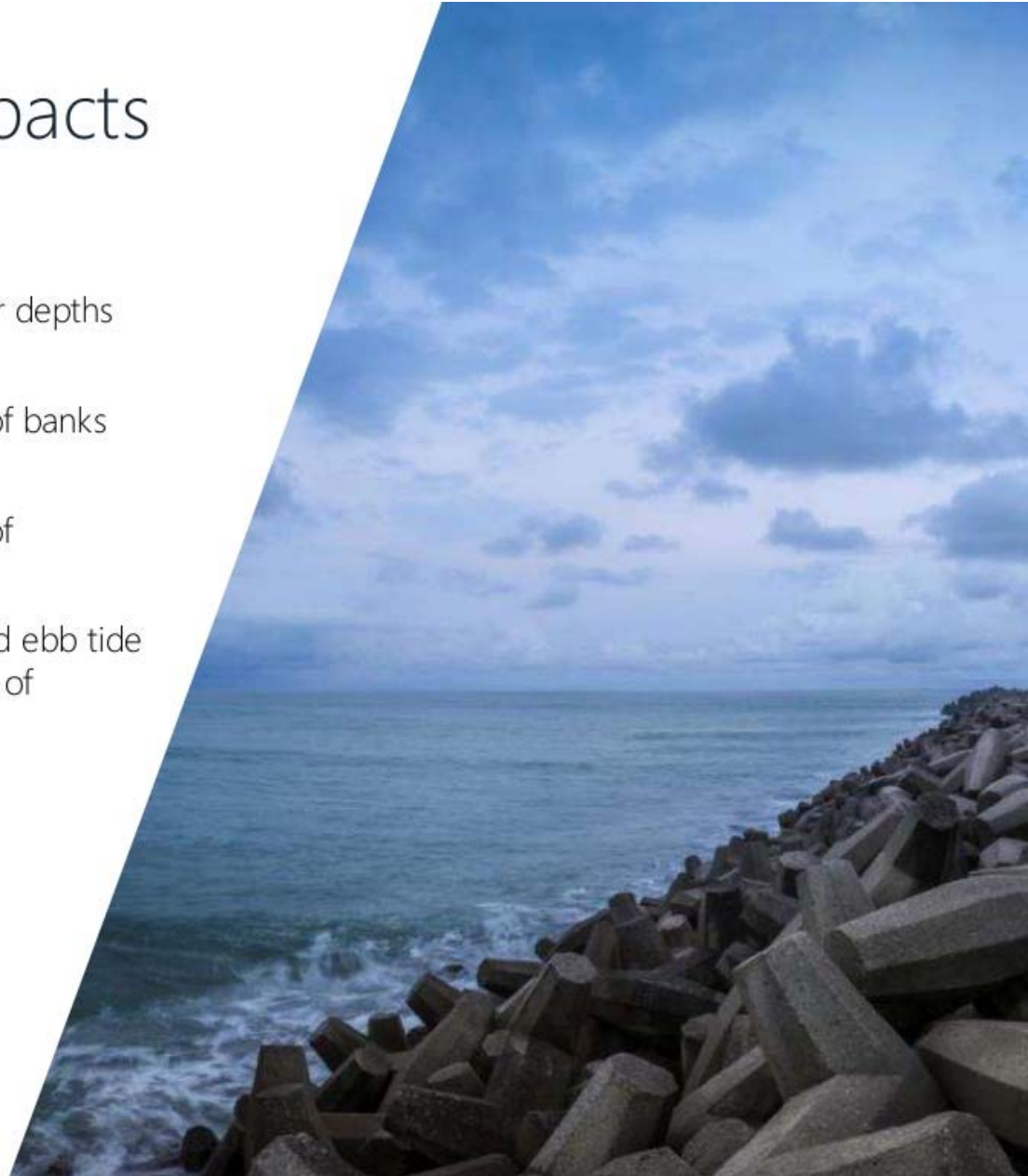
(c) Lake Wagonga



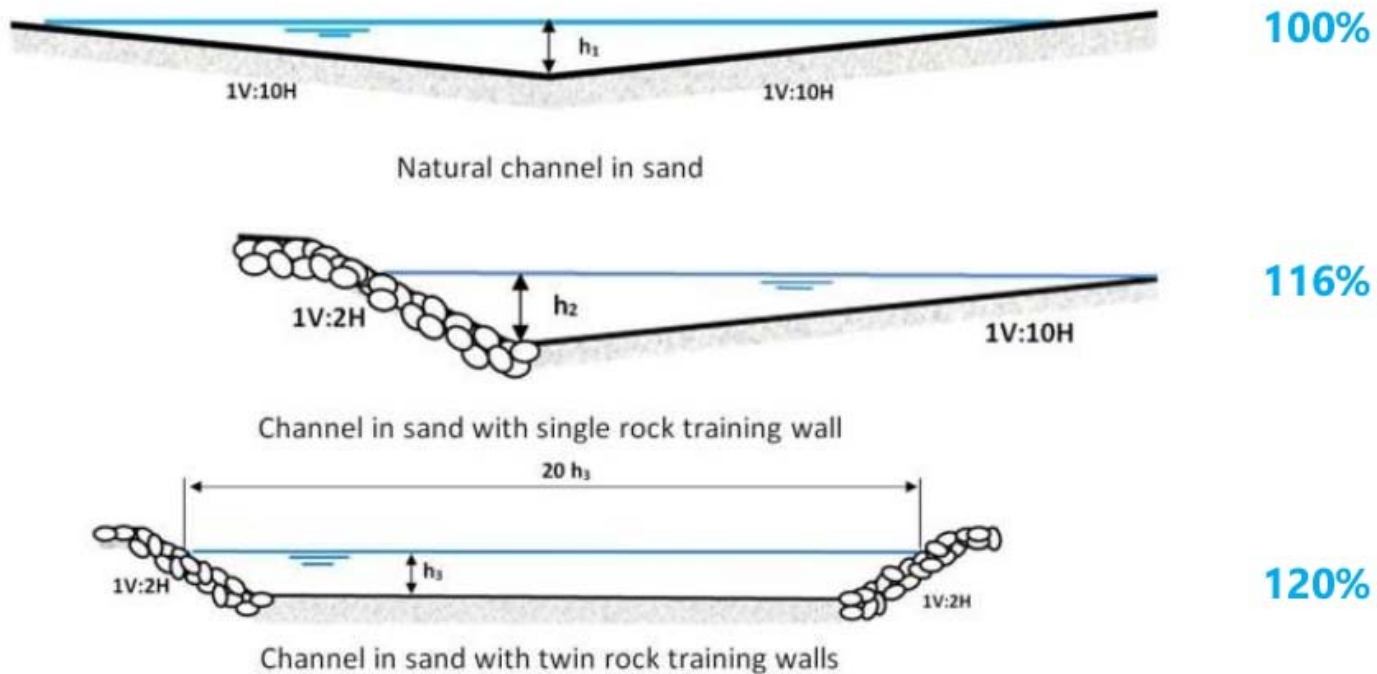
(d) Lake Illawarra

Long-term impacts on channels

- Channels scoured to greater depths with removal of seagrasses
- Undermining and collapse of banks and retaining structures
- Undermining and collapse of infrastructure (e.g. bridges)
- Deposition on flood tide and ebb tide deltas including smothering of seagrasses



