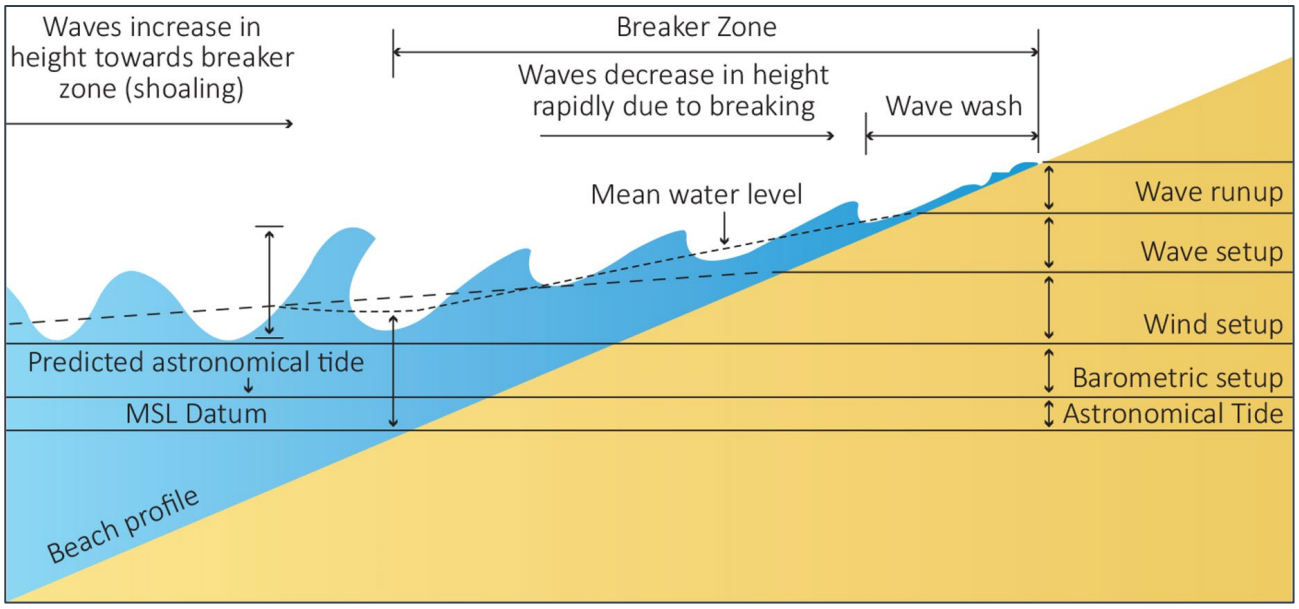
Understanding Coastal Inundation

Port Macquarie-Hastings Coastal Management Program

What is coastal inundation?

Coastal inundation is when ocean levels rise high enough that there is temporary flooding of a portion of land in the coastal zone. It occurs when a combination of marine and atmospheric forces raise ocean water levels higher so that t**he ocean floods low-lying areas** or overtops dunes, structures, or barriers. It is often associated with storms that result in storm surge and large waves. Coastal inundation is typically short-lived and the duration varies depending on the timing of the storm (e.g. if the storm surge occurs at the same time as a high tide) and how long the storm goes for. Over time, rising sea levels are expected to increase coastal inundation risk if we do not plan ahead.



Conceptual model illustrating components of contributing to inundation during a coastal storm event (source: NSW Government (1990) *NSW Coastal Management Manua*l)

How does coastal inundation differ from tidal inundation?

Coastal inundation can be made worse by high tides, but it is different from tidal inundation. Tidal inundation is driven by regular high tides and can occur more frequently in some low-lying areas. In contrast, coastal inundation is related to storm events. Larger coastal storms with strong winds and waves cause coastal inundation, pushing ocean water levels over dunes or coastal structures. Coastal inundation events occur less frequently and resolve once the storm is over and ocean conditions return to normal.

Coastal inundation:

- Caused by storm surge
- Occurs infrequently during a coastal storm event
- Short duration - hours
- Can be made worse if the peak of the storm coincides with high tide
- Will be worse with climate change due to increased storm intensity and sea level rise.

Tidal inundation:

- Occurs due to regularly due to astronomical tides
- Causes flooding over hours or days, a few times a year (e.g., during King Tides)
- Will be worse with climate change due to increased sea level rise
- Over time land may be permanently inundated.

