Australian Government
Department of Climate Change

Climate Change Risks to Australia's Coast

A FIRST PASS NATIONAL ASSESSMENT

thinkchange

About this report

Adaptation is one of the three pillars of the Australian Government's climate change strategy.

The first pass national assessment of *Climate Change Risks to Australia's Coast* is one of the key actions identified in the *National Climate Change Adaptation Framework* endorsed by the Council of Australian Governments (COAG) in 2007. The Framework recognised that national assessments are required in key sectors and regions to support informed decisions on adaptation action by policy-makers, business and industry, resource managers and the community.

Scope of the assessment

This Report presents the findings of the first national assessment of the risks of climate change for the whole of Australia's coastal zone. The objectives of the first pass national coastal risk assessment are to:

- Provide an initial assessment of the future implications of climate change for nationally significant aspects of Australia's coast, with a particular focus on coastal settlements and ecosystems.
- Identify areas at high risk to climate change impacts.
- Identify key barriers or impediments that hinder effective responses to minimise the impacts of climate change in the coastal zone.
- Help identify national priorities for adaptation to reduce climate change risk in the coastal zone.

The assessment focuses on risks to settlements and infrastructure, ecosystems and industries in the coastal zone. The spatial and quantitative analysis is restricted to risks to residential buildings at 2100. Analysis of other risks has been through literature review and expert opinion. The scope has not included any analysis of efforts to mitigate climate change impacts through reducing emissions of greenhouse gases and any associated implications for adaptation. The geographic scope of the assessment is the mainland coast and Tasmania; smaller islands and external territories have not been comprehensively considered.

The results from the assessment of residential buildings at risk are useful at a national broad regional scale. They will assist in prioritising future coastal adaptation planning needs. However, the available national data is insufficient to answer all questions underpinning decision-making at local and regional scales. The assessment has also highlighted major current data and analytical capacity limitations which can inform future investment in capacity building.

The assessment focuses on impacts and risks at the end of this century. However climate change including sea-level rise will not stop then and impacts beyond 2100 will need to be anticipated in decision-making with long horizons. Nearer term impacts have also not been considered in this assessment as finer scale modelling processes are required for this. Understanding of both the shorter and longer term implications will also be needed to inform adaptation planning. A number of on-ground adaptation options have been identified in the report to support consideration of Australia's adaptation needs.

Community engagement in a discussion on coastal vulnerability is critical. Much of the time spent on this first pass assessment was allocated to building the national tools so that risks could be identified, and so that the assessment can support an informed national consideration on adaptation in the coastal zone. All spheres of government, business, industry and the community will need to be involved in developing an appropriate national response.

Structure of the report

The Report is structured into six chapters. Chapter 1 provides an overview of the geological history of Australia's coastal zone and explores how past variability could inform our understanding of future change. The four broad coastal regions which emerge from this history and the importance of the coastal zone are described.

Chapter 2 discusses the science that supports understanding of climate change risks in the coastal zone. It brings together the science of climate change and geomorphology to understand how coastal risks from inundation and erosion could change in the future.

Chapter 3 describes the investments in national capability that have occurred to enable this first pass national assessment, and the methodology that was applied to identify areas at risk of inundation and coastal instability.

Chapter 4 provides an overview of the implications of climate change for the natural environment. The different responses of the four broad coastal regions (first discussed in Chapter 1) to climate change are identified, as well as key implications for coastal biodiversity and habitats.

Chapter 5 identifies the key risks to built infrastructure with a particular focus on residential buildings at state and local government scales. Risks to infrastructure, services and industries in the coastal zone are also summarised.

Chapter 6 concludes the Report with a discussion on coastal adaptation. It explores whether there is a case for early action and whether there are barriers to adaptation. The Chapter describes emerging areas to enable coastal adaptation which could benefit from national coordination.

One appendix is included; it describes the common elements of an adaptation response particularly for the built environment: planned retreat, accommodating the impacts, and protection through building protective structures.

Technical and scientific terms are used throughout this Report. To assist readers with these terms a glossary is included in the Report.

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Executive Summary

Australia has become a coastal society. Around 85 per cent of the population now live in the coastal region and it is of immense economic, social and environmental importance to the nation. All Australian state capital cities are located within the coastal zone, it is the conduit for our exports and imports, and much of the nation's commercial activities occur in coastal areas. Large numbers of Australians enjoy the recreational benefits the coast provides and it is home to a vast array of treasured environmental values that underpin essential ecosystem services.

The Australian coast is a dynamic place and since initial occupation over 50,000 years ago humans have witnessed major changes in sea level, in habitats and in the shape of the shoreline from great storm events. Over the geological past this dynamism has been even more pronounced, with sea levels up to 4–6 metres higher than today and the shoreline in some places more than 500 kilometres inland.

