Information Sheet: Storm surge modelling for Bunbury

What causes a storm surge

A storm surge is a rise in the normal water level caused by strong onshore winds and reduced air pressure. Reduced air pressure and strong winds can be caused by low pressure weather systems such as tropical cyclones or winter storms.

This build-up of water can be 100 kilometres wide or wider, and may surge 2–5 metres above normal sea level. It can be greater in height in exceptional circumstances such as during a Category 5 cyclone, and can be exacerbated if the storm coincides with a high tide (Fig. 1). A storm tide can persist for several hours after a weather system or storm event crosses the coast.

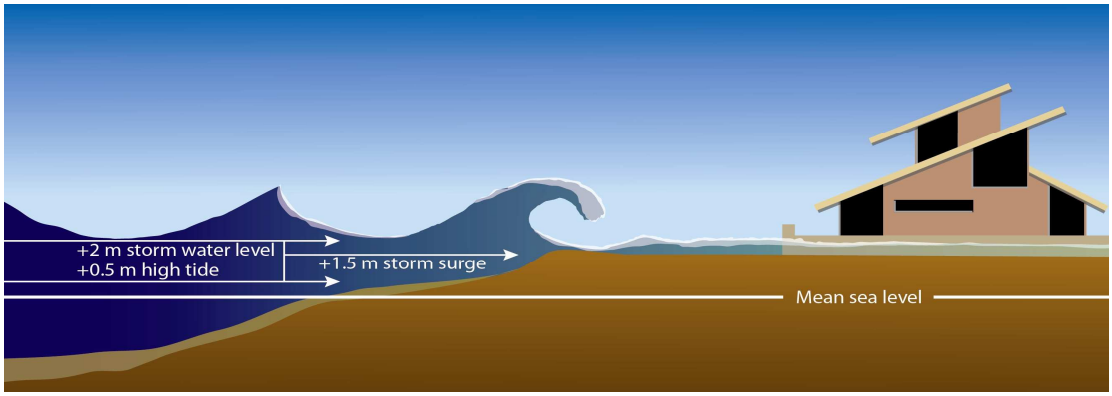

Figure 1. A storm surge results in water levels on the coast being higher than normal, and the resulting storm tide may result in inundation and destruction of buildings and infrastructure during an event.

Storm surge modelling for Bunbury

Rising sea levels pose a risk for many low lying countries around the world and for some coastal communities in Australia as well.

The risk of coastal flooding is even greater under storm surge conditions because sea-water levels rise higher than normal on the coast.

Some of the Western Australian coast line is particularly vulnerable to the impacts of storm surges because it is low-lying.

To improve our understanding of these processes the Western Australian Department of Planning and the Western Australian Planning Commission engaged Geoscience Australia to undertake storm surge modelling for Bunbury.

For this exercise, Geoscience Australia integrated two existing modelling systems — GCOM2D for storm surges, and ANUGA for coastal inundation scenarios — and then used them in conjunction with a sediment transport model developed by geoscientists from the University of Sydney. The latter modelling system is known as the Shoreface Translation Model, and can be used to represent coastal erosion.

Untested until now, the results have been described as an important first step in an area of active research.

From the combined modelling exercise undertaken by Geoscience Australia, a series of storm surge inundation maps were produced for Bunbury and Australind.

The inundation maps estimate levels of water inundation in a worst-case scenario, based on the most severe weather event in Bunbury's recorded history: tropical cyclone Alby, which struck the coast on 4 April 1978.

During tropical cyclone Alby, winds exceeding 130 km/h impacted Bunbury and the South West of WA. The accompanying storm surge also breached the retaining wall along Leschenault Inlet, flooding 100 homes in the nearby residential area, and badly eroded Ocean Drive, the port city's main coastal road.

Trying to establish the probability of another cyclone event of the same magnitude as TC Ably is problematic, because of the limited historical record documenting the number of cyclones that have had a major impact on the State's South West coast. It could be two or 200 years before a storm surge of such magnitude is experienced again in the Bunbury area.

Another severe storm surge event could adversely affect some low-lying parts of Bunbury, especially in and around the lagoon behind Koombana Bay and in the vicinity of the Stratham Golf Course. The impacts of these storms are likely to become more severe in the future as sea levels continue to rise, because the storm surges will reach further inland.

The key modelling outputs of the studies undertaken by Geoscience Australia are provided in the following images (figures 2, 3, & 4). These show the potential inundation arising from a hypothetical worst case track of a storm similar to Cyclone Alby, under three different sea level rise scenarios – no sea level rise, 0.4 metres sea level rise and 0.9 sea level rise. It should be noted that while this modelling uses the best available data, it does not take into account all built structures such as buildings and earthworks, which may affect the path and depth of flood waters.

