Australian Government

Australian Climate Service

2025

Australia's National Climate Risk Assessment: An Overview

The Australian Climate Service is a partnership of:

Australian Government
Bureau of Meteorology

CSIRO

Australian Bureau of Statistics

Australian Government
Geoscience Australia

Acknowledgement of Traditional Owners

The Australian Climate Service pays respect to Aboriginal and Torres Strait Islander peoples and their diverse Nations.

The Australian Climate Service acknowledges their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

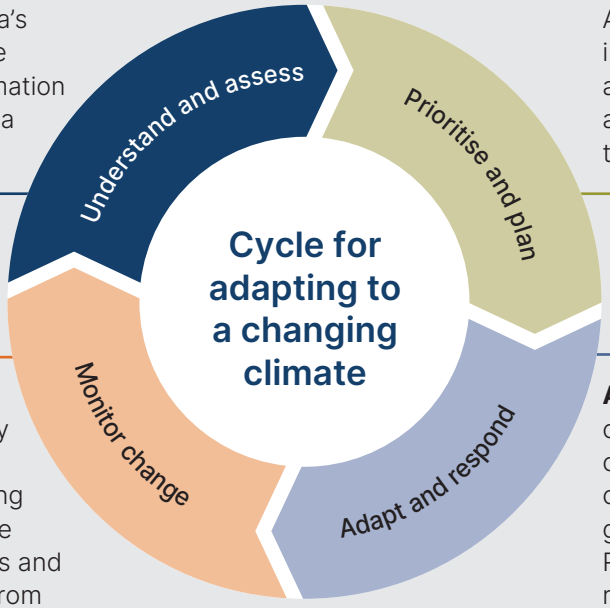
The Australian Climate Service values the role Aboriginal and Torres Strait Islander peoples' Knowledges and Cultural Values can provide in understanding and responding to Australia's climate and natural hazard risks.

Photo: Nitmiluk Gorge, NT, Australia. Source: Matt Scherf

The National Climate Risk Assessment (National Assessment) identifies climate risks across Australia, now and in the future.

This document is the National Climate Risk Assessment Overview. Along with its supporting technical reports, it provides a detailed understanding of climate risks for Australia at a key point in time. It plays an important role in informing an ongoing cycle of climate adaptation and improvement (illustrated right). The Australian Government's National Adaptation Plan considers these risks in prioritising and planning action at a national scale.

Understand and assess: The National Climate Risk Assessment provides a comprehensive understanding of Australia's current and future climate risks, consolidating information from various sectors into a national perspective.



Prioritise and plan: The National Adaptation Plan, prepared by the Australian Government, identifies immediate and future priorities, and outlines actions underway and those needed to respond to complex climate challenges.

Monitor change: To continue to effectively understand and respond to climate risks, monitoring trends, understanding the characteristics of impacts and evaluating and learning from adaptation actions is needed.

Adapt and respond: Addressing climate change requires collective action from individuals, communities, businesses, and governments. The National Climate Risk Assessment's analysis and resources can inform planning and implementing adaptation actions.

Australia's first National Climate Risk Assessment applies a risk-based approach to identify and assess the most significant climate-related threats facing the nation. This approach focuses on the 11 priority risks selected by the Australian Government – risks identified as having the greatest potential consequences and where action may be most needed. It supports decision-makers by providing a clear understanding of where Australia is most exposed and where responses can be most effective.

This risk-based method is consistent with international practice and has been used in countries such as the United Kingdom, Canada and Japan. The assessment identifies residual risk – the risks that remain even after current mitigation and adaptation efforts are in place. These risks help highlight where further action may be required.

As the first national assessment of its kind, there are limitations in the availability of data and evidence to fully assess residual risk. The assessment has expanded the availability of data and resources, providing a baseline to inform future decisions. It will be strengthened over time through improved monitoring, targeted research, and continued adaptation efforts.

The Australian Climate Service led the development of this first National Assessment and will continue to provide information to support climate-related decision-making. Future resources may explore different methods or focus areas to meet evolving decision-maker needs.

Executive summary

Australia's climate is changing, posing risks to key systems that underpin our way of life. Understanding these risks, their impacts, conditions and characteristics is important in informing effective adaptation.

Australia's first National Climate Risk Assessment assesses climate risks across our society and environment, including our economy, communities, agriculture, health, infrastructure, and ecosystems.

This National Assessment provides new data and analyses assembled in a nationally consistent way that can be used by governments, communities, industries and businesses to drive adaptation at national, regional and local scales.

Changing hazards

- Australia's climate is changing and will continue to change into the future. The country is likely to experience more intense and extreme climate hazards, and in some cases in areas where people and places haven't experienced these hazards before.
- Climate science indicates that our future extreme weather is likely to differ significantly from the past. Changes in the timing, duration, intensity and spatial patterns of hazards are likely, with many events occurring more frequently, in combination or affecting new locations.
- The change in distribution, timing and severity of extreme weather events means that historical observations on their own are not likely to be a good indicator of future risk.
- Australia currently experiences compounding and cascading hazards, and this is going to increase. Concurrent events, and reduced time between severe events will become more common.

Risks to people

- Individuals and households already disadvantaged are the most vulnerable to the impacts of a changing climate. Actions that address underlying disadvantage can reduce the impacts of climate change.
- Aboriginal and Torres Strait Islander peoples will experience unique impacts from climate change. The changing climate threatens the health of Country, access to Country and could challenge self-determination and have flow-on impacts on their social and physical health and wellbeing.
- Extreme heat, floods, bushfires, poor air quality and communicable diseases will escalate health risks. Those with pre-existing health conditions, including mental ill-health, are most at risk. This includes the very young and our older populations. People who work outdoors will also be at increased risk.

Risks to places

- Climate impacts are experienced differently across Australia. There are several key areas that have been identified as watchpoints:
  - Sea level rise and increased coastal hazards will significantly impact coastal communities and cities. By 2050, the number of coastal communities located in high and very high risk areas nationally will increase. If populations remained as they are today, this would equate to >1.5 million people living in areas that will experience sea level rise and coastal flooding risks by 2050.
  - Northern Australia is likely to experience escalating challenges as its proneness to hazards increases as the global temperature rises. This will put pressure on health, critical infrastructure, natural species and ecosystems, and primary industries. It will also pose additional challenges to emergency responders.
  - Outer urban areas of cities stand out as watchpoints. These areas are particularly susceptible to adverse impacts because of their circumstances (location, demographics, proneness to hazards).
  - Remote communities are vulnerable today due to limitations in power and telecommunications supply and weak supply chains. This vulnerability will increase as critical infrastructure and supply chains face increased disruptions.

Risks to our way of life

- Extreme events will affect some communities more than others. High-risk communities are likely to experience domestic migration, which in turn could disrupt local economies, social networks, traditional identities and cultural heritage.
- An escalation of risks in one system is highly likely to have a ripple effect across sectors, services and structures. Extreme events will lead to property damage, increased insurance costs and even loss of homes, particularly in coastal areas vulnerable to sea level rise and erosion. These impacts will contribute to the cost of living, placing further stress on household budgets.
- Australians will be impacted by loss of important ecosystems and species by the middle of the century, without implementing direct intervention and adaptation actions. Ecosystems provide clean air and water, food security through pollination, raw materials for medicines, natural disaster protection, and regulate the local climate. Australia's plants and animals have evolved to fit their local climatic conditions.
- More frequent and more intense extreme events will affect the way of life in different ways across Australia – from impacts to sport and recreation, to unreliable infrastructure, like energy sources during heatwaves. There will be additional pressure on emergency responders and defence resources. Increased severe floods and bushfires will degrade water quality, placing pressure on already limited water sources.

Regional insights

This map illustrates examples of the climate risks and impacts across Australia.

Increases in extreme heat and heatwaves will increase health risks and heat-related mortality, making it harder to work outdoors and respond to disasters.

The risk of vector-borne diseases (e.g. malaria and dengue fever) will rise as temperatures, rainfall, and floods increase, straining the healthcare system.

Crop yields will decrease with more drought (e.g. southwest Western Australia) and increased susceptibility to fire (e.g. southern and eastern Australia).

Disruptions to supply chains from more severe rainfall and flood events can result in many regional and remote communities not receiving goods. Distribution costs will also increase, particularly the cost of transporting medicines.

Many ecosystems, such as Eucalypt woodlands, will have a lower capacity to support biodiversity under future climate change.

Sea level rise and increased coastal hazards will significantly impact coastal communities and cities.

Coral reefs (e.g. the Great Barrier Reef and Ningaloo reef) will face ever increasing risks of bleaching and biodiversity loss as oceans warm and acidity increases.

Changes to the East Australian Current will cause increased 'tropicalisation', bringing more warm water southwards, and increasing risks to temperate ecosystems along southeast coastal regions.

Water availability and accessibility for towns, ecosystems and agriculture may become limited due to rising evapotranspiration in inland regions and changes in annual rainfall.

Critical infrastructure, such as power lines and telecommunications, is likely to experience increased pressure and damage from increased climate hazards.

Contents

Photo: Elim Beach near Hope Vale, Queensland, Australia.
Source: Dominic Jeanmaire

Approach to developing the National Assessment

The Australian Climate Service has undertaken Australia's first National Climate Risk Assessment.

Photo: Thick smoke plumes from an out-of-control bushfire in south western Australia. Source: Philip Thurston

The National Assessment provides a detailed understanding of the most significant climate risks facing the nation, identifying how Australia's people, infrastructure, economy, and environment are exposed and vulnerable to climate change this century.

It draws on research and analysis from multiple sources, has been guided by international best practices, and the Australian Climate Service has engaged with leaders and subject matter experts from academia, industries, governments and the community. The Australian Climate Service has also leveraged expertise and data from its partners Bureau of Meteorology, CSIRO, the Australian Bureau of Statistics and Geoscience Australia.

The National Assessment follows a phased approach:

1 First pass assessment

(July 2023–December 2023)

The first pass assessment was a qualitative assessment of Australia's climate-related risks. It included a comprehensive literature scan, rapid adaptation stocktake, and a series of expert elicitation workshops.

The first pass assessment reviewed climate risks within 8 systems of national importance. It considered how risks can compound, cascade, and aggregate across these systems.

The outcomes provided robust, expert-led insights into which climate risks are nationally significant.

Fifty-six nationally significant climate risks were identified. A subset of 11 priority risks were selected by the Australian Government for a detailed quantitative assessment by the Australian Climate Service.

Further engagement with Aboriginal and Torres Strait Islander peoples was committed to as part of the second pass assessment. This engagement aimed to identify the nationally significant risks to the Aboriginal and Torres Strait Islander Peoples system.

2 Second pass assessment

(January 2024–July 2025)

The second pass risk assessment analysed 11 priority risks selected by the Australian Government across 7 systems, and identified 7 new nationally significant risks in the Aboriginal and Torres Strait Islander Peoples system.

The 11 priority risks selected by the Australian Government in the second pass assessment relate to:

- Coastal communities and settlements
- Concurrency pressures in emergency response and recovery
- Critical infrastructure
- Governance
- Health and wellbeing
- Natural ecosystems
- Primary industries
- Real economy
- Regional and remote communities
- Supply chains
- Water security

The analysis undertaken was both quantitative and qualitative.The second pass assessment used subject matter expert analysis to understand key risks, as well as climate hazard, exposure, vulnerability and response data.

Australia's first National Climate Risk Assessment in numbers

10 PRIORITY **HAZARDS**

8 KEY FUNCTIONAL **SYSTEMS**

>15 NEW NATIONAL **DATASETS**

41 KEY **WORKSHOPS**

2,013 **WORKSHOP** PARTICIPANTS

254 **CLIMATE RISK** EXPERTS & AUTHORS

56 **NATIONALLY SIGNIFICANT RISKS** IDENTIFIED IN FIRST PASS ASSESSMENT

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7 **NATIONALLY SIGNIFICANT RISKS** TO ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLES

7 **INDEPENDENT EXPERTS** PROVIDING EXPERT GUIDANCE ACROSS THE NATIONAL ASSESSMENT

11 **PRIORITY CLIMATE RISKS** SELECTED BY THE AUSTRALIAN GOVERNMENT FOR SECOND PASS ASSESSMENT

>15 TECHNICAL SUPPORTING **REPORTS**

Approach to understanding climate risk

Climate risks are determined by the interaction of risk elements, including hazards, vulnerability, exposure and response. This assessment is guided by the Intergovernmental Panel on Climate Change approach.

VULNERABILITY is the propensity or predisposition to be adversely affected. It encompasses a variety of concepts and elements, including sensitivity to harm and capacity to cope and adapt.

EXPOSURE is the presence of things that could be adversely affected by climate and weather-related hazards. These include people, ecosystems, services, resources, infrastructure, or economic, social, and/or cultural assets.

HAZARD is the potential occurrence of an event or trend that may cause health impacts and damage to property, infrastructure, livelihoods, services, ecosystems, and environmental resources.

RESPONSE refers to how actions to address climate risks might not work as planned or could create other problems.