Over the last 6,000–7,000 years sea level around Australia has been relatively stable, which has generally allowed current landforms and ecosystems to persist without large scale modifications. Since 1788 settlements have been built along our coast in expectation that sea level would remain broadly unchanged. Significant settlement of low-lying areas has occurred, and structures were designed and built to standards defined by a relatively narrow period of experience.

Those conditions are now changing. A new climate era driven by global warming will increase risks to settlements, industries, the delivery of services and natural ecosystems within Australia's coastal zone.

Scientific observations and modelling are pointing to changes in the climate system at the upper end (or above) of projections in the 2007 report of the Intergovernmental Panel on Climate Change (IPCC). The IPCC report estimated global sea-level rise of up to 79 centimetres by 2100, noting the risk that the contribution of ice sheets to sea level this century could be substantially higher.

Recently observed accelerated ice flow and melting in some glaciers in Greenland and Antarctica could substantially increase the contribution from the ice sheets to rates of global sea-level rise. Understanding of the magnitude and timing of ice melt processes is limited and there is currently no consensus on the upper bound of global sea-level rise projections.

There is an increasing recognition that sea-level rise of up to a metre or more this century is plausible, and possibly of several metres within the next few centuries. This timescale is relevant to decisions on the footprint of our major cities. Recent research, presented at the Copenhagen climate congress in March 2009, projected sea-level rise

Photo Credit: William Prince and DEWHA

Erosion along the Gold Coast in 1967.

from 75 centimetres to 190 centimetres relative to 1990, with 110–120 centimetres the mid-range of the projection.

Based on this recent science 1.1 metres was selected as a plausible value for sea-level rise for this risk assessment. It is important to note that the purpose of a risk assessment is to identify areas of risk and therefore plausible worse case scenarios need to be considered. This is a dynamic area of science, and it is expected that sea-level rise projections will change as new research clarifies areas of uncertainty.

Different jurisdictions around Australia have adopted sea-level rise benchmarks for land use planning based on the IPCC's 2007 projections. The intended purpose of these benchmarks for statutory decision-making is different to the approach taken in this national risk assessment, which aims to provide an indication of the magnitude and spread of risk from a plausible 'worst case' scenario over the longer term.

Rising sea levels will bring significant change to Australia's coastal zone in coming decades. Many coastal environments such as beaches, estuaries, coral reefs, wetlands and low-lying islands are closely linked to sea level. There is a lack of knowledge in many cases as to how these environments will respond to sea-level rise, but the risk of beach loss, salinisation of wetlands and inundation of low-lying areas and reefs beyond their capacity to keep pace must be considered in regional decision-making.

With a mid range sea-level rise of 0.5 metres in the 21st century, events that now happen every 10 years would happen about every 10 days in 2100. The current 1-in-100 year event could occur several times a year. For illustration, a current 1-in-100 year event is equivalent to the intensity of storms along the New South Wales central coast in June 2007 when more than 200,000 homes lost power, thousands of people were forced to evacuate their properties, and insured losses exceeded $1.3 billion. An even larger increase in the frequency of high sea level events would occur around Sydney, with smaller increases around Adelaide and along parts of the Western Australian coast. The 1-in-100 year event is used in current planning guidelines as a benchmark for assessing extreme risk.

Extreme weather events are also likely to become more intense with climate change, with larger and more damaging storm surge and the possible extension of cyclones further south along both the east and west coasts. These changes will have implications for the capacity of the built and natural environment to withstand and recover from impacts.

Over recent decades many Australian beaches have been stable or even accreting because the sediment supply has been sufficient. It is expected that sea-level rise will change this dynamic, and an important question is when stable or accreting beaches will flip to receding beaches in the face of rising sea levels. This is a key threshold for coastal management. It is possible that with climate change some beaches could recede hundreds of metres over the course of this century.

This first pass national coastal assessment brings together existing and new information to highlight the scale of problem Australia faces as a vulnerable coastal nation. The assessment provides an analysis of residential property at risk from erosion and inundation around the Australian coastline at the end of this century.

There are limitations to the modelling used in this assessment: a 'bucket fill' approach was used to assess inundation. This essentially assumes a calm surface and does not attempt to model local hydrological processes. Inundation risks for a 1-in-100 year event (on top of sea-level rise) were assessed for Victoria, New South Wales and Tasmania based on modelled storm tide data from CSIRO. Where this modelled storm tide data was not available, inundation for a (far more frequently occurring) modelled high water level event, on top of sea-level rise, was assessed for the other states. This means the assessment for New South Wales, Victoria and Tasmania is identifying inundation from a more extreme event than for the other states.

