5

CHAPTER

CLIMATE CHANGE RISKS TO SETTLEMENTS AND INDUSTRY

Photo credit: Port of Melbourne Corporation

KEY FINDINGS

- Australia's residential population is exposed to the increasing hazards of climate change in the coastal zone:
  - Of the 711,000 existing residential buildings close to the water, between 157,000–247,600 properties are identified as potentially exposed to inundation with a sea-level rise scenario of 1.1 metres.
  - Nearly 39,000 buildings are located within 110 metres of 'soft' shorelines and at risk from accelerated erosion due to sea-level rise and changing climate conditions.
- The current value of existing residential buildings at risk from inundation ranges from $41 billion to $63 billion (2008 replacement value).
- The analysis for Victoria, Tasmania and New South Wales identifies inundation from an extreme event (1-in-100 year return period), which is consistent with the risk management concept in current planning guidelines. Where modelled storm tide for a 1-in-100 year event was not available, inundation from a modelled high tide event was assessed (Queensland, Western Australia, South Australia and Northern Territory).
- There are many facilities supporting the delivery of community services in close proximity to the coastline. They include 258 police, fire and ambulance stations, 5 power stations/sub stations, 75 hospitals and health services, 41 landfill sites, 3 water treatment plants, and 11 emergency services facilities which are located within 200m of the shoreline.
- The delivery of essential services such as electricity generation and wastewater management will increasingly be impacted by inundation, erosion, the effects of sea water intrusion into coastal freshwater systems and drainage systems, and increased corrosion.
- There are significant vulnerable communities in the coastal zone including Indigenous communities. The remoteness, and in many cases low elevation, of several island communities will also place them at risk.
- Coastal industries will also face increasing challenges with climate change, particularly the tourism industry, and will need to plan to manage projected risk.

5.1 Risks to built environment assets – a national overview

With most cities and much of Australia's industry in the coastal zone, a concentration of infrastructure in the region has emerged which over time has been exposed to natural hazards that have caused damage to property and infrastructure and loss of life.

Much of this infrastructure has been constructed without regard to climate change. Chapter 2 describes how climate change will bring higher sea levels, more intense extreme events and is likely to lead to a switching point beyond which stable coasts become eroding coasts. Such changes could impact heavily on parts of the built environment and could lead to disruption of supply of services and other social and economic impacts.

The risk to the built environment from climate change is clearly not just a function of the climate hazard. Risks also arise from the extent to which a society can anticipate and prepare for an impact, how the society and its assets respond to the impact itself, and the capacity for recovery after a discrete impact. For the built environment these aspects of risk relate to how well our planning systems constrain development in high-risk areas; the requirement of all construction to accord with design, engineering, construction and maintenance codes and standards; and the effectiveness of approaches to prepare for and recover after natural disasters.

This first pass assessment focuses particularly on risks to residential buildings from inundation and erosion. The method used is simple and is described in Chapter 3. The quantitative analysis identifies buildings likely to be impacted by either inundation or erosion from climate change; their capacity to withstand or recover from that impact is not assessed.

Managing risk from extreme events is not a new concept in planning guidelines; generally an extreme event has been defined as the risk from a 1-in-100 year event. Current planning guidelines require proposed developments located in coastal areas to manage risks from these events through siting and design features. In the analysis undertaken for this assessment inundation risk from an extreme event (a 1-in-100 year event) was assessed where modelled storm tide data for the whole state coastline was available (Victoria, New South Wales and Tasmania). For the other states where storm tide values have not been modelled, inundation risk was analysed for a sea-level rise of 1.1 metres with an allowance included for a modelled high tide event (as opposed to the 1-in-100 year event). This means for Queensland, Northern Territory, Western Australia and South Australia the risk from inundation modelled in this assessment is not the risk from a 1-in-100 year event. Future modelling for these states using 1-in-100 year storm tide data would be expected to increase the total number of residential buildings at risk.

While the first pass assessment does not spatially consider the risks from climate change to other types of infrastructure or to the provision of services, a qualitative summary of the implications of climate change for transport and essential services in the coastal zone is at section 5.2. Further information on coastal communities vulnerable to climate change is at section 5.3 and risks to coastal industry are described in section 5.4.