Adapted from the Intergovernmental Panel on Climate Change (IPCC) and Simpson et al., 2021

Key concepts for the National Assessment

A range of foundational concepts were used to understand climate risks to Australia.

Priority hazards

10 priority hazards were considered in the National Assessment to determine key impacts and climate risks for Australia over the next century.


Changes in temperatures, including extremes


Drought and changes in aridity


Bushfires, grassfires and air pollution


Extratropical storms


Convective storms, including hail


Tropical cyclones


Riverine and flash flooding


Coastal and estuarine flooding


Coastal erosion and shoreline change


Ocean warming and acidification

Time horizons

The National Assessment uses 4 time periods from the past, current, and future to assess changes in climate risk.

Period	Year range	Time horizon
Historical baseline	1850–1900	-
Current climate	2011–2030	2020
Medium-term	2041–2060	2050
Long-term	2081–2100	2090

Global warming levels

The National Assessment considers different global warming levels that are likely to be reached by mid-term (2050) and long-term (2090) time horizons, according to the latest international climate science.

These include: +1.5°C, +2.0°C, +3.0°C global warming levels.

Geographic regions

11 geographic regions are used to assess risk and highlight priority risks for the National Assessment. These regions are:

- New South Wales and the Australian Capital Territory
- Northern Territory
- Queensland north
- Queensland south
- South Australia
- Tasmania
- Victoria
- Western Australia north
- Western Australia south
- Antarctica
- Australia's Exclusive Economic Zone.

Key functional systems

The National Assessment considers risks across 8 key systems:


Aboriginal and Torres Strait Islander Peoples


Communities – urban, regional and remote


Defence and national security


Economy, trade and finance


Health and social support


Infrastructure and the built environment


Natural environment


Primary industries and food

Residual risk in the National Assessment

While mitigation and adaptation can reduce risk, they may not eliminate it entirely. Residual risk refers to the risk that remains after mitigation and adaptation actions are implemented. When risks are not or cannot be avoided, the result may be loss and damage (United Nations Environment Programme, 2023; van der Geest & Warner, 2020).

To evaluate residual risk, the National Assessment considered:

- current climate impacts and risks, focusing on changes in hazards and their likelihood
- future changes to risk determinants for each system, including hazard exposure and vulnerability
- existing adaptation efforts, including both planned and autonomous (unplanned) responses.

As this is the first National Assessment, there are inherent limitations in the scope and availability of data to assess residual risk. This assessment provides a foundational understanding, and future iterations are expected to benefit from improved data, expanded monitoring, and evolving adaptation practices.

As part of the National Assessment, the Australian Climate Service commissioned an Australian Adaptation Stocktake. This stocktake draws on a newly compiled database of over 670 publicly available examples of adaptation policies, plans, projects, and actions across local, state, and national levels in Australia. It was specifically created to help identify where adaptation is occurring and to evaluate its adequacy and any shortfalls.

The stocktake focuses on publicly endorsed actions, which means it may not capture all adaptation efforts, especially those not explicitly labelled as 'climate adaptation'. This assessment does not include new actions proposed in the Australian Government's National Adaptation Plan, developed in response to this National Assessment.

Expert advice was sought within each system to assess whether current adaptation efforts are effective and adequate. This included evaluating autonomous adaptation (responses that occur without formal planning) as a potential way to reduce climate risk. When adaptation is effective, it can inspire further change, leading to more widespread autonomous adaptation over time.

The experts also considered co-benefits from adaptation in other systems. This refers to situations where actions in one area may help reduce risks in another.

The risk ratings provided in the National Assessment reflect these considerations and should be interpreted as residual risk – the level of risk remaining after current adaptation and mitigation efforts.

However, there are important limitations:

- There is limited data on adaptation effectiveness, especially at a national scale.
- Some risks may face limits to adaptation, where even the best efforts cannot prevent intolerable outcomes.
- Path dependency requires further consideration. This is where early choices or actions constrain future options.
- Future societal and climate changes may alter system dynamics, making current adaptation less effective or opening new opportunities.

These factors highlight the importance of ongoing monitoring, innovation, and regular risk-based assessments to inform future decisions.

The risk ratings in the National Assessment do not account for the full potential of future adaptation.

Confidence

International best practice to guide climate risk decision-making recommends the use of confidence and likelihood ratings to support decision-makers in understanding the probability of the risk and considering the consequences. The Australian Climate Service has applied confidence ratings in 2 areas – hazard science and findings and climate risk.

Hazards

The National Assessment has adopted Intergovernmental Panel on Climate Change guidance (IPCC, 2010) to assign confidence and likelihood to the hazard projected. Confidence in climate projections applied by the IPCC (IPCC, 2010) notes 2 crucial dimensions:

- **the amount of evidence:** limited, medium or robust (e.g. the number of models used)
- **agreement of that evidence:** low, medium or high (e.g. how consistent the model projections are for the future state).

Climate and hazard analysis in the National Assessment is drawn from multiple sources of evidence, including the range of projections from the Australian Climate Service resources, the scientific literature, recent projections of Australian climate in reports (such as Earth Systems and Climate Change Hub, 2020), and past observations and trends (e.g. State of the Climate, 2024).

The degree of certainty (confidence) is determined through extensive reviews of the evidence and published peer-review information.

CONFIDENCE

very high confidence	• High agreement, robust evidence
high confidence	• High agreement, medium evidence • Medium agreement, robust evidence
medium confidence	• High agreement, limited evidence • Medium or low agreement, medium evidence
low confidence	• Low agreement, robust evidence • Medium agreement, limited evidence
very low confidence	• Low agreement, limited evidence

More information on hazard risk confidence can be found in the *Australia's Future Climate and Hazard* report.

Climate risk confidence rating

Climate risk arises from the dynamic interaction of hazards, exposure, vulnerability, and response, each shaped by location, development, and decision-making.

When assessing and communicating climate risk, the Australian Climate Service applies a **simplified confidence rating** in the National Assessment.

The IPCC bases climate risk confidence assessments on extensive synthesis of peer-reviewed literature. This is the first national assessment for Australia and so in some areas there is limited available published literature at a national-scale.

The Australian Climate Service has developed climate risks using available literature, data and newly developed modelling and expert knowledge as part of the National Assessment, focused on addressing knowledge gaps identified by stakeholders.

Confidence ratings for climate risk findings are developed, considering the IPCC guidance, through expert elicitation.

Ratings consider:

- **type, quality and consistency of evidence:** observations, experimental results, process-based understanding, statistical analyses and model outputs, as well as the robustness of evidence as determined by its quality and consistency across multiple, independent sources.
- **level of expert confidence:** the range of explanations, demonstration of causality, and consensus within the expert community.

Three categories were adopted for the first assessment:

CLIMATE RISK CONFIDENCE

high confidence	Strong evidence and expert confidence
medium confidence	Moderate evidence and expert confidence
low confidence	Low evidence and expert confidence

More information on climate risk confidence can be found in the *National Climate Risk Assessment report*.

Confidence ratings provide useful guidance for adaptation decision-making

High and **very high** confidence ratings can be used to identify areas of high exposure to hazards and provide robust information for decision-making. Where a high climate risk rating is applied, this notes the quality of the underpinning exposure and vulnerability information and agreement with literature.

Where confidence is **medium**, additional regional and local information should be sought.

For example, national projections can provide context and fill some information gaps, but if local topographical information or fine-scale climate models are available these should be used to augment the national information. Additional evidence, including exposure, vulnerability and response information, should be used to support adaptation planning and action.

Low confidence still provides information for decision-making. These findings can point to areas that may be at risk but should be supplemented with additional information such as regional modelling, fine-scale local modelling, and local information. Where confidence in hazard projections is low but a range is given, this provides information on the evidence provided by climate models and can be used to develop scenarios for operational and adaptation planning that consider both low and high outcomes. This approach can identify 'no regrets' adaptation actions and improve preparedness that are common across scenarios.

National vs regional confidence: It is worth noting that in many cases, confidence in regional climate projections or risk information may be available at higher confidence levels than for national averages.

Changes to Australia's climate hazards

Australia's climate hazards are changing. How bushfires, floods, heatwaves, tropical cyclones, storms, and other hazards are experienced will be different in the future.

Understanding future changes in Australia's climate and extreme weather is the first step in understanding climate risk.

With this information, the nation can start to understand who or what might be at risk and why, providing a better understanding of how we as a nation can reduce possible impacts and adapt to risk.

Photo: A pelican paddles across a flooded rural road in Walker Flat on the River Murray in South Australia.

Future changes to climate hazards

- For decades, Australia's leading climate agencies, the Bureau of Meteorology and the CSIRO, have been at the forefront of advancing knowledge about climate science and natural hazards. The Australian Climate Service draws on this expertise to provide a unified national perspective of climate change and weather-related hazards.
- Our climate has already changed and will continue to change, even if global temperatures stabilise. **Keeping global temperatures at +1.5°C, +2.0°C or +3.0°C above pre-industrial temperatures will stabilise some, but not all, climate impacts** (*high confidence*).
- **Future changes in Australia's climate will not occur gradually or smoothly** (*very high confidence*). Reaching potential climate and ecological tipping points is very likely to result in abrupt changes.
- **As climate hazards change in frequency and increase in severity, it is likely we will experience more compounding, cascading and concurrent hazards in the future** (*medium to high confidence*). For example, heavy rainfall and severe flooding following a tropical cyclone and extratropical low or increased air pollution following an extreme heatwave during a bushfire.
- **While some hazards are likely to occur less often, when they do occur, they may be more intense and occur in different locations than previously.** For example, it is anticipated that Australia will see fewer tropical cyclones, but proportionally more will be severe under all warming levels (*medium confidence*).

Photo: Thunderstorm over Melbourne, Victoria.

RIVERINE FLOODS

A decrease in maximum daily runoff and annual runoff totals is possible (*low confidence*) indicating less frequent riverine flood events. However, **when floods do occur, they are likely to be higher due to higher event rainfall totals** (*medium confidence*)**.** Southern and particularly south-western Australia are projected to experience reduced runoff. In contrast, parts of the east coast and tropics are likely to see an increase in heavy runoff events, which could lead to higher risks of flooding.

TROPICAL CYCLONES

The frequency of tropical cyclones is likely to decrease (*medium confidence*), but the proportion of category 4 and 5 events may increase (*low/medium confidence*). Little change or a small southward shift in tropical cyclone tracks is possible (*low confidence*).

HIGH TEMPERATURES

Extreme temperatures are likely to increase nationwide (*very high confidence*), with the greatest increases over northern Australia, the Great Dividing Range in the southeast, and in desert regions. Severe and extreme heatwave events are projected to double if global warming reaches +2.0ºC and more than quadruple under +3.0ºC of warming.

COASTAL HAZARDS

Sea levels around Australia will continue to rise (*very high confidence*), with a median projection of half a metre by the end of the century. Far higher levels cannot be ruled out this century if polar ice sheets collapse (*low confidence*). As sea levels rise, **coastal flood events are projected to become more frequent, accompanied by greater levels of coastal erosion and shoreline change** (*high confidence*)**.** By 2090, coastal erosion events may occur around 10 times more often than now.

Summary of Australia's changing climate hazards

STORMS

Extratropical storms (including east coast lows) are projected to become less frequent (*medium confidence*); however, they may have greater impacts when they do occur (*medium confidence*). Changes in rainfall intensity and sea levels mean a higher chance of coastal flooding from future extratropical storms. **Convective storms producing large hail may increase in the east** and occur further south (*low confidence*).

DROUGHT

Time spent in drought is likely to increase across most of the country (*low to medium confidence*), particularly in southern and eastern areas. **Drying in the southwest of the nation, where increased time in drought has occurred since the 1970s, is projected to increase** at all future levels of global warming (*high confidence*). Long-term changes towards drier conditions are likely to occur in parts of southern Australia, with higher confidence of such change for southwest Australia.

BUSHFIRE

Higher temperatures and drier conditions will increase the risk of bushfires in most currently forested areas (*high confidence*). However, some areas may see less intense fires later in the century as forests transition to grassland, reducing fire fuel loads. **Dangerous fire weather days are projected to become more frequent in southern and eastern areas** with a longer fire season and the potential for more megafires (*high confidence*). Northern regions are projected to have an increased susceptibility to savannah fire as rainfall patterns and vegetation change.

OCEAN WARMING AND ACIDIFICATION

Oceans surrounding Australia are expected to become more acidic (*high confidence*) **and warmer, with more frequent and longer marine heatwaves** (*high confidence*). The ocean environment will become more stressful for marine organisms, with a higher chance of coral bleaching. Marine heatwaves will become more frequent, particularly in the Tasman Sea. In Antarctic waters, more acidic oceans will mean some areas may become incapable of supporting the development of shells and coral skeletons.

Summary of potential changes to climate hazards across Australia

The Australian Climate Service has assessed climate hazards and how they may change in the future. The top table represents potential changes under different global warming levels (+1.5°C, +2.0°C and +3.0°C). These potential changes are relative to the current climate (+1.2°C).