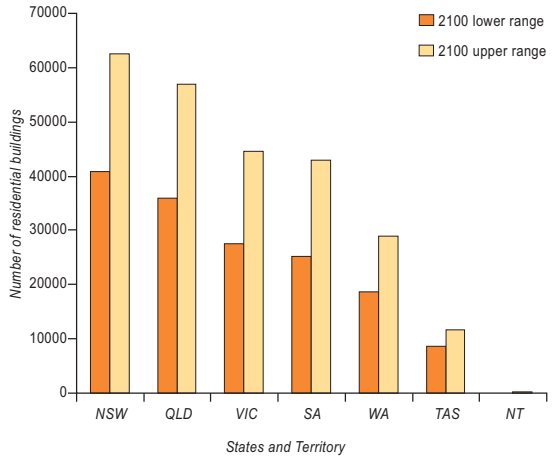

Figure ES.1 Estimated number of existing residential buildings at risk of inundation from a 1.1 metre sea-level rise (incl. 1-in-100 storm tide for NSW, VIC and TAS and high tide event for others).

While these modelling limitations need to be acknowledged, the analysis presented identifies widespread risk – significant stocks of residential housing, and social and economic infrastructure (schools, hospitals, ports, roads, etc) are exposed to risk of inundation and damage.

Up to $63 billion of existing residential buildings are potentially at risk of inundation from a 1.1 metre sea-level rise, with a lower and upper estimate of risk identified for between 157,000 and 247,600 individual buildings. The distribution of these properties across states and the Northern Territory is shown in Figure ES.1.

Coastal communities outside of capital cities generally have less adaptive capacity than capital city communities and may therefore be more adversely affected by climate change impacts. While there is a lack of national information on social vulnerability to climate change, remote Indigenous communities in the north of Australia and communities living on the low-lying Torres Strait Islands are particularly vulnerable to sea-level rise. Some Torres Strait communities are affected under current king tide conditions and even very small levels of sea-level rise are likely to have a major impact on these communities.

With much of Australia's infrastructure concentrated in the coastal zone around centres of population, climate change will bring a number of risks to built environment assets which could have consequences for the delivery of community and essential services, regional economies and possibly the national economy.

Industry reliant on access to or use of the coastal zone will also need to prepare for the impacts of climate change. While coastal industries such as tourism or fisheries as a whole have considerable resilience to climate change impacts, parts of these industries are made up of small to medium sized operators that have less capability to adapt.

Photo Credit: David Hanslow

Inundation from king tide in the Torres Strait.

Terrestrial and aquatic plants and animals that rely on coastal habitat are likely to be adversely affected by sea-level rise, increases in sea surface temperature and ocean acidification. Change in coastal ecosystems is already occurring, with southward migration of some species being observed particularly along the south-east coast of Australia. A major question for several coastal ecosystems is whether they are likely to face a threshold with modest climate change beyond which they will flip into a less desirable state. It is expected that initial responses from ecosystems in response to climate change will be either inland or poleward migration. In southern Australia the effect of 'coastal squeeze', where built infrastructure such as housing development prevents such movement, could constrain this natural adaptation response. The coastal systems most at risk are estuaries and associated wetlands, coral reefs, constrained tidal flat communities and saltmarshes, and beaches where there is a lack of sediment for replenishment.

The assessment provides a case for early action to reduce risk. There is a large legacy risk in the coastal zone from building and other infrastructure constructed in the past without regard to climate change. For 'at risk' areas, strategies to protect, accommodate or retreat will need to be developed as sea level is projected to continue rising for several centuries. Triggers will be needed to identify when on-ground responses are needed to manage increasing risks.

Where possible, avoidance of future risk is the most cost-effective adaptation response, particularly where development has not yet occurred. While little analysis has been done to date, the application of planning and building regulations to constrain an increase in risk from climate change impacts will deliver considerable savings in damages avoided.

Detailed regional and local assessments under worse case scenarios are needed to inform decision-makers of future risks and enable climate change adaptation to be incorporated into planning approaches. In this context planning approaches need to build resilience of natural ecosystems as they also provide a buffer to communities from changes in sea level. There is also a benefit in aligning disaster risk reduction strategies with adaptation assessments at this scale. Difficult decisions will need to be made in the future on what assets need to be protected and how this should be done; better information is needed to ensure that trade-offs and consequences of decisions are understood.

Engagement of all stakeholders – governments, individuals, and the private sector – is essential if we are to develop and implement a comprehensive, well considered and carefully staged national coastal adaptation agenda. All parties will have a role to play. National issues must be debated and effective collaborative arrangements developed to improve the

Simulated inundation of Sydney Airport for the first half of next century.

resilience of Australia's coast in the face of climate change. An effective adaptation agenda will need to include national standards and benchmarks, information and tools for decision-makers, better understanding of risks to critical infrastructure, and enhanced local capacity to manage on-ground impacts. Leadership from governments will be required in a national partnership to maintain the public good assets in the coastal zone for future generations. States, territories, local government, industry and communities will have a primary role in on ground coastal adaptation action. Where a national response is required, the Council of Australian Governments (COAG) can be an appropriate vehicle to progress reform.

This first pass national assessment of *Climate Change Risks to Australia's Coast* is intended to contribute to that debate. The preparation of the assessment has also identified a range of issues that will need further consideration over the years ahead in order that the Australian community can build on this initial assessment and develop resilient, robust and sustainable responses.