Training walls enhance hydraulic efficiency and tidal conveyance



Long-term impacts of training walls

Training walls stabilise channel and increase hydraulic conveyance

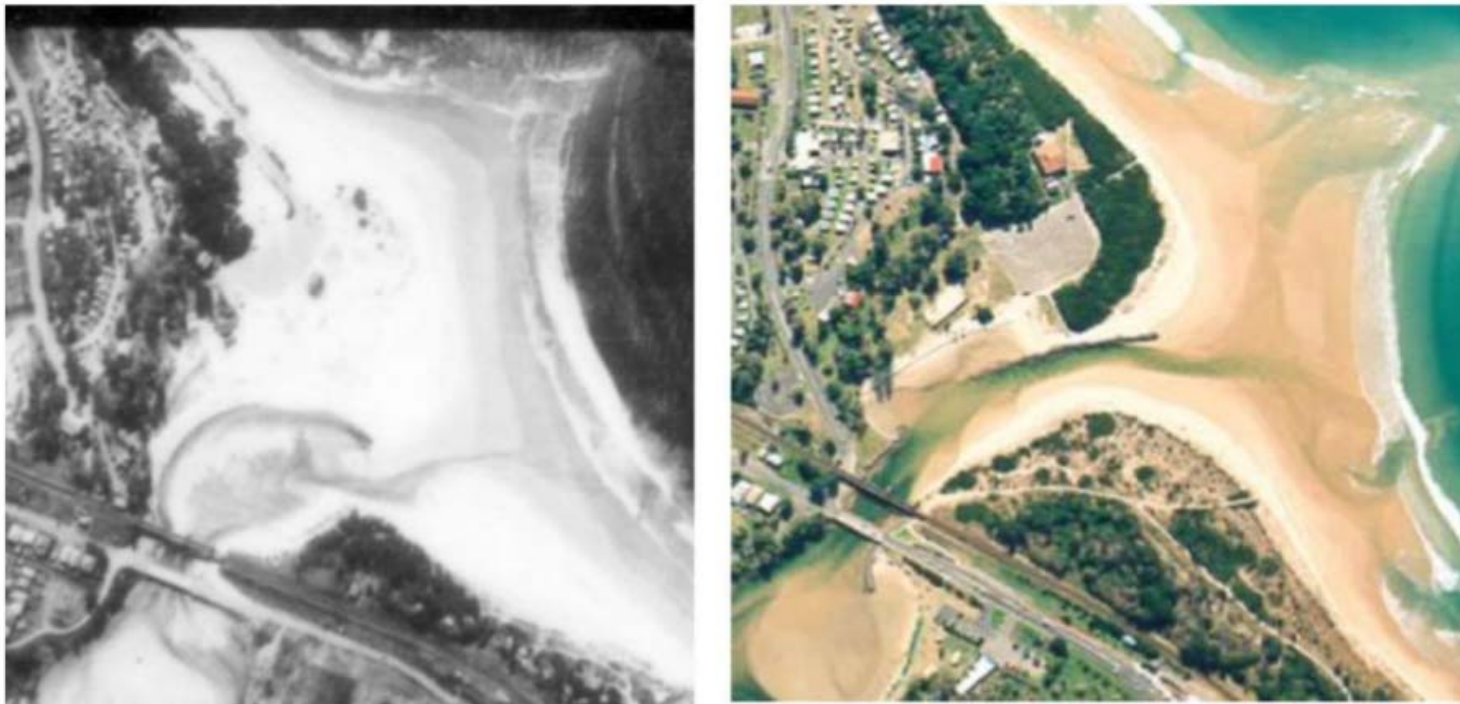


Figure 8. Coffs Creek entrance 1969 (left) and 1996 (right) © NSW Land Information Centre

A rock training wall was constructed on the northern bank of the Coffs Creek entrance changed an ICOLL (Intermittently Closed and Open Lakes and Lagoons) to a permanently open estuary.

The Good

- Improve hydraulic conveyance of entrance channels to increase discharge capacity, eliminating nuisance flooding of low-lying areas and improve water quality
- Stabilise channel thalwegs and increase depths, improving navigation
- Safer entrance navigation
- Marine sands added to the littoral system and nourished beaches where entrance scour has jetted sand out into the littoral system
- Improved surfing opportunities due to “new breaks” created by breakwaters