The bottom table represents how hazards related to sea level are expected to change across Australia under future sea level rise increments (0.14m, 0.32m, 0.54m).

Global warming is currently confirmed at +1.2°C, however warming across the Australian continent has already reached +1.5°C. Global warming levels are used for reference throughout this report. Values presented in these tables are annual estimates.

	Current	Future change relative to current		
	GWL +1.2°C	GWL +1.5°C	GWL +2.0°C	GWL +3.0°C
Severe/extreme heatwave days	4 days	+2 days ○○○	+5 days ○○○	+14 days ○○○
Time spent in drought	19 months per decade	-10% to +36% ○	-8% to +69% ○	-15% to +89% ○○
Fire susceptibility		↑ in south, east ○○○	↑↑ then ↓ in south, ↑ east ○	↑↑ then ↓ in south, ↑ east ○
Frequency of extratropical lows	88 hours per year	No clear change ○	-19% to +8% ○○	-25% to -3% ○○
Frequency of large hail events	5–10 events in east	Insufficient data	↑ in east ○	Insufficient data
Tropical cyclone frequency (cat 4/5)	2–3 per year on average	Little change or small ↑ ○	Little change or ↑ ○	Little change or ↑ ○
Maximum daily runoff	2.6mm	-39% to +47% ○	-53% to +58% ○	-57% to +59% ○
Marine heatwave duration	18 days	+22 days ○○○	+77 days ○○○	+161 days ○○○

	Current rise since 1880	Future change relative to current sea level			
		GWL +1.5/ +2.0°C at 2050	GWL +2.0°C at 2090	GWL +3.0°C at 2090	Planning benchmark
Sea level rise	0.2m	+0.14m	+0.32m	+0.54m	+0.94m
Frequency of coastal flooding	15 days ○○○	+24 days ○○○	+87 days ○○○	+193 days ○○○	+257 days ○○○
Extreme water level frequency	x 1.0 ○○○	x 2.0 ○○○	x 5 ○○○	x 14 ○○○	x 101 ○○○

National summary of potential changes to climate hazards. Circles indicate a confidence rating based on the direction of change. 3 circles = *high confidence*, 2 circles = *medium confidence*, 1 circles = *low confidence (ACS, 2025)*. Note: confidence in regional changes will differ from national confidence ratings and in many cases will be higher

Australia's Future Climate and Hazards Report provides key analysis of how Australia's climate and hazards are changing in Australia, now and over the coming century.

Climate risks to Australia

In the first National Assessment, 63 nationally significant climate risks have been identified. This includes an additional 7 nationally significant climate risks for the Aboriginal and Torres Strait Islander Peoples' system.

Of those, 11 priority risks were selected by the Australian Government for further analysis in the second pass assessment. The 11 priority risks were analysed by the Australian Climate Service across to provide an understanding of risks to Australia.

This section summarises the Australian Climate Service's independent analysis and observations across the priority risks and key systems.

Photo: Burleigh Heads beach on a sunny Gold Coast day, Queensland, Australia

Climate risks to Australia

The National Assessment considers what is at risk nationally from climate change and provides information and observations at a national scale across key systems.

Eleven priority risks were selected by the Australian Government for detailed qualitative and quantitative analysis in the second pass assessment.

These risks have been analysed in detail, both within and across key systems to provide insights into how these risks will impact different aspects of Australian society.

The process and the description of the 7 nationally significant climate risks to Aboriginal and Torres Strait Islander peoples is captured in a separate report released as part of the National Assessment – **Climate Risks to Aboriginal and Torres Strait Islander Peoples report**.

Other systems contain findings related to Aboriginal and Torres Strait Islander people. Perspectives shared by Aboriginal and Torres Strait Islander people as part of the National Assessment have also been included.

Australia's 8 key functional systems

- Aboriginal and Torres Strait Islander Peoples
- Communities – urban, regional and remote
- Defence and national security
- Economy, trade and finance
- Health and social support
- Infrastructure and the built environment
- Natural environment
- Primary industries and food

Key cross-system risks

- Coastal communities and settlements
- Governance
- Supply chains
- Water security

Nationally significant climate risks to Australia

At the end of the full National Assessment, 63 nationally significant climate risks have been identified. Eleven of these risks have been assessed in detail and findings have been organised by system. More information on these nationally significant risks can be found in the **First pass assessment report** and the **Climate Risks to Aboriginal and Torres Strait Islander Peoples report**.

Risks to Aboriginal and Torres Strait Islander Peoples

Risks to:

- Self-determination
- Land, sea and Country
- Cultural knowledges, practices, values and sites
- People's health, wellbeing and identity
- Economic participation and social and cultural economic development
- Water and food security
- Remote and rural communities

Risks to Communities

Risks to:

- Natural environments and ecosystem services
- Water
- Physical and mental health
- Biosecurity
- Community cohesion and resilience
- Viability of businesses and industries
- Workforce stability and productivity
- Emergency services and recovery
- Supply chain infrastructure
- Governance

Risks to Defence and national security

Risks to:

- Disaster response and recovery
- Migration and displacement
- Social cohesion
- Supply chains
- Personnel health and safety
- Natural environments
- Critical infrastructure
- Essential services

Risks to Economy, trade and finance

Risks to:

- Governments' finances and capacities
- Australian economy
- Individual and household budgets
- Financial system
- Production and consumption of goods and services

Risks to Health and social support

Risks to:

- Individuals and communities at risk
- Heat and extreme weather
- Mental health
- Service delivery and workforce
- Air quality
- Communicable diseases
- Food and water security
- Aboriginal and Torres Strait Islander peoples
- Infrastructure

Risks to Infrastructure and the built environment

Risks to:

- Buildings and community infrastructure
- Transport and telecommunications
- Human health, and medical and emergency services
- Water and wastewater management
- Urban natural environments
- Critical and essential services infrastructure
- Supply chains
- Energy
- Circular economy and waste management
- Building liveability

Risks to Natural environment

Risks to:

- Landscape function
- Vulnerable environments
- Natural resources
- Species loss
- Use and management of natural places
- Rural and Aboriginal and Torres Strait Islander peoples' livelihoods
- Human health and wellbeing
- Natural places and associated values

Risks to Primary industries and food

Risks to:

- Ecosystem services
- Infrastructure
- Health and wellbeing
- Productivity and profitability
- Community
- Trade and export markets

Evaluating climate risks to systems

The Australian Climate Service has undertaken an evaluation of relative risk to Australia's key functional systems.

The National Assessment considers a range of impacts and consequences, including:

- impact on the population affected
- public safety and health
- geographical reach
- social cohesion
- long-term environmental impact
- national resource security
- the potential for cascading impacts across systems and regions.

Risk ratings use 2 timeframes (current and 2050), acknowledging the uncertainty of evaluating systems by 2090 due to their dynamic nature. The timeframes consider a 20-year window centred on the year. The 'current' risk considers impacts that have happened, or could happen between 2011 and 2030, while the 2050 risk evaluation considers the 20-year window from 2041 to 2060.

Rating categories have been developed to describe the impacts and risks to systems. These are qualitative ratings, based on the weight of evidence and expert judgment.

These categories are:

LOW MODERATE HIGH VERY HIGH SEVERE

Photo: Sunset over Lake Burbury, West Coast, Tasmania.

Risk rating categories for risks to key systems

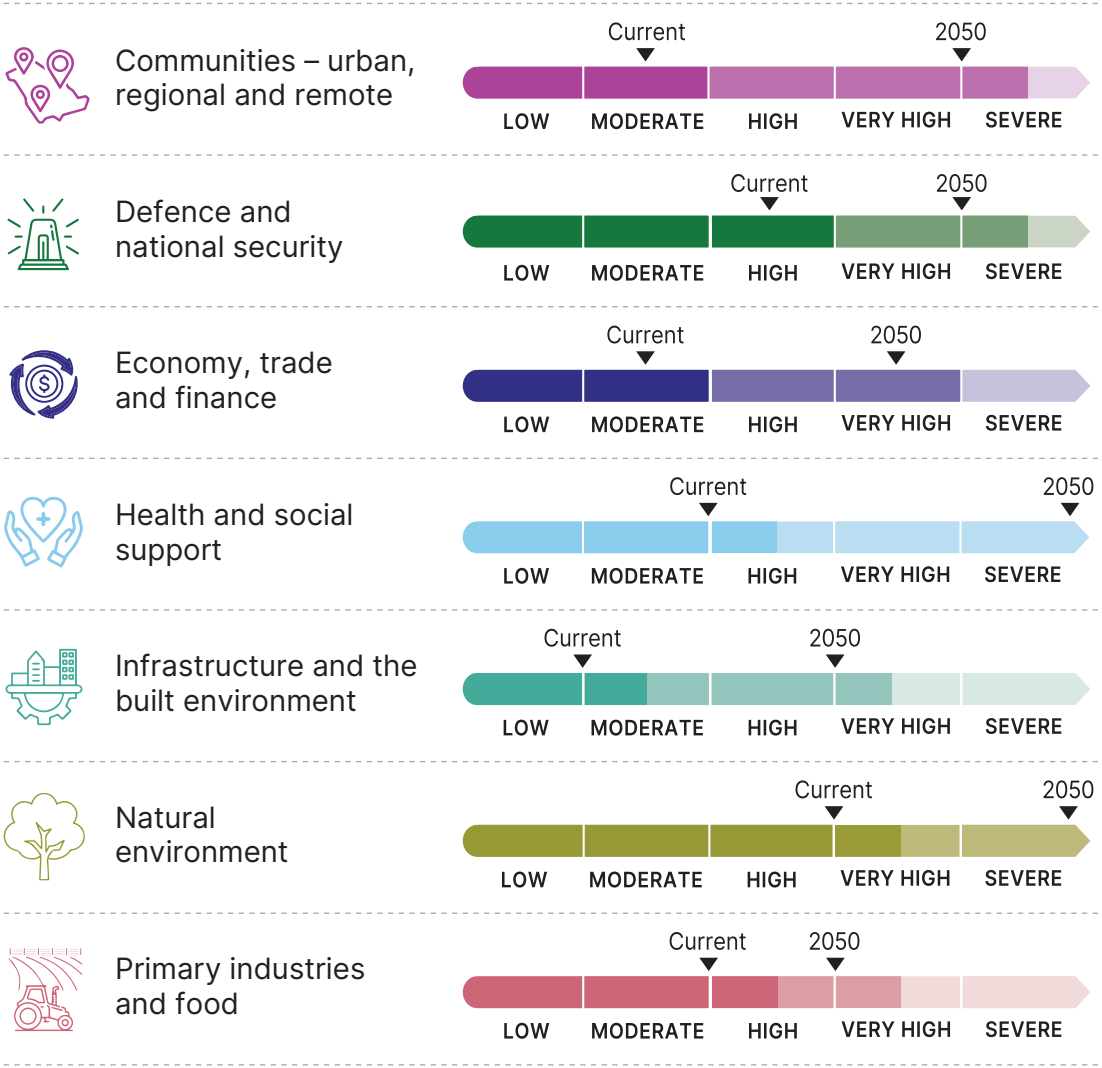
LOW	MODERATE	HIGH	VERY HIGH	SEVERE
The impacts are minimal, with negligible effects on vulnerable communities and existing inequalities. There is minor potential for loss of life or significant property damage, and minimal disruption to community stability, livelihoods, and natural systems. The risk of long-lasting impacts to national security, resource security, and environmental health is insignificant, with no major threats to biodiversity or natural assets.	The impacts are limited to a few local regions, with minimal effects on a state or national level and on vulnerable communities. There is moderate potential for loss of life or property damage, and limited disruption to community stability, livelihoods, and natural systems. The risk to national security, resource security, and environmental health is low, with minor threats to biodiversity and sustainable resource use.	The impacts affect multiple regions within one or 2 states, noticeably impacting vulnerable communities and moderately exacerbating inequalities. There is a high potential for loss of life and property damage, with noticeable disruptions to community stability, livelihoods, and natural systems. National security, resource security, and environmental health face high risks, with threats to biodiversity and sustainable resource use.	The impacts are significant across multiple states, affecting safety and security nationally. Vulnerable communities face substantial impacts, exacerbating inequalities. There is a very high risk of significant loss of life and property damage, with major disruptions to community stability, livelihoods, and natural systems. National security, resource security, and environmental health face substantial threats.	The impacts are widespread across multiple states, severely affecting vulnerable communities and exacerbating inequalities. There is a major risk of significant loss of life and property damage, with severe disruptions to community stability, livelihoods, and natural systems. National security, resource security, and public health face severe threats.

Summary of current and future climate risks

The Australian Climate Service has rated climate risks to Australia's key systems, both now and in the future.

These ratings aim to inform decision-makers on the severity of expected impacts. It should be noted that future ratings assume no change in adaptation investment or approach.

A collaborative approach to identify nationally significant climate risks to the Aboriginal and Torres Strait Islander People system occurred during 2024 and 2025. Further analysis of these climate risks and their impacts could be undertaken in the future.