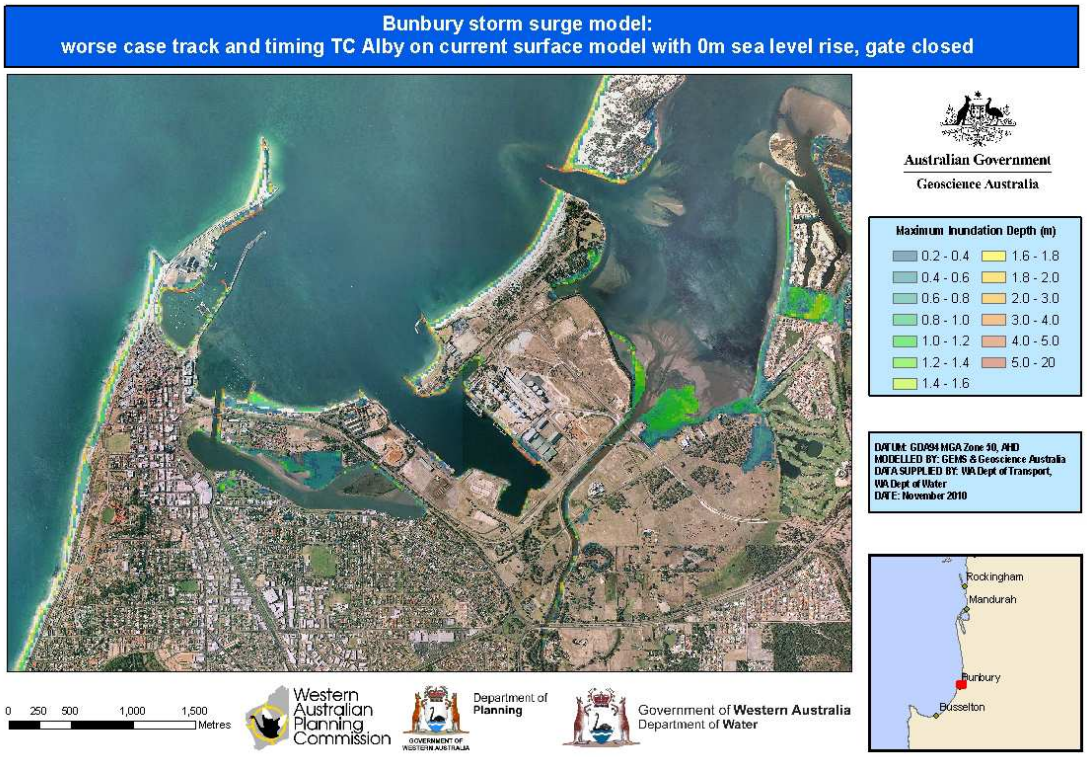

Figure 2. The area of Bunbury potentially inundated by a tropical cyclone event under current climate conditions with the flood control gates closed.

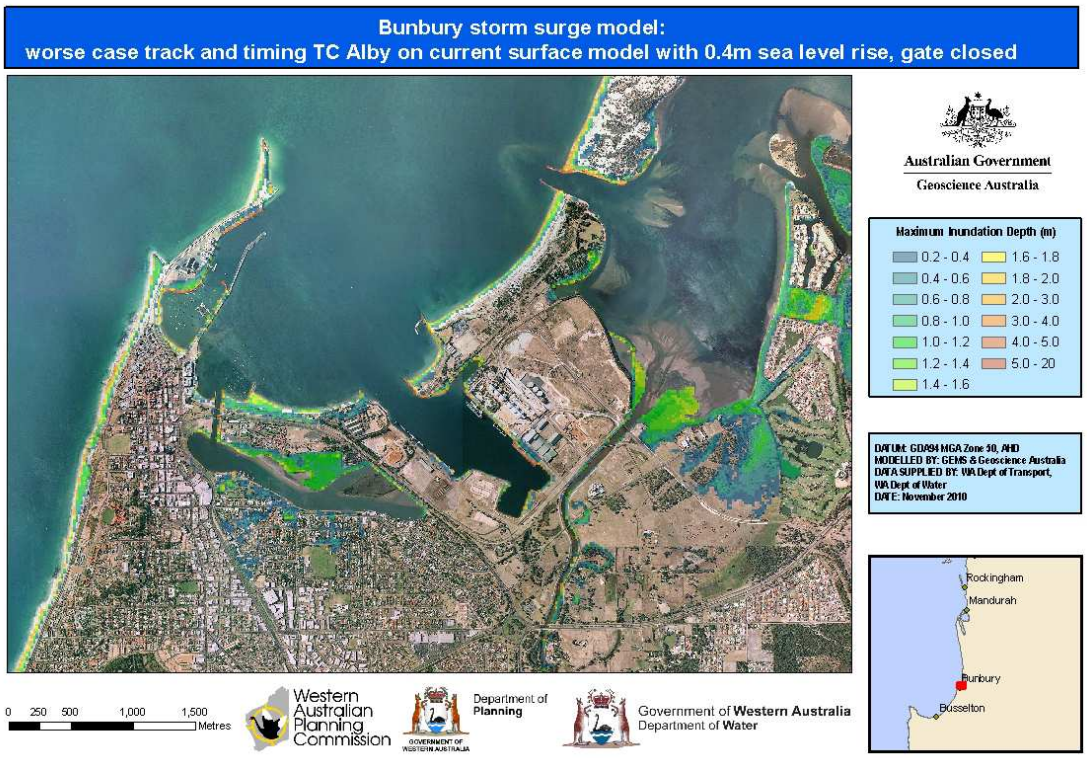

Figure 3. The area of Bunbury potentially inundated by a tropical cyclone event with sea level 0.4m higher than present with the flood control gates closed.