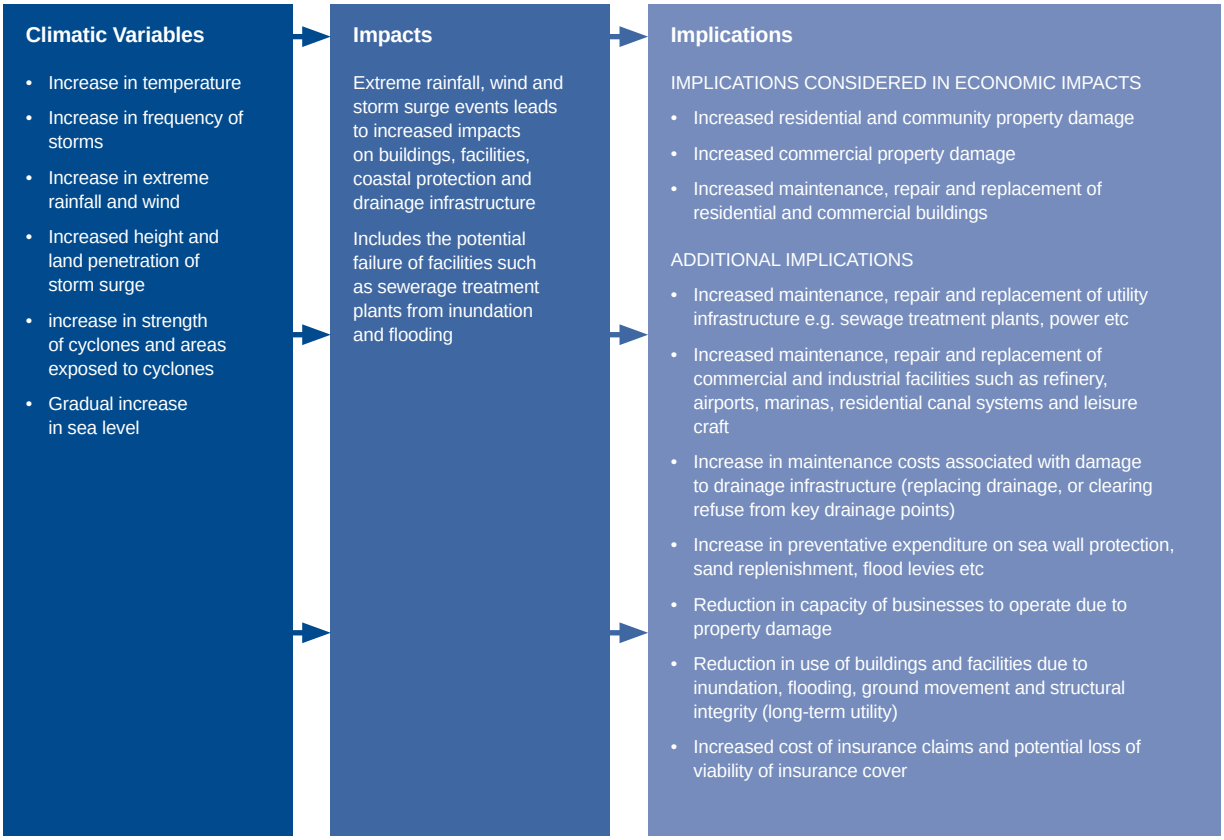

Figure 5.1 Impact storyline for buildings in coastal settlements commissioned by the Garnaut Climate Change Review. Note: The impact of cyclones on buildings has not been factored into the impacts of this study as it is being considered under a separate assessment of the Garnaut Climate Change Reivew. Source: Maunsell 2008[1]

5.1.1 Impacts of climate change on buildings in coastal settlements

As noted by the Parliamentary Committee Report *Managing our coastal zone in a changing climate: the time to act is now* of October 2009, there are 711,000 addresses sited within 3 kilometres and under 6 metres elevation of Australia's coast. Much of Australia's stock of commercial buildings, industrial facilities, airports, ports, hospitals, schools, and other economic and social infrastructure are also in close proximity to the coast.