Communities – urban, regional and remote

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to urban, regional and remote communities. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Communities system encompasses a wide range of communities across Australia, including regional centres, towns, remote settlements, urban areas and cities. This system covers all natural, social, economic, and built aspects of these communities, which face risks from multiple hazards including coastal hazards.

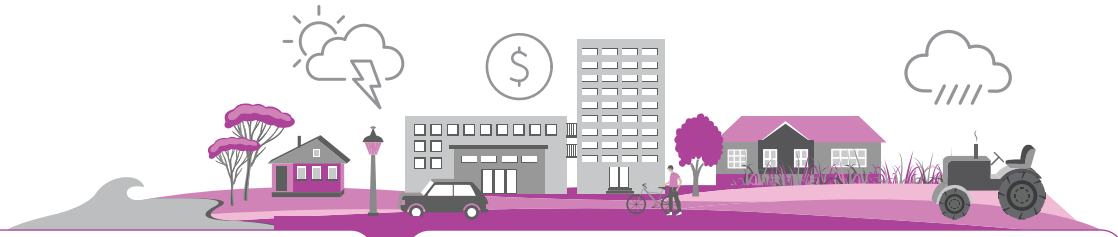
Priority risks considered in this system include:

- Risks to regional, remote and Aboriginal and Torres Strait Islander communities that are supported by natural environments and ecosystem services.
- Risks to coastal communities from sea level rise particularly where legacy and future planning and decision-making increases the exposure of settlements.

Photo: Elizabeth Quay development, Perth, Western Australia

Communities – urban, regional and remote

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Communities system.



Climate and hazards

- Bushfires
- Changing precipitation patterns, including drought
- Flooding
- Heatwaves
- Sea level rise
- Tropical cyclones

Exposures

- Buildings (residential and commercial)
- Critical and essential goods and services
- Economic drivers (e.g. small businesses, agriculture productivity)
- Essential infrastructure (e.g. major roads, electricity lines)
- Finance and the real economy
- Health services (e.g. GP clinics, hospitals, aged care services)
- Population

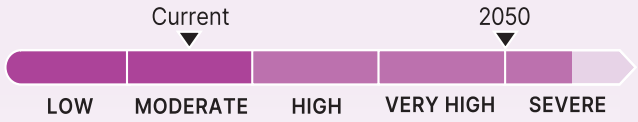
Vulnerabilities

- Access to essential resources and services
- Communities and individuals with already heightened vulnerability
- Exposure to multiple hazards and compounding events
- Infrastructure and supply chains that are limited or not climate adapted
- Lack of diversity of industry, reliance on single industries
- Water security pressures

IMPACTS AND RISKS

- Multiple rising pressures on coastal communities
- Less time to recover from severe events
- Inaccessible or unaffordable insurance for high risk areas
- Increasing water security risks and competition for water
- More disruptions to supply chains
- Increasing demand on health services
- Disruption to communities that rely on single industries

Key climate risks to Communities



The current climate risk to the Communities – urban, regional and remote system is rated as **Moderate** (*high confidence*).

By 2050, the climate risk to the Communities – urban, regional and remote system is projected to escalate to **Very High–Severe** (*high confidence*).

1. Communities at highest risk

Communities in northern Australia – including the Northern Territory, Queensland north, and Western Australia north – are exposed to multiple climate hazards, including heatwaves, flooding, tropical cyclones, and bushfires. These regions also have a high proportion of their populations living in high-risk areas. Increases in extreme heat are compounding existing socioeconomic vulnerabilities, such as low income and high poverty rates. These factors particularly affect Aboriginal and Torres Strait Islander communities, as well as older populations. By 2050, the increasing frequency and intensity of many hazards, along with increasing water security challenges, are likely to further increase risks in these areas.

2. Coastal and island communities

Coastal and island communities across Australia face heightened risks from rising sea levels, which intensify coastal flooding, erosion, and inundation. Low-lying communities located within 10 km of soft shorelines are particularly vulnerable, with the percentage of areas at high risk expected to increase significantly by 2050. By 2090, 34% of coastal communities could be at high or very high risk, representing over 3 million people based on current population distributions. Exposure is increasing in both urban and regional coastal areas, with vulnerability shaped by socioeconomic factors, infrastructure density, and adaptive capacity.

3. Regional communities

Regional communities are highly vulnerable to climate change due to their reliance on climate-sensitive industries, such as agriculture and tourism. These sectors face increasing risks from droughts, heatwaves, floods, and other risks, such as from reduced access to markets or increased biosecurity risks. Limited employment diversity and economic dependence on natural resources heighten the potential for disruption and reduce resilience.

Critical infrastructure, particularly water, transport, and energy systems, is often sparse and lacks redundancy, resulting in slower recovery and greater vulnerability to repeated climate shocks. Socioeconomic factors such as older populations, lower incomes, and limited access to services further reduce adaptive capacity.

Regions in northern and central Australia are more prone to multiple types of climate hazards, particularly extreme heat, compared to other parts of the country. This elevated proneness means communities in these areas are more likely to experience severe events more frequently, placing greater pressure on infrastructure, services, and emergency response systems.

4. Urban communities

Urban centres and cities, especially those along the coast, are emerging as primary hotspots for sea level rise impacts. Rising sea levels increase risks to critical and community infrastructure, while high population densities and residential buildings near soft shorelines heighten risk to erosion impacts. The relatively high value of assets exposed to hazards will increase the impacts if risks are realised.

In addition to sea level rise, urban communities are increasingly at risk of extreme weather events. Heatwaves strain energy systems, impact public health, and disrupt transport networks. Flooding from intense rainfall threatens essential community infrastructure and services, while also driving up economic costs due to property damage (insurance coverage and costs), business interruptions, and recovery expenses. Major urban areas will need to prioritise risk-based planning and infrastructure resilience to mitigate these growing threats.

5. Aboriginal and Torres Strait Islander and remote communities

Remote communities, including Aboriginal and Torres Strait Islander populations, are particularly vulnerable to climate hazards due to their geographic isolation, limited infrastructure, and systemic disadvantage. These communities face heightened risks from extreme events such as heatwaves, floods, droughts and bushfires, which can disrupt essential services and supply chains.

Sea level rise poses a significant threat to homes, livelihoods, and cultural connections, particularly in locations such as the Torres Strait Islands. The loss of access to Country and the ability to practice traditional ways of life can have profound social and emotional impacts. Long distances to service centres and weak infrastructure links also increase energy and supply chain insecurity, underscoring the need for targeted support and adaptation strategies.

6. Critical and essential services

Climate change poses immediate risks to critical and essential services such as health services, aged care, water supply, energy, and transportation. Rising temperatures, extreme weather events, and shifting rainfall patterns threaten the reliability, efficiency, and accessibility of these services, particularly in high-risk locations.

Infrastructure in exposed areas may struggle to meet growing demand under climate stress, with disruptions affecting vulnerable populations most acutely. To maintain service continuity and reduce long-term risks, development in hazard-prone areas must include climate-informed urban planning, building codes and infrastructure investment.

7. Finance and the real economy

Climate change is expected to drive escalating economic costs across all communities. Sea level rise will intensify coastal flooding and erosion, exacerbate flood and tropical cyclone impacts, and increase the severity and frequency of extreme events. These changes will notably increase insurance costs, leading to more underinsured or uninsured properties.

Business interruptions caused by extreme events will raise costs for local economies and may have broader impacts on the national economy when disruptions are widespread or prolonged. Effective adaptation actions – including risk-based planning, resilient building codes, and long-term infrastructure investment – will be essential to mitigate financial risks. Inclusive community engagement and forward-looking planning will also be critical to support economic resilience.

Photo: Collaroy Narrabeen Beach on the Northern Beaches of Sydney. Source: Steven Tritton

Notable insights

Current / near-term

- **Cities**, especially coastal cities, have moderate to high exposure to **climate hazards** but they also have significant variations in socioeconomic vulnerability. **Outer urban areas of cities** stand out as watch points as they have moderate levels of both exposure and vulnerability, making them particularly susceptible to adverse impacts and are likely to experience prolonged recovery times.
- **By 2030**, **small businesses** in areas of greater than average climate risk will increase from 8.7% to 10.1% nationally (an **additional 35,000 businesses**).
- Sea levels are rising around Australia, and more frequent extreme events are increasing the risk of inundation and damage to **coastal infrastructure and communities** in low-lying areas, including in major cities and external territories. **By 2030**, if populations remained as they are today, this would place **597,000 people** at direct risk from coastal hazards.
- Remote communities are vulnerable today due to limitations in **power and telecommunications supply and weak supply chains**. This vulnerability will increase as critical infrastructure and supply chains face increased disruption from hazards.

Future

- In the future, more communities will be above today's national average **hazard proneness** (see Figure 1). This suggests that **normal combined hazard conditions in the future will resemble the extremes of today**.
- **By 2050**, the number of **coastal communities** located in high and very-high risk areas will increase from 8% to 18% due to sea level rise. If current populations remained as they are today, this would represent an increase to **1.5 million people at risk. By 2090**, 34% of coastal communities could be in at-risk areas. If populations remained as they are today, this would represent an increase to **>3 million people at risk**.
- The compounding effects of climate change, particularly in **highly exposed communities**, are very likely to result in **significant economic costs**. Repeated extreme events, especially with prolonged displacement, could result in loss of social cohesion and distrust in governments.

Figure 1: Overall hazard proneness is projected to increase in all regions, compared to current conditions. Hazard proneness is a measure across different regions that accounts for the prevalence of multiple hazards (heatwaves, bushfires, riverine and flash flooding and tropical cyclones) at different warming levels.

Hazard proneness refers to the combined frequency, probability, or severity of multiple hazards. The Australian Climate Service has assessed hazard proneness for 4 of the priority hazards – heatwaves, bushfires, riverine and flash flooding, and tropical cyclones.

Defence and national security

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to the Defence and national security system. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Defence and national security system refers to the structures and functions dedicated to safeguarding Australia. Australia's domestic disaster response is primarily the responsibility of state and territory governments. The Australian Government provides support where state and territory capacities are overwhelmed, including through requests for deployment of the Australian Defence Force and other Australian Government capabilities for disaster response and recovery as required.

The priority risk considered in this system is the risks to domestic disaster response and recovery assistance from the competing need to respond to multiple natural hazard events resulting in concurrency pressures and overwhelming the capacity of all levels of government to effectively respond and to do so while reducing reliance on the Australian Defence Force.

Photo: Fire truck attending bush fires in Victoria, Australia

Defence and national security

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the priority risk assessed for this system.

Climate and hazards

- Bushfires
- Compounding and cascading hazard events
- Extreme heat
- Flooding
- Tropical cyclones
- Sea level rise

Exposures

- Remote communities, and people already disproportionately at risk
- Buildings (residential and commercial)
- Critical and essential goods and services
- Critical infrastructure
- Economic drivers (small businesses, agriculture productivity)
- Hazard-prone and remote communities
- Indo-Pacific region

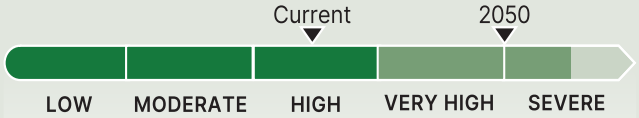
Vulnerabilities

- Declining volunteer workforce
- Community cohesion and resilience
- Rising costs of disaster response and recovery
- Expectation that the Australian Defence Force will respond to domestic disasters
- Legacy infrastructure, just-in-time supply chains, imported fuel

IMPACTS AND RISKS

- Straining of emergency management resources
- Compounding risks across all sectors
- Intensifying pressure on government resources
- Challenges to community cohesion and resilience
- Heightening of health risks from infections
- Physical and mental stress on responders and communities
- Increasing pressure on response organisations including Defence
- Potential for loss of trust in government
- Loss of connection to Country for Aboriginal and Torres Strait Islander peoples
- Slower response and recovery times
- Rising biosecurity threats
- Climate-induced regional changes from migration

Key climate risks to Defence and national security



The current climate risk to the Defence and national security system is rated as **High** (*high confidence*).

By 2050, the climate risk to the Defence and national security system is expected to rise to **Very High–Severe** (*medium confidence*).

1. Compounding and cascading events

Climate change is exerting unprecedented pressure on Australia's structures and functions needed for disaster readiness and response, challenging its capacity to respond effectively to multiple concurrent events. The system faces significant risks due to the compounding impacts of climate change, which cascade across various sectors such as agriculture, transport, supply chains, human health, and energy and water security. This interconnectedness amplifies the challenges for Australia's national security and emergency management response, stretching the system's resources and funding to their limits. One of the most pressing issues is the increased frequency, severity and complexity of extreme weather events. These events are likely to require additional capacity and new approaches to response and recovery, as well as greater investment in risk reduction.

2. Communities at risk

Communities disproportionately at risk, including Australia's Aboriginal and Torres Strait Islander peoples, face heightened risks from disrupted critical infrastructure, climate-sensitive infections and communicable diseases. Biosecurity risks are also on the rise, further complicating the emergency management landscape. The unique cultural and social dynamics of Aboriginal and Torres Strait Islander peoples' communities require tailored responses that respect their traditions and knowledge systems, adding another layer of complexity to the national disaster response.