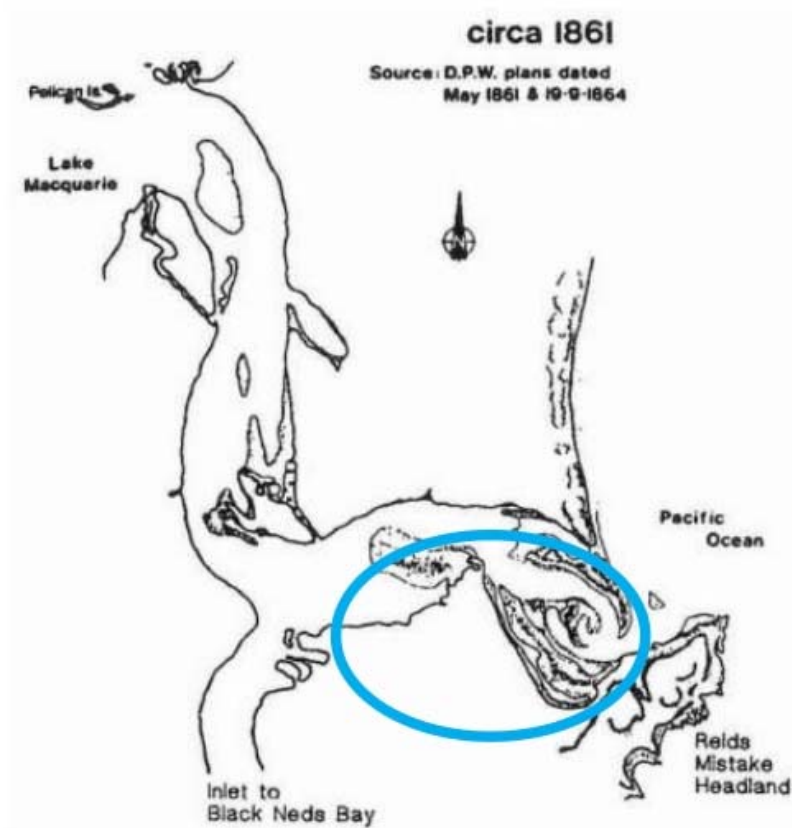
The Bad



Channel scour has removed seagrass and sand transport into the lakes as flood tide delta growth has smothered seagrass

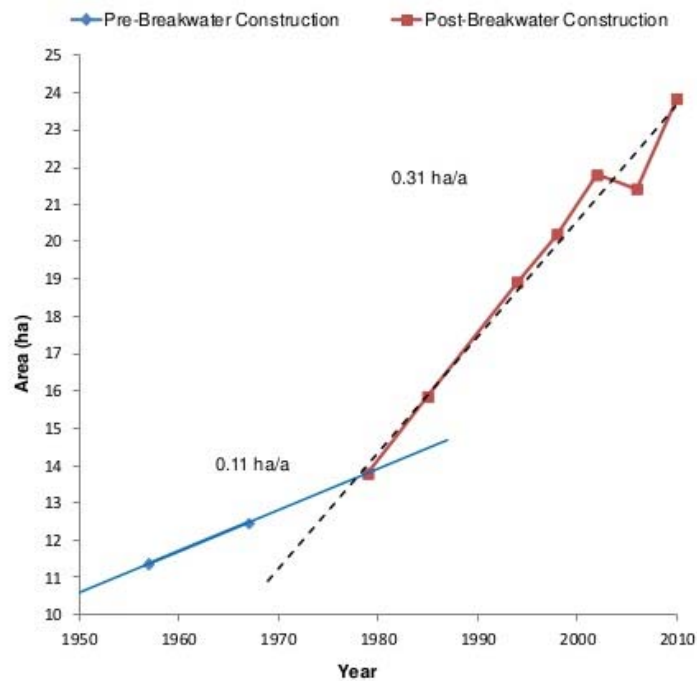
The Bad

Wetland areas have been eroded (e.g. Lake Macquarie)

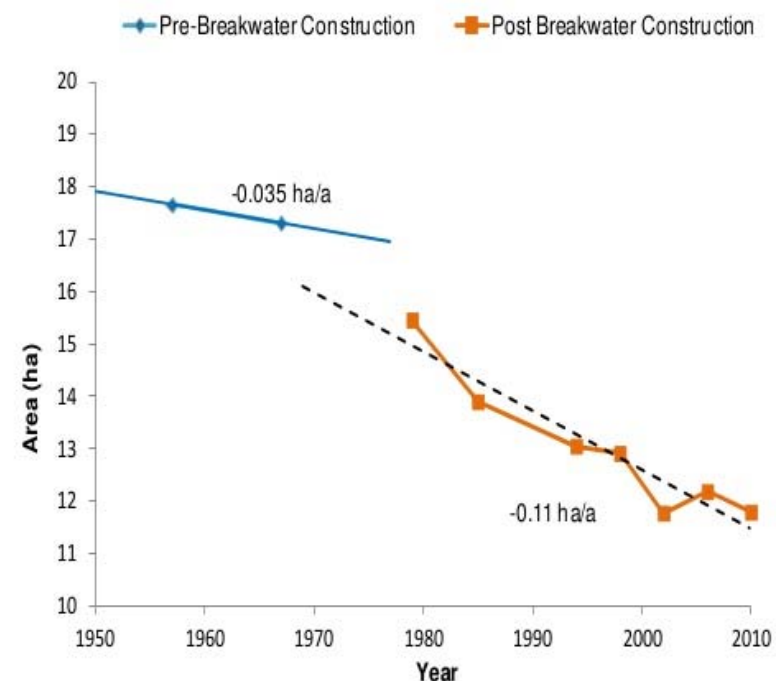


The Bad

Changing tidal planes have increased the rates of mangrove colonisation and salt marsh loss (e.g. Lake Wagonga).