The Garnaut Climate Change Review commissioned analysis of the impacts of climate change on coastal buildings using a number of scenarios. Figure 5.1 outlines the range of impacts and their implications identified in that analysis[2], many of which relate to property damage and increased costs of maintenance and repair in response to that damage. For most scenarios analysed, the magnitude of the impacts reached moderate to high levels in the period 2031–2070, and five of the seven scenarios predicted up to high or extreme impacts to coastal settlements by the end of this century.

Damage costs from extreme climate events in the coastal zone are already high. The total estimated cost of major floods, tropical cyclones and severe storms between 1967 and 1999 was $28.6 billion. This represented over 75 per cent of the total cost of natural disasters in Australia during that period.[3] As outlined in Chapter 2 climate change will increase the overall magnitude of such extreme weather events and in some cases will increase their frequency.

Cyclones are a regular feature across northern Australia and occasionally they have tracked further south. Cyclones that make landfall near coastal communities can be devastating. In March 2006 *Cyclone Larry* made landfall near Innisfail in north Queensland, with wind gusts of up to 240 km/hr. There was significant damage to coastal townships, infrastructure and crops, and flooding of coastal rivers.[5] The cost of insured losses alone was estimated at $540 million, with total damage costs estimated at more than $1 billion.[6] Modelling by Risk Frontiers[7] suggests that if the cyclone had directly impacted Cairns the insurance losses could have been in the order of $1.5–$4 billion, and up to $8 billion for a category 5 cyclone. Much of the damage (60–80 per cent) from the cyclone was to residential infrastructure built before the mid 1980's, after which time building standards in North Queensland were enhanced (Figure 5.2).[8]

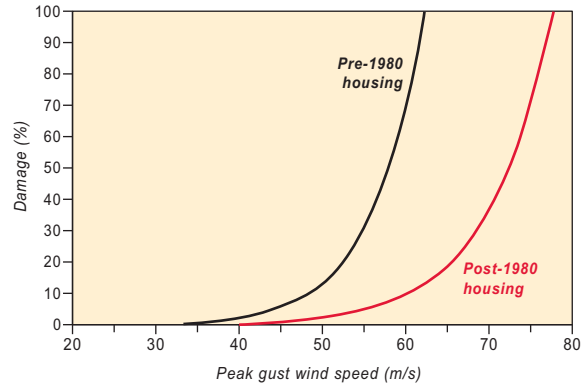

Figure 5.2 Impact of building code improvement on housing damage from wind gust. Source: Stewart and Li 2009[4]

Coastal areas generally are subject to greater impacts from extreme wind events than inland areas and climate change could increase the intensity of wind gusts. This could lead to a significant increase in damage to buildings as illustrated in Figure 5.3 where a 25 per cent increase in wind gust speed generates a 650 per cent increase in building damage. A preliminary study of the risk to buildings in Australia from extreme wind gust speeds found that building Standard specifications may not be adequate for Brisbane, Sydney and Perth when the combined hazard of cyclonic and non-cyclonic winds is considered.[9]

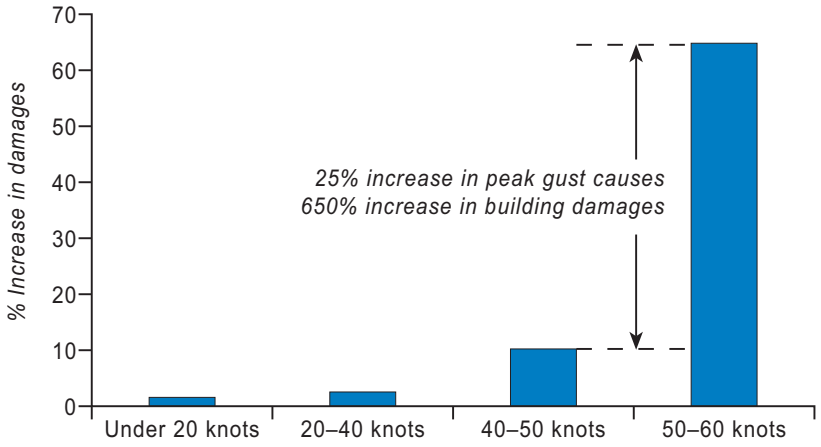

Figure 5.3 Increase in building damage as a result of increased wind gust speed. Source: Insurance Australia Group 2003[10]

Photo credit: Newspix/Angelo Soulas

Bulk carrier Pasha Bulka aground stranded off Nobbys Beach in Newcastle, 9 June 2007.