3. Emergency management resources

The additional pressure from increased extreme weather events is challenging the physical and mental health of emergency management personnel and volunteers, who are increasingly exposed to extreme heat and impacts from other hazards. This exposure not only affects their wellbeing but also slows their response and recovery efforts, adding psychological and physical stress that hampers their effectiveness. The system, which includes emergency management services and a dedicated workforce of volunteers, is facing significant risks due to these compounding impacts.

Hazard proneness refers to the combined frequency, probability, or severity of multiple hazards. The Australian Climate Service has assessed hazard proneness for 4 of the priority hazards – heatwaves, bushfires, riverine and flash flooding, and tropical cyclones.

4. Defence

The growing reliance on the Australian Defence Force for disaster response could be detrimental to public trust if the force is perceived as being overstretched. The public may perceive reliance on the Australian Defence Force for disaster response as stretching them beyond their mission. Conversely, seeking to reduce reliance on Australian Defence Force may raise concerns if alternatives are not readily available. A careful balance must be achieved. The concurrent risks associated with the geostrategic environment and acceleration of major climate events risks overwhelming the Australian Government's capacity to respond effectively and detract from Defence's primary objective of defending Australia (Defence Strategic Review 2023).

Notable insights

Current

- Current **hazard proneness** is most pronounced in **northern Australia (WA north, NT, and north Queensland), particularly north-western Australia**. This hazard proneness is driven by increases in the intensity of tropical cyclones and floods, and by increases in extreme temperatures.
- Australia's **electricity system and telecommunications assets** are already vulnerable to heat and other extreme events. **Disruptions to critical infrastructure** both exacerbate disasters by creating further disruption and make it harder to respond to natural hazards and consequent disasters.
- As **severe hazard events increase**, **supply chain disruptions are becoming more frequent,** making it harder to respond to, and to recover from disasters.

Future

- Average Australian Government expenditure under the **Disaster Recovery Funding Arrangements could increase by 2090, on average, by 5 times** under an equivalent +2.0°C warming scenario or **by 7.2 times** under a sub +4.0°C warming scenario (Figure 2). This will place increasing fiscal pressure on governments. This indicates that new approaches to disaster response and recovery will be required as well as increased investment, resilience and adaptation.
- **Hazard proneness** is projected to increase across Australia as global warming intensifies (Figure 3). It is projected to **increase most significantly and rapidly in Queensland, Tasmania, and NSW and the ACT**.
- **Heightened health risks** from **climate-sensitive infections and communicable diseases** further complicate the emergency management landscape, while an increased need for emergency agricultural feed is likely to **increase biosecurity risks**.
- **Severe and extreme events will increase and compound** in novel ways. **High economic costs** resulting from more frequent rebuilding efforts and the competing demands for resources across government are likely to make it harder to invest in resilience.

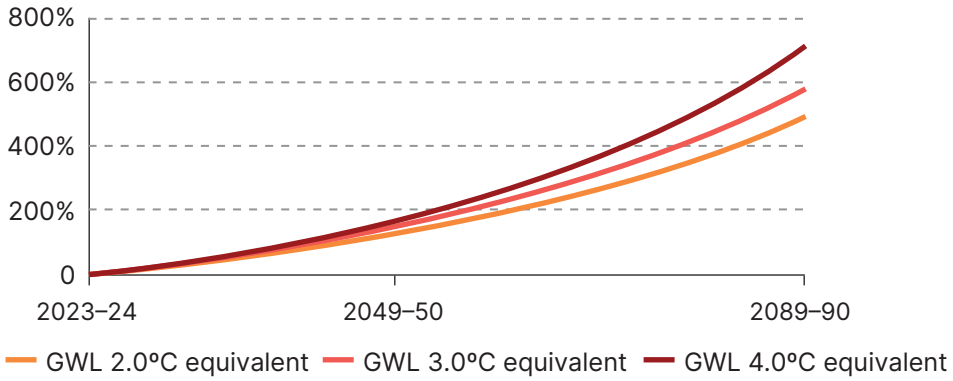


Figure 2: Modelled increase in costs to the Australian Government of disaster recovery funding modelled by The Treasury. This excludes additional funding from states and territories, and the cost of disasters borne by businesses and households.

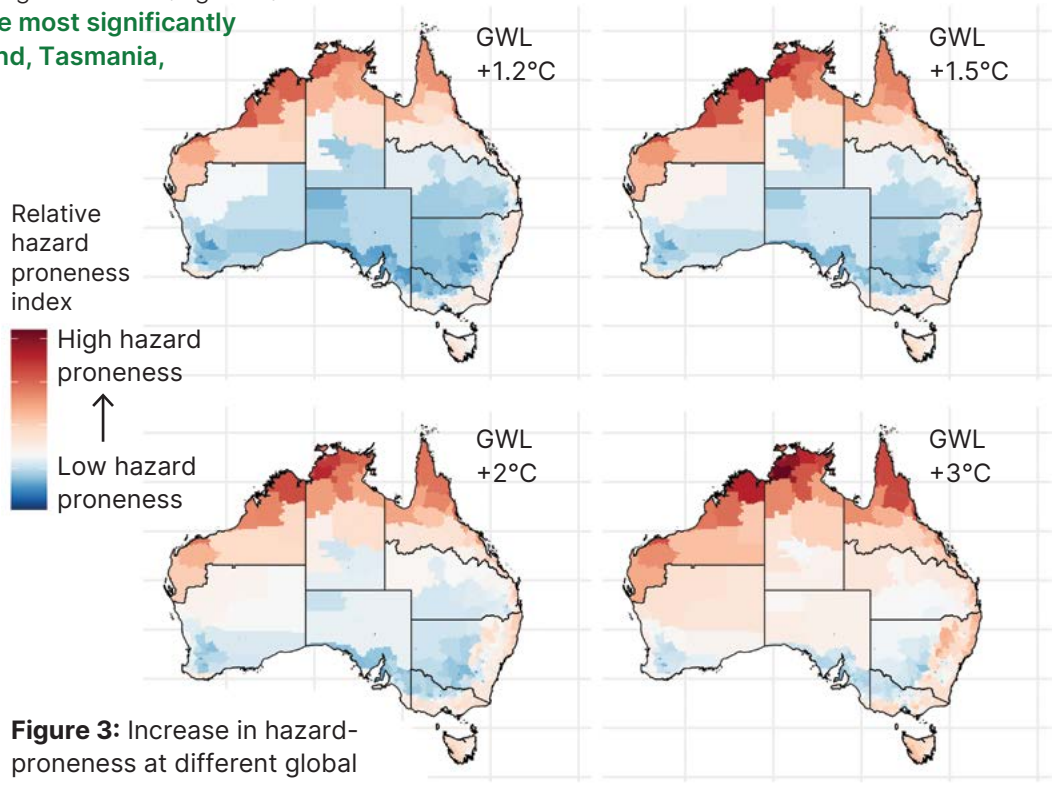


Figure 3: Increase in hazard-proneness at different global warming levels.

Economy, trade and finance

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to the Economy, trade and finance system. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Economy, trade and finance system is about how we access and use resources and how we work. It encompasses Australia's interconnected insurance and investment markets, import and export markets, the labour market, the production, distribution and consumption of goods and services, and the institutional arrangements governing economic activities and trade networks across all scales.

The priority risk considered in this system is risks to the real economy from acute and chronic climate change impacts, including from climate-related financial system shocks or volatility.

Photo: Port of Melbourne shipping container terminal at Swanson Dock, Victoria, Australia

Economy, trade and finance

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Economy, trade and finance system.

Climate and hazards

- Bushfires
- Tropical cyclones
- Changes in temperature including extremes
- Coastal and estuarine flooding
- Coastal erosion and shoreline change
- Drought
- Riverine and flash flooding

Exposures

- Agriculture, mining, construction and tourism
- Businesses and supply chains
- Coastal housing stock and infrastructure
- Finance and markets
- Government resources for recovery
- International trade and finance
- Outdoor workers
- People and households

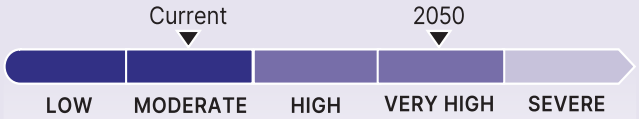
Vulnerabilities

- Ageing or unadapted infrastructure
- High household debt
- Interconnectedness and volatility of financial markets
- Land-use planning that has not considered climate change
- Unaffordable or inaccessible insurance
- Reliance on climate-sensitive industries
- Resource limited communities
- Reliance on global markets

IMPACTS AND RISKS

- Withdrawal of investment
- Damaged and devalued assets
- Health and social costs
- Higher insurance premiums and increasing non-insurance and under-insurance
- Higher recovery costs and insurance payouts
- Reduced wealth and rising cost of living
- Increasingly limited access to loans and mortgages
- Reduction in productivity and real wages growth
- Financial impacts cascading across the economy and increasing other risks

Key climate risks to Economy, trade and finance



The current climate risk to the Economy, trade, and finance system is rated as **Moderate** (*medium confidence*).

By 2050, the climate risk to the Economy, trade, and finance system is projected to increase to **Very High** (*low–medium confidence*).

1. People and households

Extreme weather events, such as heatwaves, floods and bushfires, are becoming more frequent and severe, directly affecting homes and communities. Such events can lead to property damage, increased insurance costs and even loss of homes, particularly in coastal areas vulnerable to sea level rise and erosion. These events may also reduce asset values, especially in high-risk areas. These impacts, as well as disruptions in supply chains and increased prices for essential goods, will contribute to the cost of living, placing further strains on household budgets. These pressures may also threaten the cohesion of some coastal communities and those reliant on climate-sensitive industries.

2. Businesses and supply chains

Physical risks to infrastructure and critical assets, especially in coastal regions, are expected to increase. Extreme heat is likely to reduce productivity of outdoor workers. Extreme weather events can damage facilities, disrupt operations, and lead to financial losses. Supply chains, particularly those dependent on agriculture, fisheries and mining, are vulnerable to climate impacts both domestically and globally. Disruptions in global supply chains caused by extreme weather in key trading regions compound these risks, affecting the availability and cost of raw materials and products. This can reduce food security and productivity and challenge the viability of some businesses, especially those in primary industries and construction.

3. Finance and markets

The affordability and availability of insurance for at-risk communities are likely to worsen, with flow-on impacts on related sectors. Loans and private and public equity markets are climate-exposed through asset investments. Climate change poses long-term risks to the Australian economy that are difficult to quantify and often sit beyond the planning horizons of financial institutions. Novel risks and rare high-impact low-likelihood or 'Black Swan' events represent significant threats to the financial system, with potential cascading effects on the broader economy. Large companies in the energy, insurance and banking sectors have the resources to conduct climate risk assessments on their own portfolios and to invest in resilience, but they remain vulnerable to cascading risks.

4. Government and governance

All levels of government are exposed through revenue (erosion of tax base) and fiscal (disaster and welfare spending) channels. Governance vulnerabilities include adequate and equitable resource allocation for adaptation and recovery, outdated regulation and role ambiguity in addressing climate risks and inadequate information.

5. International trade and finance

While the assessment of international risk is out of scope, it is noted here for completeness. Disruptions in global supply chains due to extreme weather events in key trading regions can affect Australia's import and export markets. Additionally, climate-related financial system shocks or volatility in international markets can have ripple effects on the Australian economy. Significant risks and opportunities are likely to be driven by climate change–related impacts outside Australia's borders, as our biggest trading partners and nearest neighbours experience the impacts of climate change. Global reinsurance pricing is increasing domestic home and building insurance premiums against perils.

6. Cascades

Impacts on one sector can quickly spread to others, creating a complex web of interdependencies. Disruptions in supply chains can lead to shortages of essential goods, affecting businesses and households. Increased insurance costs can strain household budgets, reducing disposable income, consumer spending and economic growth. Financial system shocks or volatility can be triggered by asset write-downs or loan defaults across a region, with potential ripple effects for households and businesses by reducing access to finance, the value of investments or superannuation. Novel risks and high-impact low-likelihood or 'Black Swan' events can destabilise financial markets, leading to broader economic consequences. The system also carries significant governance risk, as dynamic and urgent financial decisions have the potential to drive maladaptation.

Notable insights

Current/near-term

- Insured losses from **declared insurance catastrophes** have grown historically from **0.2% of GDP (or $AUD2.1 billion) in 1995–2000** to **0.7% of GDP (or $AUD4.5 billion) in 2020–2024** (Insurance Council of Australia, 2024).
- **In 2024, 15%** of **household insurance premiums** could be priced at more than 4 weeks of gross household income, a **25% increase from 2023** (Paddam, Liu, Philip, Smith, & Nagarajan, 2024).