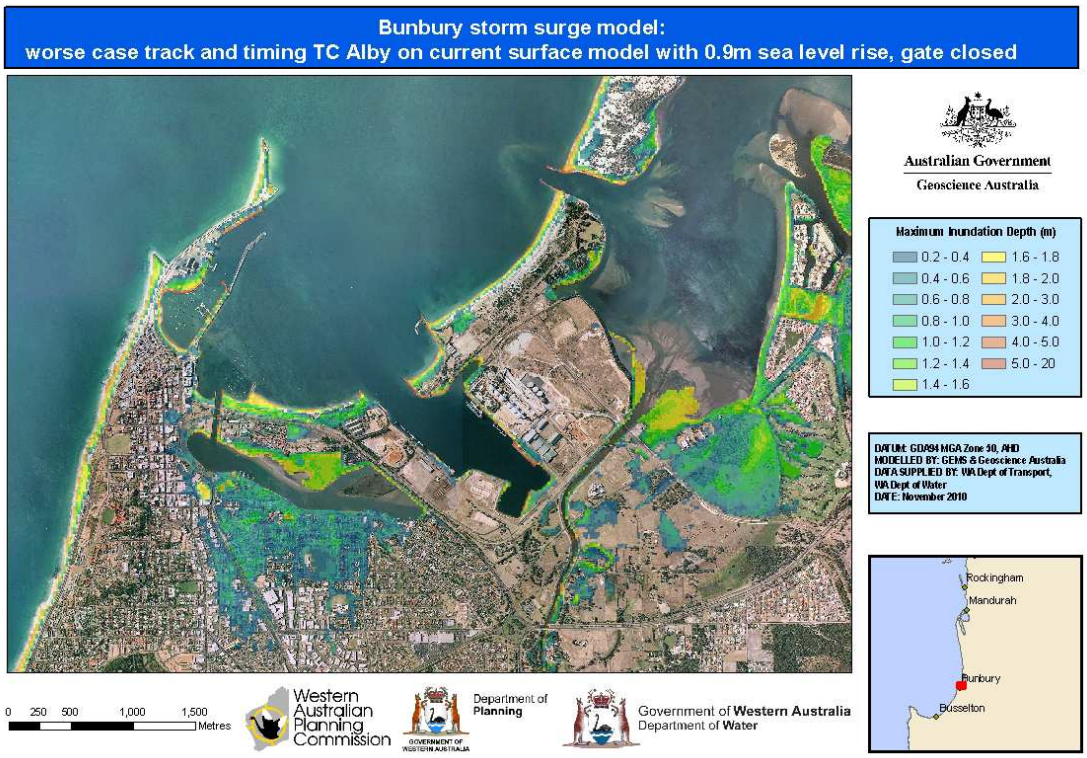

Figure 4. The area of Bunbury potentially inundated by a tropical cyclone event with sea level 0.9m higher than present with the flood gates control closed.

The modelling also indicates that significant erosion could occur to the exposed sandy beaches in the Bunbury area during the 21st century. By 2100 shoreline recession could be as much as 450 metres in some places, although it is more likely to be much less than this. This recession modelling does not take into account

coastal protection works or artificial structures such as buildings and earthworks. Consideration of local geology is also limited.

Other observations from the Geoscience Australia modelling exercise indicate that:

- The foredunes on the open coast play a significant role in protecting the Bunbury area from storm surge inundation .
- If these foredunes are pushed landward, they may also increase in height.
- The storm surge barrier built at the western end of the Leschenault Inlet in 1980 was considered in the model. If shut during, and then opened after a storm surge it would reduce the extent of water inundation under circumstances similar to cyclone Alby.

Geoscience Australia recommended that further modelling be undertaken to validate the results obtained from its initial storm surge assessment risk for Bunbury.

It stated that information in the report should not be considered as “totally accurate or complete”, and as a result “does not guarantee the results (of the modelling study)”.

Geoscience Australia said that the results are meant to “be used as an indicative guide only” and that people “should not solely rely on this information when making a commercial decision”.

One way in which the Department of Planning is already making use of the modelling is through contributing to a Peron Naturaliste Partnership Coastal Adaptation Decisions Pathways Project which will undertake an economic analysis of adapting to sea level rise across the nine coastal local governments from Point Peron to Cape Naturaliste. For further information go to http://peronnaturaliste.org.au/.