Australia's southern coastal areas are also vulnerable to the effects of extreme weather with severe storms that sweep south along both west and east coasts. East coast low systems dominate the east coast and across southern Australia, the passage of intense low pressure systems can also result in severe wave and wind damage. Between 1967 and 1999 the estimated cost of severe storms in Australia was over $9 billion, in large part due to the increasing coastal population density.[11]

The risks to natural and built assets associated with these events can be heightened when they occur in clusters and affect low-lying areas such as deltaic plains, estuaries and coastal lakes. These areas can be affected simultaneously by river floods and wave-driven storm surges. They are also particularly susceptible to erosion under high energy conditions causing dramatic shifts in shoreline position.

Box 5.1 Development in the Mandurah region, Western Australia

Mandurah has been one of the fastest growing areas in Australia over recent decades. Between 1986 and 2006, the built up area of Mandurah and the surrounding region, shown in Figure 5.4, increased by over 80 per cent and the population tripled. While the majority of development during that period was above 3m elevation, there was a more than 40 per cent increase in development in low-lying areas (below 3m), representing a quarter (23km^2) of the built up area in 2006.

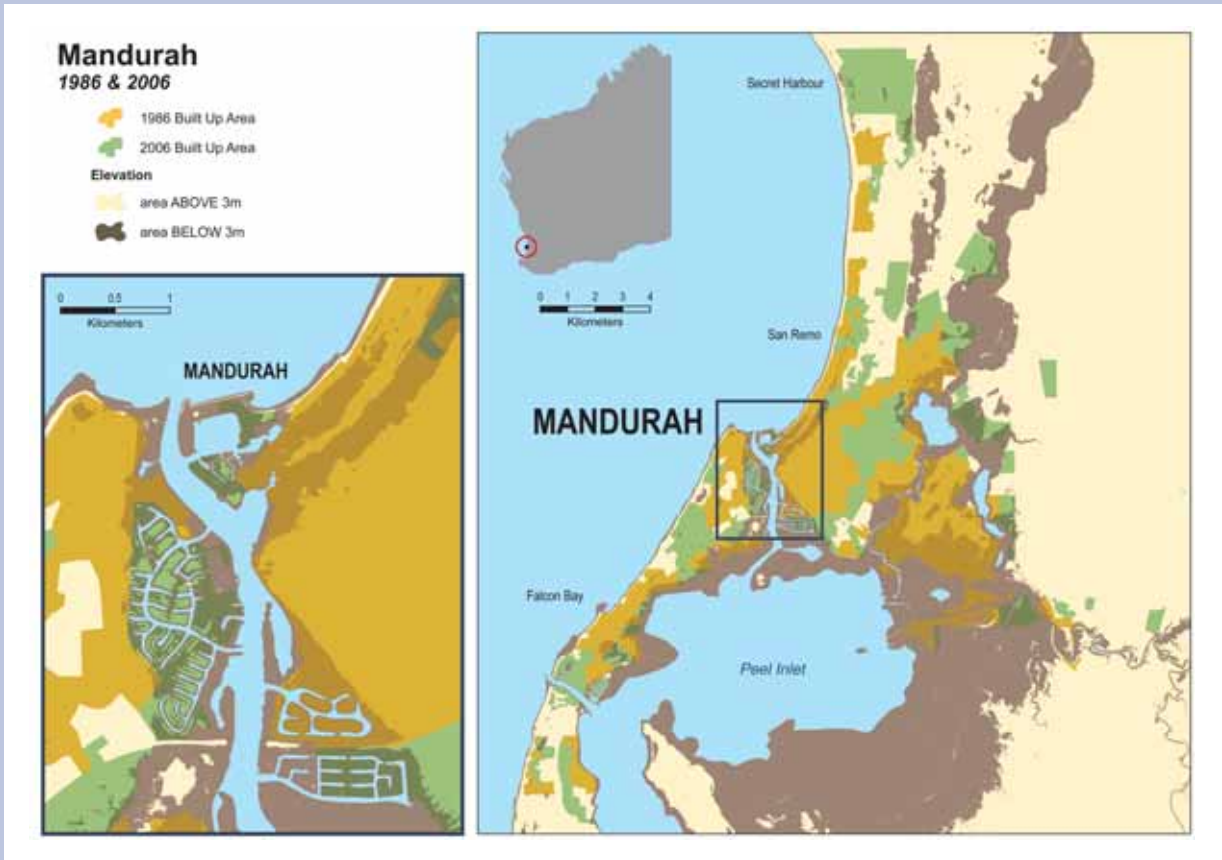

Figure 5.4 Mandurah development at 1986 and 2006 with elevation shown below and above 3 metres.
Source: Geoscience Australia 2009