Future

- **Response and recovery efforts and costs will increase** with the growing frequency and severity of compounding hazards.
- **Projected disaster costs** across each state and territory for flood, bushfire, storm surge and tropical cyclones for a moderate emissions scenario (+1.5°C) could total an annual cost of **$AUD40.3 billion** in 2049–50 (median value). This modelling included both financial and social costs (Colvin, 2024). **By 2090, average annual Australian Government expenditure under the Disaster Recovery Funding Arrangements** could increase by **5 times** under an equivalent +2.0°C warming scenario or by **7.2 times** under a sub +4.0°C warming scenario (The Treasury, 2023a).
- Losses in **Australian property values** are estimated to increase to **$AUD611.0 billion by 2050** and could increase to **$AUD770.0 billion by 2090** (Steffen et al, 2019). However, changes across our society, such as people and businesses migrating out of high-risk areas and shifts in global financial markets, leave large uncertainties in financial projections for 2090.
- A perceived risk to the **construction industry** in the medium to long term is **unaffordable or financially unsustainable insurance** due to pricing a high level of risk and the cost of rebuilds (housing and infrastructure) after extreme events.
- Between **700,000 (+3.0°C) and 2.7 million (>+3.0°C) additional days of work** are projected to be lost every year by 2061 due to the higher frequency and intensity of heatwaves, particularly affecting agriculture, construction, manufacturing and mining (NSW Treasury, 2021).
- It is estimated that **labour productivity** could **decrease by 0.2% to 0.8% by 2063**, which would reduce economic output by between $AUD135 billion and $AUD423 billion (The Treasury, 2023a). Labour productivity is generally viewed as a key driver of real wages and national income growth.
- Disruptions in **global supply chains** due to extreme weather events in key trading regions can affect Australia's import and export markets. These disruptions can lead to **increased costs and reduced availability of goods**.
- **Climate-driven events could result in cascading shocks to the financial system**. Impacts on one sector can quickly spread to others. Disruptions in supply chains can lead to shortages of essential goods. Financial system shocks or volatility can be triggered by asset write-downs or loan defaults across a region, with potential ripple effects for households and businesses by reducing access to finance, the value of investments or superannuation.

The Australian Climate Service has consolidated information from a wide range of reputable sources to understand risks to the Economy, trade and finance system. These details can be found in the full National Climate Risk Assessment report.

Why is 2063 used as a projection date?

The Australian Government's 2023 Intergenerational Report, prepared by The Treasury, projects the outlook of the Australian economy and the Australian Government budget to 2062–63. Using these projections and drivers of economic growth provides decision-makers with consistent and comparable information for use.

Health and social support

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to the Health and social support system. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Health and social support system refers to population health and wellbeing, as well as the provision, availability, and access to health, wellbeing and social support. This system includes services that encompass healthcare, public and preventative health, aged care, disability services, housing support, employment and financial wellbeing and their supporting infrastructure.

The priority risk considered in this system is risks to health and wellbeing from slow-onset and extreme climate impacts.

Photo: Team of medical staff in personal protective equipment walking in hospital corridor

Health and social support

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Health and social support system.

Climate and hazards

- Bushfires
- Droughts
- Changes in temperature, including extreme heat
- Flooding
- Tropical cyclones

Exposures

- People and communities particularly in rural and remote areas, including Aboriginal and Torres Strait Islander communities
- People and services in multi-hazard-prone locations
- Ecosystem services that underpin population health (e.g. clean air, water)
- Health system infrastructure, and other critical infrastructure that supports the health system
- Health system supply chains
- Health workforce and service delivery

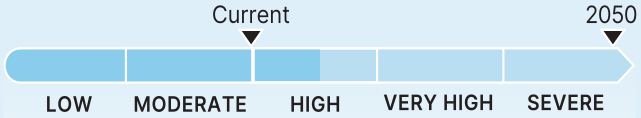
Vulnerabilities

- Poor socio-economic and/or environmental conditions
- Poor social and community connection
- Limited access to, or quality of, health and social services
- Pre-existing health conditions, including mental ill health
- Extremes of age (i.e. older or very young people)

IMPACTS AND RISKS

- Greater morbidity and mortality
- Increasing heat-related illnesses
- Exacerbations of chronic health conditions, including respiratory and cardiovascular disease
- Higher risk of communicable diseases, including vector-borne diseases
- Rising mental ill health
- Increasing transport costs and reduced access to medicines
- Exacerbation of health inequalities
- Overburdening of health services and infrastructure
- Increasing biosecurity risks
- Reduction in productivity and economic impacts

Key climate risks to Health and social support



The current climate risk to the Health and social support system is rated **Moderate–High** (*medium confidence*).

By 2050, the climate risk to the Health and social support system is expected to increase to **Severe** (*medium confidence*).

1. Heat, bushfires and health

Australia is already feeling the effects of climate change on human health, with hazards such as heatwaves, floods, bushfires, droughts and tropical cyclones becoming more severe. Heat and bushfires with associated air pollution in particular can have large impacts on population health due to their broad geographic area of impact. These hazards cause a range of health issues, including increased mortality and morbidity. The healthcare system is under growing pressure as it deals with these increasing demands.

2. Communicable diseases

Communicable disease transmission is a growing concern as many disease pathogens and vectors (such as mosquitoes and ticks) are sensitive to increasing temperatures, altered rainfall patterns, and flooding. Vector-borne diseases such as dengue fever and Japanese encephalitis are particularly climate-sensitive, so risks from these diseases are likely to increase. The Australian healthcare system has less experience managing some of these diseases, which may pose challenges for preparedness and response. There is also evidence that pathogens such as influenza viruses and Staphylococcus bacteria are climate-sensitive, meaning there may be an increasing risk of diseases caused by these pathogens in a changing climate. Preliminary evidence suggests that climate change may also cause mutations in diseases such as influenza and Japanese encephalitis, further increasing health risks.

3. Risk factors for climate impacts on health

The risks and impacts of climate change on health vary widely depending on factors such as individual health status, geographic region, socioeconomic status and access to support. Neighbouring areas can experience very different levels of risk and impact, and the risk factors can change depending on the hazard. For example, older people are vulnerable to heatwaves as they tend to have poorer thermoregulation, but they may also be vulnerable to tropical cyclones and flooding, as reduced mobility may mean they are unable to evacuate as quickly. Other groups particularly susceptible to the health impacts of climate change include people in rural and remote areas, those working outdoors, women, volunteers, and emergency responders.

4. Aboriginal and Torres Strait Islander peoples' health

Aboriginal and Torres Strait Islander peoples have a holistic understanding of health and social and emotional wellbeing. Aboriginal and Torres Strait Islander peoples are already experiencing the adverse impacts of climate change, which exacerbate existing health and social disparities. Displacement from Country due to climate change can have severe health and wellbeing consequences, including increased homelessness and weakening of family and social connections, identity, and belonging. Other climate risks to the health and wellbeing of Aboriginal and Torres Strait Islander peoples are due to reduced air quality, extreme heat, flooding, interrupted health services, and energy insecurity.

5. Infrastructure, including supply chains and water security

Climate change is also disrupting the Health and social support system by disrupting critical infrastructure and supply chains, which can reduce access to health services and, as a result, increase morbidity and mortality. For example, the transport of medicines and other essential products is becoming more costly due to climate impacts on road and rail infrastructure. Some extreme events could increase costs up to 25% by 2050 and could double transport costs by 2090.

Notable insights

Current/near-term

- The changing climate is already having **noticeable impacts, particularly in disadvantaged communities**. Key hazards such as heatwaves, floods, bushfires, droughts, and tropical cyclones are becoming more severe, leading to **increased mortality and morbidity**, particularly from heatwaves and bushfire smoke. These events are putting **additional pressure on the healthcare system** as it manages the rising demands.
- **Aboriginal and Torres Strait Islander peoples** have a holistic understanding of health and social and emotional wellbeing. They are **already experiencing the adverse impacts of climate change, which exacerbate existing health and social disparities**. Other climate risks to the health and wellbeing of Aboriginal and Torres Strait Islander peoples include reduced air quality, extreme heat, interrupted health services from flooding, and energy insecurity. **Displacement from Country can have severe health and wellbeing consequences.**
- **Children and young people are already reporting that climate change is having an impact on their health**. Nearly one in 5 (18.6%) of Australians is aged between 12 to 25, numbering over 4 million. A 2023 poll of Australians aged 16–25 found that **76% are concerned about climate change** (Orygen Institute, 2023).

Future

- Public **health risks will become more pronounced,** with a significant potential for loss of life and strain on health systems.
- **The relationship between increased heat and increased mortality is not linear, but increases significantly from +2.0°C to +3.0°C** (Figure 4). The nature of the risk varies considerably depending on factors such as socio-economic vulnerability, the local climate, and access to support. By **+3.0°C**, **heat-related mortality is projected to increase across Australia**. For example, modelling suggests an **increase in heat-related mortality of 444% for Sydney and 423% for Darwin under a +3.0°C scenario** compared to current conditions.
- Future climate modelling of air quality in 2050 related to climate change and bushfire smoke indicates that **deaths attributable to poor air quality will likely increase**, with the projected rise in the frequency and severity of bushfires **compounding adverse health outcomes related to poor air quality**.
- The risk from **communicable diseases, including vector-borne diseases** (diseases carried by vectors such as mosquitoes and ticks) **is likely to continue to rise**. Increasing temperatures, altered rainfall patterns and flooding could contribute to increased transmission of diseases with which the Australian healthcare system is less familiar, such as dengue fever. The changing climate could also drive increased transmission of other communicable diseases such as influenza, which may increase risks in Australia.
- The **transport costs of medicines** and other products could **increase 100% towards 2090**, due to hazard disruption to the east-west freight route (Eyre Highway and the trans Australian rail line).
- The **mental and physical wellbeing of communities** will continue to deteriorate due to climate impacts, especially among those already disadvantaged.

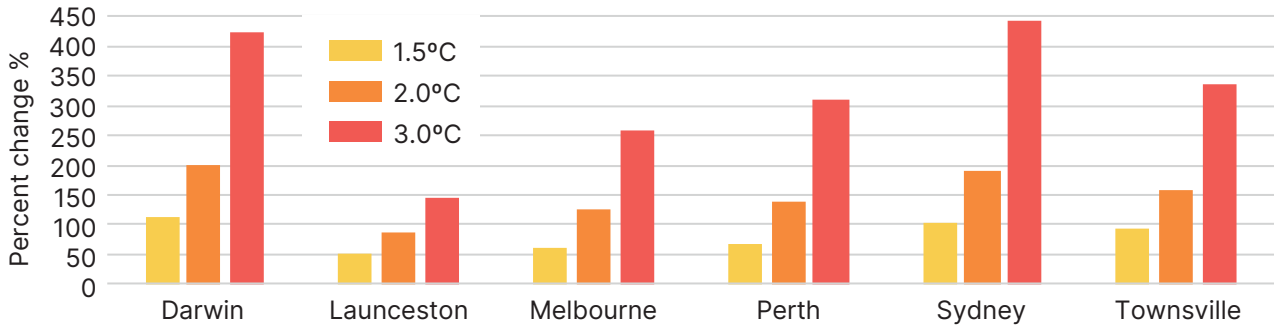


Figure 4: Examples of the projected increase in heat-related mortality for different global warming levels compared to the current period.

Infrastructure and the built environment

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to our infrastructure and the built environment. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Infrastructure and the built environment system refers to the intricate networks of human-made structures across Australia. This system includes physical buildings, green and blue spaces, and their supporting infrastructure, such as transport, telecommunications, water, and energy systems.

Priority risks considered in this system include:

- Risks to critical infrastructure that impact access to essential goods and services.
- Risks to supply and service chains from climate change impacts that disrupt goods, services, labour, capital and trade.

Photo: Melbourne train station with Melbourne city background, Victoria, Australia

Infrastructure and the built environment

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Infrastructure and the built environment system.

Climate and hazards

- Bushfires
- Extreme heat
- Flooding
- Extratropical and convective storms
- Sea level rise
- Tropical cyclones

Exposures

- Community infrastructure
- Energy infrastructure
- Residential dwellings
- Supply chains and transport infrastructure
- Telecommunications infrastructure
- Water infrastructure

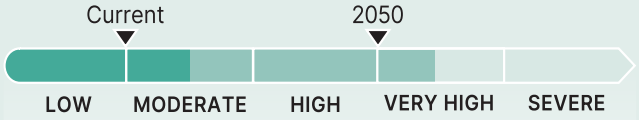
Vulnerabilities

- Coastal and remote locations
- Limited redundancy in critical systems
- Locations that are hazard-prone
- Old or not climate adapted infrastructure

IMPACTS AND RISKS

- Disruption to energy supply
- Damage to transport networks
- Compromised telecommunications
- Increasing housing and community infrastructure damage
- Water infrastructure failures
- Coastal infrastructure damaged or destroyed
- Exacerbation of inequalities for Aboriginal and Torres Strait Islander peoples and remote communities
- Supply chain disruptions
- Higher infrastructure upgrade and repair costs

Key climate risks to Infrastructure and the built environment



The current climate risk to the Infrastructure and the built environment system is rated **Low–Moderate** (*medium–high confidence*).