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How can the CMP plan for coastal inundation?

Coastal inundation can have damaging consequences for land & assets close to the shoreline. Sea level rise is likely to increase the risk of coastal inundation over time unless we plan ahead. Natural defences like sand dunes, or hard structures such as sea walls, can help to lessen this risk. The Coastal Management Program (or 'CMP') helps Council understand where coastal inundation may occur and how serious the impacts could be.

The Coastal Hazard Assessment prepared for the Port Macquarie-Hastings CMP estimates water levels from storm events of different sizes and likelihoods (for example, a 1-in-100-year storm). This information is used to design protective structures, maintain natural dune defences, and prioritise actions that reduce risk to public spaces, infrastructure and the community.

The CMP will include a Coastal Zone Emergency Action Strategy which will identify actions to be undertaken by Council, the NSW State Emergency Service and other authorities before, during and after a coastal storm that places members of the public and infrastructure such as roads, surf clubs and foreshore reserves at risk from coastal inundation.

Coastal inundation, Town Beach (date: 17/07/2020)

Coastal inundation, Lake Cathie Beach (date: 15/12/2020)

Frequently Asked Questions About Coastal Hazards

What happens if sea levels rise?

According to the **CSIRO** *State of the Climate Report* (2024), global sea level has risen by over 22 cm since 1900. Half of this has occurred since 1970. However, observations show sea levels have risen higher along south-eastern Australia when compared to global averages.

Rising sea levels can accelerate erosion along the coastline and lead to increased coastal inundation in low-lying areas. Sea level rise will also impact inland waterways and estuaries through saltwater intrusion and higher groundwater levels. Waterfront and low-lying areas of the Port Macquarie-Hastings region are at risk of impact from rising sea levels as a result of climate change.

What are storm surges?

A storm surge is a rise in sea level as a result of severe weather such as a coastal storm or low-pressure system (extra-tropical cyclone or East Coast Low). Changes in wind and atmospheric pressure can cause ocean waters to rise above normal levels, inundating homes, businesses, and infrastructure on the waterfront and inland.

Storm surge and associated inundation of low-lying coastal lands are expected to increase due to climate change.

How does storm tide differ from storm surge?

The term 'storm tide' describes the total ocean water level during a coastal storm. It is the combination of storm surge (see above) and the natural ocean tides. When storm surge occurs on a high tide, the extent of coastal inundation will be greater, flooding a larger area of low-lying foreshore land.

How is coastal inundation different from catchment flooding?

When we refer to flooding, we are generally describing flooding as a result of heavy rainfall rather than coastal inundation associated with higher ocean water levels. This type of flooding is also referred to as catchment flooding and is caused by heavy rainfall on the catchments causing lakes, creeks, and rivers to overtop their banks and flood the surrounding area. Heavy rainfall is increasing as a result of climate change and when coupled with coastal inundation, low-lying areas are increasingly at risk of inundation.

The National Oceanic and Atmospheric Administration's (NOAA's) Office for Coastal Management offers **this tool** to allow users to look at how different factors, such as tidal inundation, coastal inundation, sea level rise and rainfall, can combine to cause coastal flooding.

What is an extreme weather event and how are these events affected by climate change?

The term '**extreme weather**' is used to describe events such as storms, droughts, heatwaves, or floods, that occur infrequently and exceed historical typical climate measurements for the area. Homes, businesses, and infrastructure are at risk of damage as a result of these episodic events. The Port Macquarie-Hastings region experienced flooding in 2021 as a result of an extreme weather event.

The coast is a changing environment; it evolves in response to extreme weather events and the movement of sediment and water. Climate change is expected to increase pressure on beaches over time. This includes higher sea levels, more frequent or intense storms, and longer recovery periods following erosion. Together, these factors are likely to accelerate long-term shoreline recession and affect how beaches and nearby assets are used and managed. We are already seeing the impacts of climate change on our coast now.

The way we are used to enjoying our coastal environment will change. Changing coastal processes will impact popular fishing, camping, and boating locations, while erosion and rising sea levels will impact our beaches and estuaries. Your homes, businesses, local community facilities, services, and infrastructure will also be at risk from the changes affecting your coast.

Where can I find more information on the Coastal Management Program?

For more information, visit Council's Have Your Say webpage by scanning the QR code below.

Port Macquarie Hastings Council

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