Photo credit: Gosford City Council

Results of coastal erosion in Wamberal 1978.

This combination or cluster of extreme storms is usually associated with La Nina conditions. Clustering may occur over a period of one to four years as was the case from 1974 to 1978. The storms of 1974 generated widespread erosion along the entire eastern seaboard. The lack of beach recovery in the next few years allowed for further house destruction in a storm in 1978.

The risk of damage to settlements from a climate event and climate change is also due to the number of buildings exposed to that event. Over the past few decades there has been rapid growth in many Australian coastal settlements including the emergence of the Gold Coast and other new coastal cities and towns.[12] Box 5.1 below shows the extent of recent development in Mandurah, Western Australia. In this area there has been substantial development since 1986 in low-lying areas. As described in Chapter 1 the sea change phenomenon is expected to continue into the future, and as a result coastal risk is likely to continue to increase.

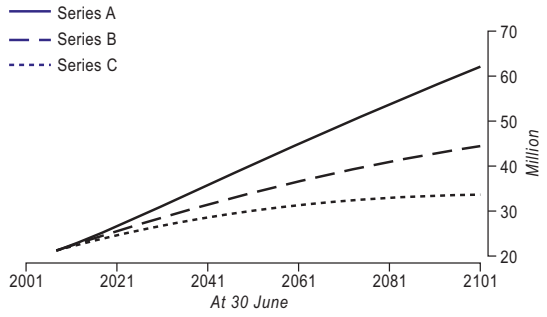

Figure 5.5 Population growth projections for Australia 2008–2101. Series B largely reflects current trends in fertility, life expectancy at birth, net overseas migration and net interstate migration, while Series A and Series C are based on high and low assumptions for each of these variables respectively.
Source: ABS 2008[13]

Australia's population, which was estimated at 21 million in mid-2007, is projected to increase significantly. The Australian Bureau of Statistics has forecast an increase to between 30.9 and 42.5 million people by 2056, and to between 33.7 and 62.2 million people by 2101 (see Figure 5.5).[14] These projections are based on the growth and change in population based on current fertility, mortality, internal migration and overseas migration, with an extrapolated 'high' and 'low' scenario. The combination of global climate change and global population pressures may lead to successive Australian governments accepting more overseas migration. Recently, a new Intergenerational Report being prepared by the Australian Government has projected that Australia's population will grow by 65 per cent to reach over 35 million people in 2049.[15] Based on current trends much of this growth would be accommodated in coastal settlements and cities.

5.1.2 National estimate of residential buildings at risk

As noted above, it has been estimated that approximately 711,000 addresses are located within 3 kilometres of the shore and in areas below 6 metres, with more than 60 per cent of those addresses located in Queensland and New South Wales.[16] This analysis also found that the majority of those addresses are adjacent to sea-connected coastal waters, alongside lakes or lagoons, river banks and estuaries, rather than directly facing the open ocean.

The inundation analysis for this report has refined the above estimate, and has identified between 157,000 and 247,600 existing residential buildings at risk of inundation with a sea-level rise of 1.1 metres. New South Wales has the greatest exposure (between 40,800–62,400 residential buildings at risk) followed by Queensland (35,900–56,900), Victoria (27,600–44,600), South Australia (25,200–43,000),

Western Australia (18,700–28,900), Tasmania (8,700–11,600) and the Northern Territory (up to 180) (Figure 5.6). Storm tide estimates (for a 1-in-100 year event) were included in the analysis for New South Wales, Victoria and Tasmania only. For other states only modelled high water level was included in the analysis, so actual exposure to extreme events would be expected to be higher.