By 2050, the climate risk to the Infrastructure and the built environment system is expected to increase to **High–Very High** (*medium confidence*).

1. Energy

Australia's energy infrastructure is increasingly vulnerable to the impacts of climate change. Extreme heat events, which are becoming more frequent and intense, will result in temperatures that are outside safe operating levels, forcing network operators to increase outages (load shedding). This will lead to disruptions in energy supply when it is most needed to keep people safe. These disruptions are further compounded by damage to energy infrastructure caused by fires and the increasing occurrence of megafires, as well as storms and extreme winds.

2. Transport and supply chains

Transport and supply chain infrastructure are at significant risk from climate change. Acute hazards such as bushfires, floods, and extreme winds can cause widespread damage, leading to disruptions. Regional and remote communities are particularly vulnerable due to their reliance on long and sparse transport networks. These communities often lack alternative modes of supply, which increases their vulnerability during disruptions. When regional hubs are affected, the impacts can flow to other communities, disrupting the movement of goods and services. This can lead to shortages, increased costs, and significant economic impacts.

3. Residential infrastructure

Residential infrastructure faces growing risks from climate change, with the number of houses currently considered high risk potentially doubling by 2100. Modelled extreme wind events show that higher levels of housing stock loss could occur in coastal and hinterland regions, particularly Queensland, Western Australia, and the Northern Territory. These impacts not only threaten the safety and security of homes but also place additional strain on emergency services and recovery efforts.

4. Water infrastructure

Water security infrastructure will be challenged by climate change, especially by increases in climate extremes including floods, extended dry periods, storms and increased temperatures. Regional and remote communities are at particular risk from compromised water infrastructure.

5. Telecommunications

Telecommunications infrastructure is at a high risk from climate hazards such as extreme heat, bushfires, flooding, and extreme winds. Coastal areas are particularly vulnerable, with the risk to telecommunications infrastructure being generally high near the coasts. Disruptions to telecommunications can have far-reaching impacts, affecting emergency responses, business operations and daily communications.

6. Coastal infrastructure

Coastal infrastructure is vulnerable to the impacts of sea level rise and other coastal hazards. Urban coastal centres and infrastructure hotspots, especially in Queensland, are among the most at-risk areas. Rising sea levels coupled with increased storm activity can lead to significant damage to coastal infrastructure, affecting homes, businesses, and critical services, and potentially disrupting maritime shipping.

7. Infrastructure that services Aboriginal and Torres Strait Islander communities

Regional and remote Aboriginal and Torres Strait Islander communities may face heightened risks due to climate change impacts on their infrastructure and built environment. As hazards like severe weather events, extreme heat events, and bushfires intensify, the disproportionate risks associated with already unsafe infrastructure are exacerbated, with cascading consequences. One such risk is the loss of opportunity for education, which will occur if school buildings are unable to withstand all hazards, such as floods and severe weather. Another indirect risk is the loss of access to Country, resulting in reduced opportunities for sharing Lore, caring for Country, and practising ceremonies.

Notable insights

Current

- **Telecommunications assets** have the **greatest overall exposure to severe and extreme hazards today**, especially near the coast.
- **Transport** has moderate exposure which is **highest in regional areas of the major states**. This has implications for the criticality of roads supplying regional centres.
- **Energy assets** have a **high combined hazard index**, which is generally high in urban and regional areas.
- **Extreme heat** is particularly a risk for our **power systems** with impacts on power lines and renewable and thermal generators.
- **Regional and remote communities** are at particular risk from **compromised water infrastructure**.

Future

- **1 metre of sea level rise** will see an increase in **minor coastal flooding** from an average of about 15 days per year in different coastal locations to **around 257 days per year of flooding** at +3.0°C of warming.
- Coastal hazards, such as **coastal erosion, flooding, and saltwater intrusion**, are likely to **compromise communities, infrastructure, and drinking water supplies**.
- **More severe storms** are likely to **damage water infrastructure**, potentially leaving communities without access to quality water and increasing the risk of cross-contamination from sewage.
- For **roads**, the **largest change in the social cost of disruption** between the baseline current climate and +3.0°C of global warming is in **Central Queensland**, where local government areas including Central Highlands, Isaacs, and Western Downs, show an increased risk to the major roads (Figure 5). There is also a noticeable increase in risk in northern and eastern Victoria.

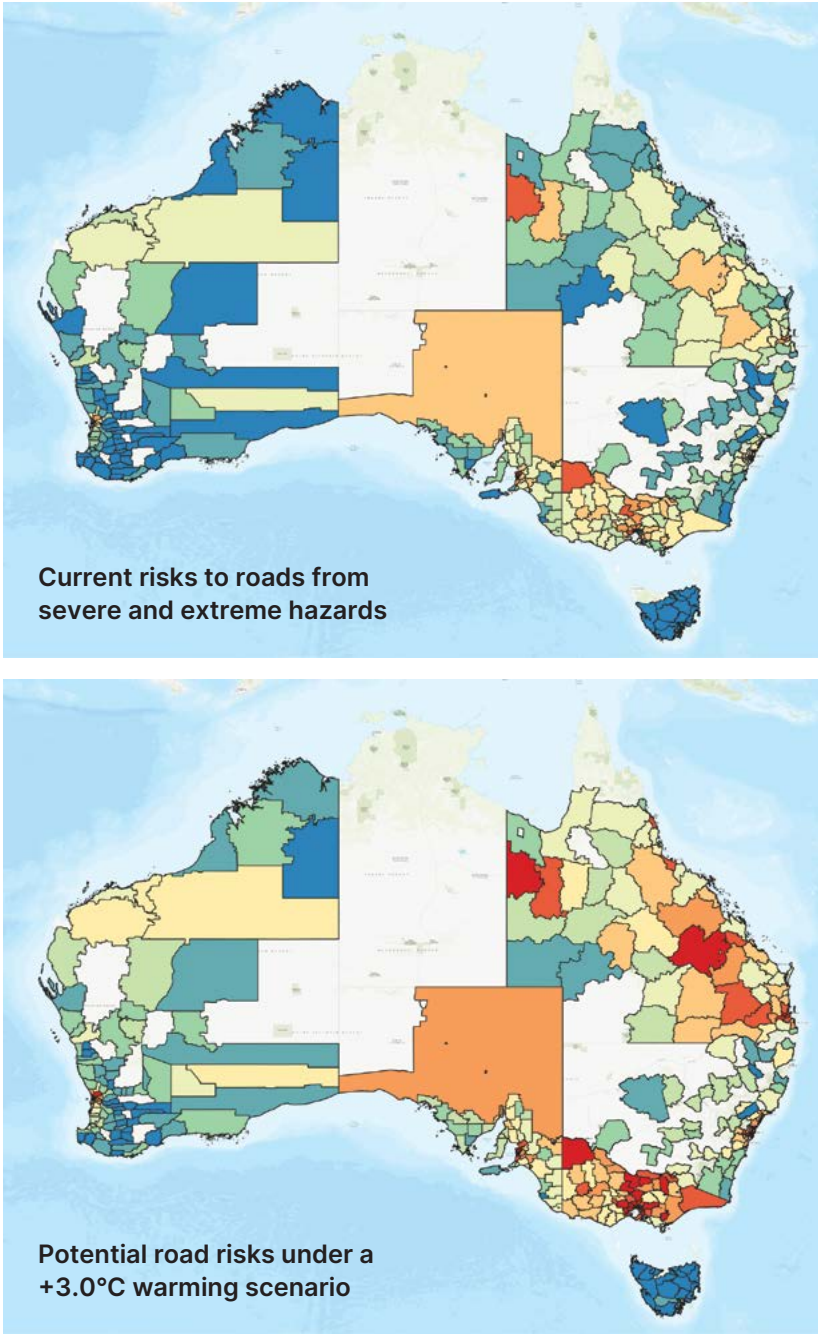


Figure 5: Social cost of road disruption from bushfires, heat and coastal flooding that will increase in future. The top map shows risks to roads today, while the bottom map show what risks could look like at +3.0°C warming, with noticeable increases in risk particularly in Queensland, Victoria and South Australia. (Note that regions with limited road usage data are unshaded.) Basemap © OpenStreetMap

Natural environment

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to the Natural environment system. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Natural environment system refers to Australia's ecosystems and biodiversity. This system includes Australia's lands, waters and oceans.

Priority risks considered in this system include:

- Risks to ecosystems, landscapes and seascapes, including risk of ecosystem transformation or collapse, and loss of nature's benefits to people.
- Risks to water security that underpin community resilience, natural environments, water-dependent industries, and cultural heritage.

Photo: Meandering rivers and mangroves of Hinchinbrook Island. Source: Coral Brunner

Natural environment

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Natural environment system.

Climate and hazards

- Bushfires
- Drought
- Changes in temperature
- Flooding
- Ocean warming and acidification
- Changes in precipitation patterns

Exposures

- Aboriginal and Torres Strait Islander communities
- Carbon sequestration
- Communities that rely on ecosystem services
- Freshwater ecosystems
- Marine and estuarine ecosystems
- Terrestrial ecosystems
- Water quality and supply

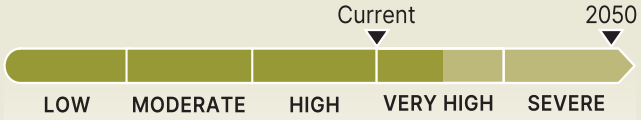
Vulnerabilities

- Primary industries and tourism
- Biodiversity loss
- Ecosystem degradation
- Habitat connectivity
- Rural and remote communities
- Water use and availability

IMPACTS AND RISKS

- Aboriginal and Torres Strait Islander peoples' connection to Country
- Changes to ecosystem services underpinning other systems
- Ecosystem collapse
- Marine and terrestrial biodiversity loss
- Reduction in ability to sequester carbon and mitigate climate change
- Reduction in ecosystem adaptive capacity
- Increased biosecurity risks and significant species loss
- Tropicalisation of temperate marine ecosystems

Key climate risks to the Natural environment



The current climate risk to the Natural environment system is rated **High-Very High** (*high confidence*).

By 2050, the climate risk to the Natural environment system is expected to increase to **Severe** (*medium confidence*).

1. Carbon cycle and sinks

Australia's natural environment plays a crucial role in stabilising the global carbon cycle. However, the broad scale, fast pace and increased intensity of climate impacts have fundamentally altered these natural systems. Forests, wetlands and oceans, which act as carbon sinks, are increasingly compromised by climate change and other human activities. Widespread clearing and degradation of terrestrial ecosystems have reduced their condition and capacity to sequester carbon, exacerbating climate change.

2. Ecosystem resilience

Climate change and other human influences have already had impacts on Australia's marine, terrestrial and freshwater environments, with many ecosystems showing signs of collapse at a local level. The resilience of these ecosystems and of native biodiversity is being tested by increased temperatures, altered precipitation patterns and more frequent extreme weather events, with compounding threats like invasive species. For example, higher temperatures and drier conditions are increasing the risk of bushfires, and facilitating increases in invasive species impacts, thereby threatening sensitive ecosystems and species.

3. Terrestrial

Terrestrial ecosystems across Australia are facing significant challenges due to climate change. The capacity for biodiversity to respond to climate shifts will be limited across all regions of Australia, especially in the context of existing pressures on biodiversity, including habitat loss and invasive species. Species will be forced to move, adapt to the new conditions or die out, with on average half of native plant species being exposed to climatic conditions that they do not currently experience, leading to changes in the species present at a location. Increased aridity and higher temperatures are placing ongoing pressure on plant productivity and reproduction, particularly in eucalypt forests. These changes are forcing ecosystems to shift towards drier conditions, impacting wildlife that depends on current ecosystem conditions for survival. However the specific responses of biodiversity to future climates will vary among regions in ways that will be important when designing adaptation responses.

4. Freshwater

Freshwater ecosystems are highly exposed to climate change pressures, particularly water security issues. Increased variability in rainfall, changes in temperature, and more frequent droughts are having devastating impacts on freshwater systems. These changes affect water availability for both ecosystems and human use, leading to increased competition over water resources. Future increases in intense rainfall events, changes in temperature, and prolonged droughts will further strain freshwater ecosystems. For example, changes in maximum temperatures will mean freshwater organisms are increasingly exposed to heat-related stress and may not have sufficient physiological capacity or tolerance to survive.

5. Marine and estuarine

Australia's marine and estuarine environments are experiencing significant climate change impacts. Ocean warming and changing ocean currents and acidification are affecting biodiversity and ecosystem services. Coral reefs, such as those in the Great Barrier Reef and Ningaloo World Heritage area, are particularly at risk. Seagrasses and mangroves are also impacted by warming, sea level rise and altered storm patterns. The poleward migration of the East Australian Current is intensifying the 'tropicalisation' of temperate ecosystems, posing high risks to coastal temperate ecosystems.