Mangrove Increase



Saltmarsh Decrease

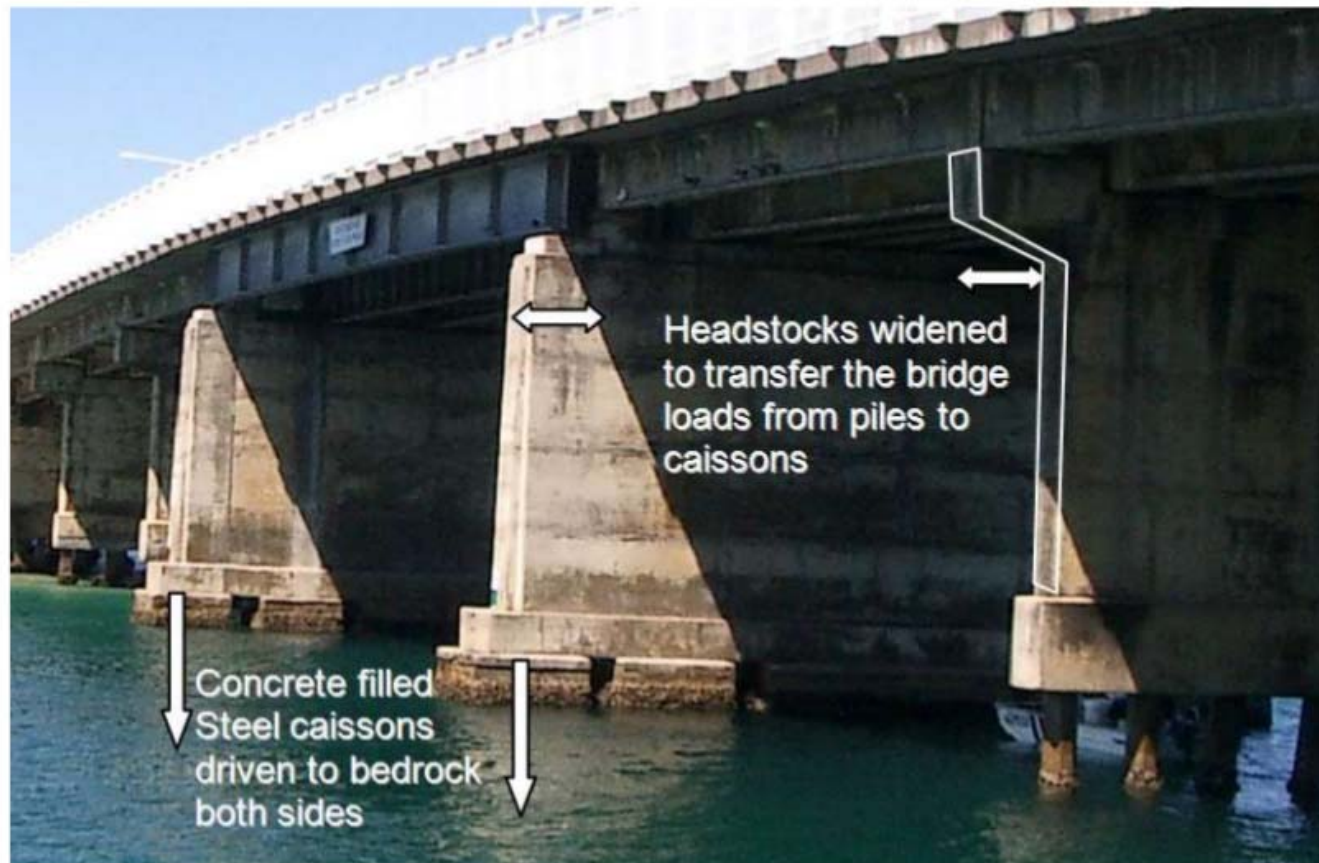
The Bad

Channel scour has necessitated rock works along the banks (e.g. Lake Macquarie, Lake Wagonga).