The current replacement value of existing residential buildings at risk from inundation ranges from $41 billion to $63 billion. The replacement value data and the number of buildings at risk are drawn from the National Exposure Information System database.

Estimates of residential buildings at risk of inundation are based on current assets only. Given projections that Australia's population could double by 2100 (Figure 5.5), significantly increased exposure of coastal assets would occur in the future in the absence of adaptation measures.

Soft shorelines prone to instability were also identified, based on shoreline characteristics in the National Coastal Geomorphology Mapping (Chapter 3). Nationally, nearly 39,000 residential buildings are located within 110 metres of potentially erodible shorelines, with nearly 40 per cent of those buildings located in Queensland (see Figure 5.7). It should be noted that there was no consideration of existing protective structures in this assessment.

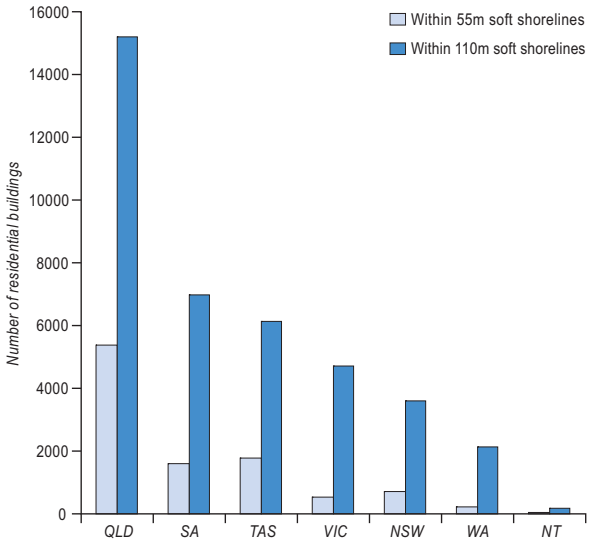

Figure 5.7 Number of residential buildings located within 55 and 110 metres of 'soft' coastlines.[17]

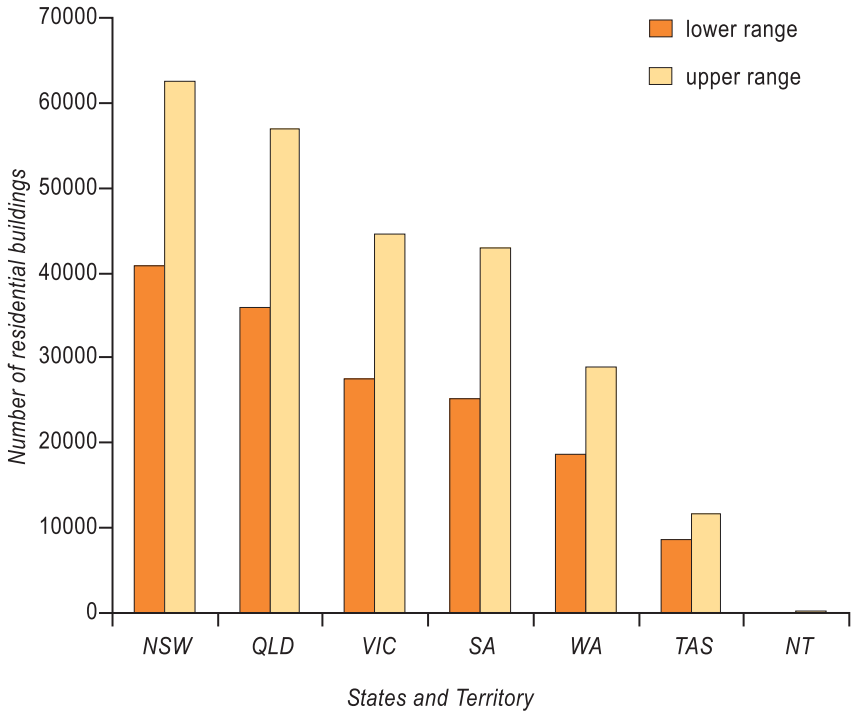

Figure 5.6 Estimated number of existing residential buildings at risk of inundation from a sea-level rise of 1.1 metres (including 1-in-100 storm tide for New South Wales, Victoria and Tasmania, and high tide event for other states and the Northern Territory).