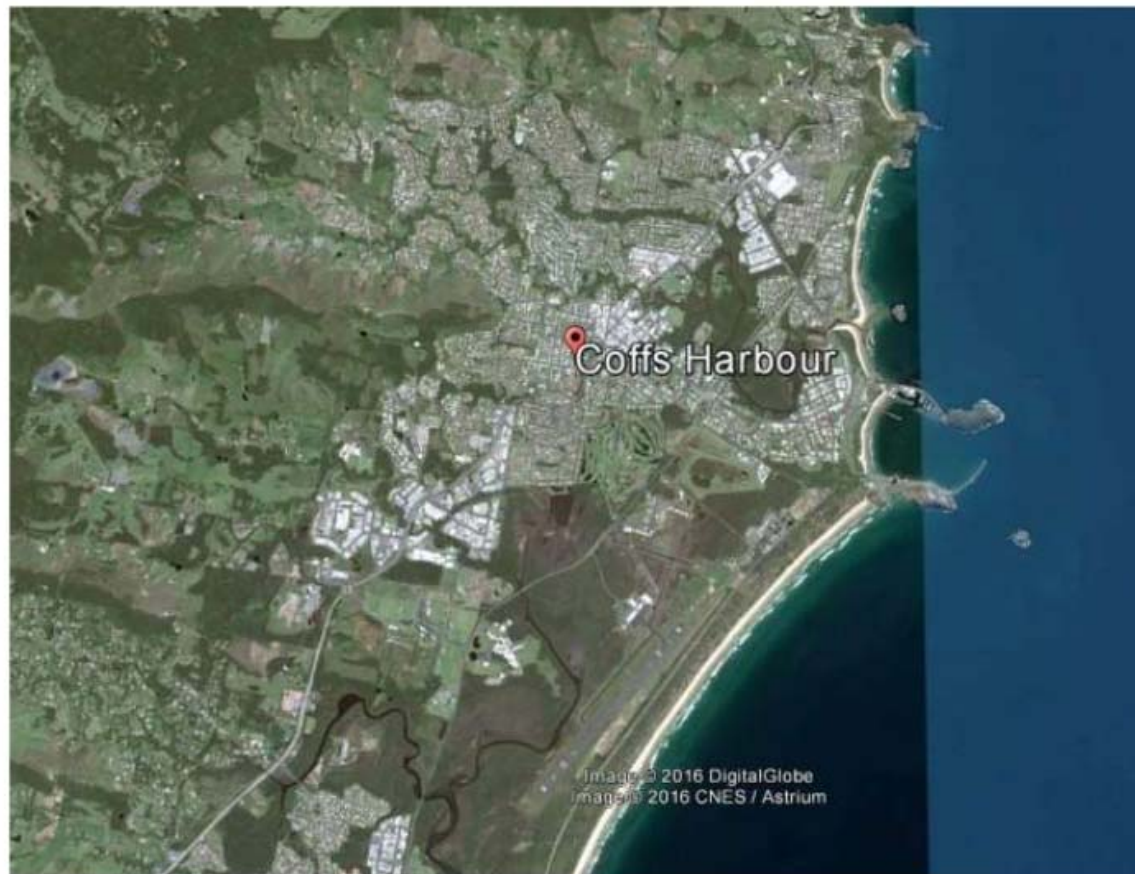
The Bad

Channel scour has necessitated expensive bridge foundation works
(e.g. Wallis Lake)



The Bad

Coastal littoral drift has been interrupted (e.g. Coffs Harbour), harbour siltation.



The Bad

Expensive capital works have been necessary to reinstate beaches that have eroded as a consequence of breakwater construction (e.g. Tweed River)





The Ugly

The Ugly

Channel scour has resulted in the total collapse of some foreshore buildings and undermined bridge foundations as well as undermining river training works (e.g. Swansea Channel Lake Macquarie)



The Ugly

Breakwaters have re-aligned the foreshore causing beach erosion, loss of residential development and other infrastructure (e.g. loss of the entire village of Sheltering Palms at Brunswick Heads)



The Ugly

Breakwaters causing erosion have sometimes necessitated revetment construction to limit erosion thereby destroying beach amenity (e.g. Stockton Beach at Hunter River Newcastle).



The Ugly

Training walls in tidal channels can create dangerous conditions that may cause serious injury to swimmers (e.g. Coffs Creek).

High ebb tide velocities on the ocean bars have presented challenges to recreational boating and have seen boating fatalities (e.g. Foster and Lake Wagonga, Narooma).



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