6. Aboriginal and Torres Strait Islander peoples

Climate change is putting at risk Aboriginal and Torres Strait Islander peoples' ability to connect with Country, affecting their physical, mental, community, and cultural health and wellbeing. Aboriginal and Torres Strait Islander peoples are directly impacted by hazards that compromise natural environments and services, particularly in remote communities. Recognising and integrating Aboriginal and Torres Strait Islander peoples' knowledge into climate adaptation strategies, particularly across the extensive Indigenous estate, can help mitigate climate change impacts and support the resilience of both natural environments and Aboriginal and Torres Strait Islander communities.

Notable insights

Current/near-term

- **Ecosystem resilience is low** across Australia, threatening both climate mitigation effectiveness and ecosystem services, such as coastal protection and water quality provision.
- **Loss of ecosystem services** that benefit society, such as clean water, food and stable coastal sediments, **may increase regional and remote community vulnerability** to extreme natural hazard events.
- Continued exposure to **increased average temperatures**, combined with more **frequent and intense heatwave events and bushfires** **threatens terrestrial species and ecosystems** across the continent.
- **Coral reef habitats** are one of the natural systems most affected by cumulative impacts and extreme climate events. **At +1.5°C,** the **pH of our oceans** is projected to change **by –0.18** (compared to the historical baseline), meaning **our oceans are becoming more acidic**. This makes it harder for calcium shell-making organisms, and corals, phytoplankton and zooplankton to form hard skeletons.

Future

- **Widespread, significant ecosystem compositional change** is predicted (Figure 6). **At +3°C**, species will be forced to move, adapt to the new conditions or die out, with **40 to 70% of native plant species exposed to climatic conditions that they do not currently experience**. Roughly **half of the native plant species** occurring in any location in a **+3.0°C** climate will become different to the species that occurred in that location in 1990.
- **At +2.0°C**, the **ocean pH** is projected to decrease **by 0.4** compared with the historical baseline.
- The compounding effects of higher temperatures, increased evaporation and lower volumes of inflow will result in pressure on water quality and freshwater ecosystems including wetlands.

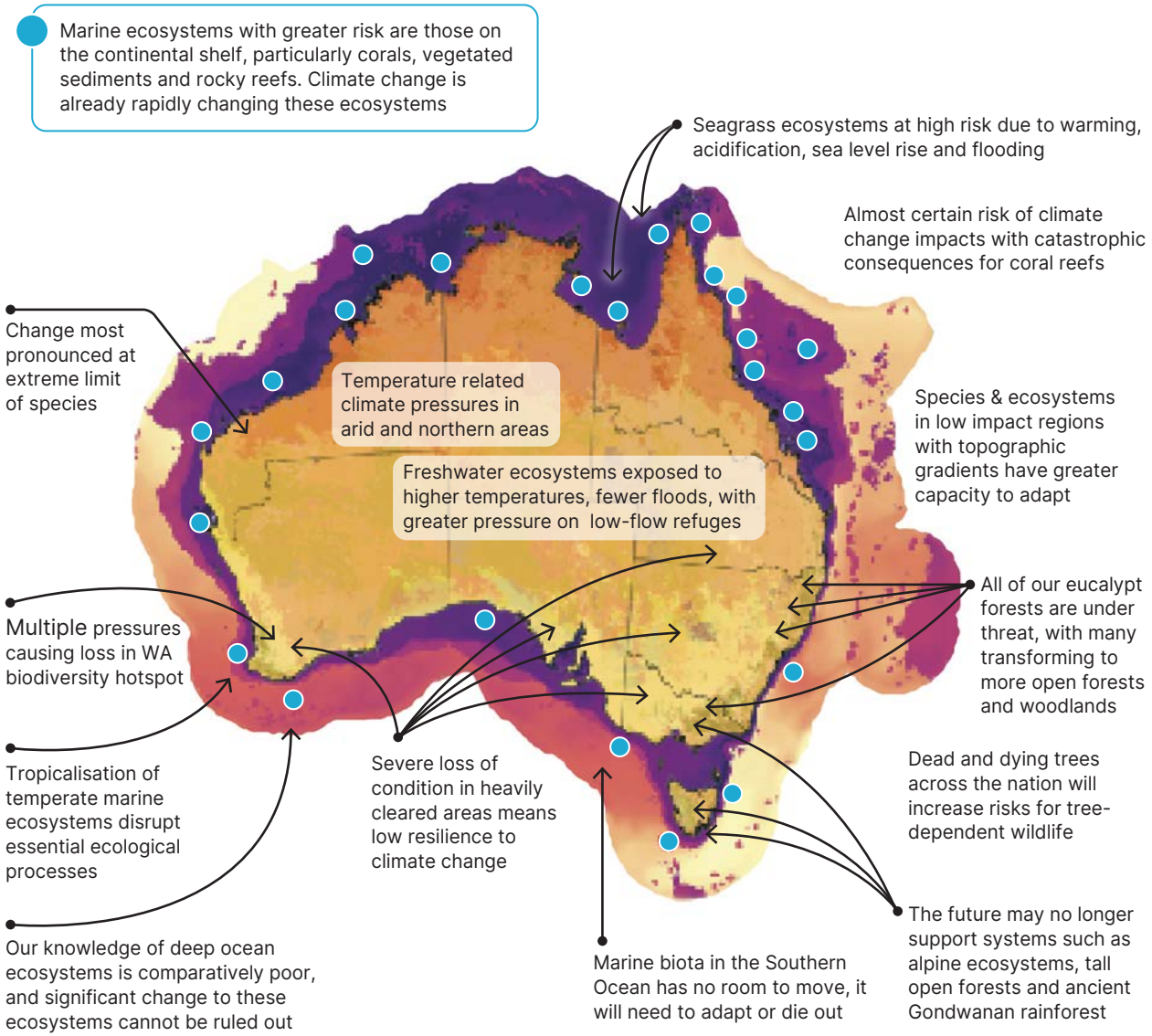


Figure 6: All levels of biodiversity will be affected by a changing climate in the future. Examples of changes are indicated in the map above.

Primary industries and food

This section outlines the key hazards, exposures, vulnerabilities, risks and impacts to the Primary industries and food system. Key risks and notable insights have been assembled to demonstrate how this system is and will continue to be affected by a changing climate.

The Primary industries and food system refers to land, marine and estuarine activities dedicated to producing food, fibre, wood, fuel and other products. This system includes agriculture, aquaculture, fisheries and forestry sectors spanning large-scale and smallholder operations, covering the entire chain from production to the consumer.

The priority risk considered in this system is risks to primary industries that decrease productivity, quality and profitability and increase biosecurity pressures.

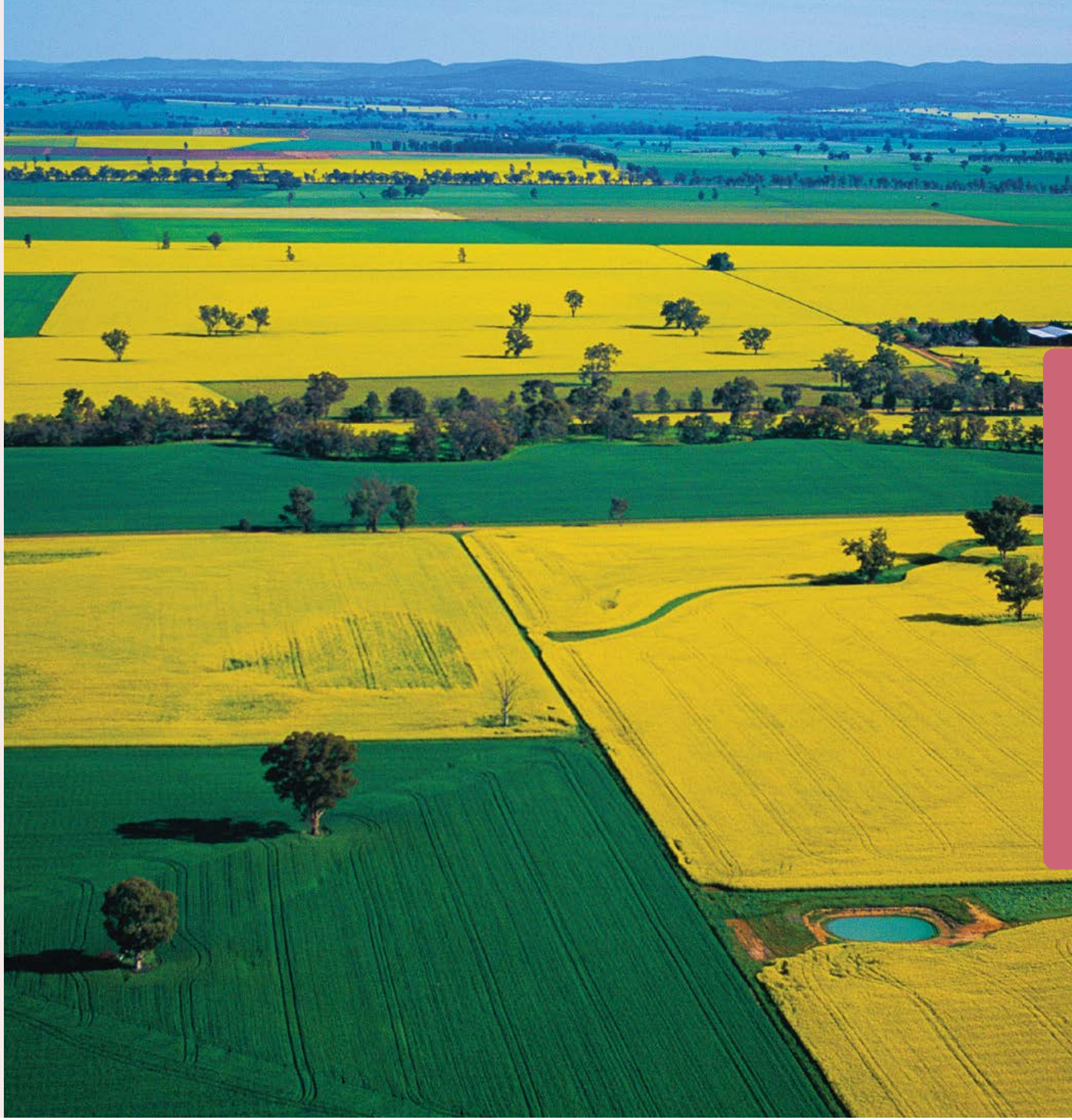


Photo: A view from the air of a large canola field in central western NSW

Primary industries and food

Climate risks are determined by the interaction of risk elements, including hazards, exposures and vulnerabilities. This is a risk summary for the Primary industries and food system.

Climate and hazards

- Bushfires
- Changes in rainfall patterns, including drought
- Extreme heat
- Flooding
- Ocean warming and acidification

Exposures

- Agricultural workers
- Cropping
- Fisheries and aquaculture
- Forestry
- Horticulture
- Livestock

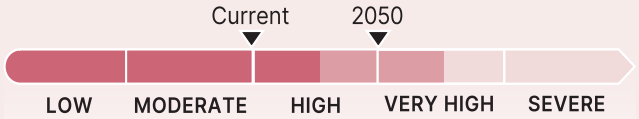
Vulnerabilities

- Communities that rely on agriculture
- Biosecurity
- Ecosystem services and soil health
- Financial stability of producers
- Infrastructure and resilience
- Supply chain
- Water security

IMPACTS AND RISKS

- Reduced yields for some crops
- Increasing livestock heat stress
- Higher biosecurity risks
- Declining forestry growth rates
- Impact on productivity of fisheries
- Increasing water competition
- Destruction of forest assets
- Risk of food insecurity
- Reduction in workforce
- Challenges for agricultural communities

Key climate risks to Primary industries and food



The current climate risk to the Primary industries and food system is rated **Moderate–High** (*medium confidence*).

By 2050, the climate risk to the Primary industries and food system is expected to increase to **High–Very High** (*medium confidence*).

1. Cropping

Climate change is significantly impacting Australia's cropping sector. Rainfall variability and extreme heat are major concerns, as they influence soil moisture and crop yields. In regions like the southwest and southern Australia, changes in rainfall patterns and higher evapotranspiration rates are leading to lower soil moisture, which in turn reduces crop productivity. Extreme heat events further exacerbate these challenges, stressing crops and decreasing yields. A lower risk of frost might benefit some areas.

2. Horticulture

Horticulture is facing severe challenges due to climate change, particularly from increased extreme heat. High temperatures can cause fruit sunburn, reducing the quality and marketability of produce. Additionally, higher cool season temperatures can negatively affect flowering and yields in temperate perennial nuts and fruits, such as walnuts and apples, as well as some tropical crops like mangoes and avocados. Although reduced frost risk might offer some benefits, the overall impact of rising temperatures is likely to be detrimental.

3. Forestry

Hotter climates, increased fire weather risk and changes in rainfall and drought patterns could place pressure on the forestry industry. These factors collectively impact tree establishment, growth rates and mortality. Higher temperatures stress trees, increasing their water requirements and making them more susceptible to heat-induced mortality and pest infestations. Increased bushfire frequency is a significant risk for forestry, with impacts including loss of timber stocks and increased costs to prevent and remediate fire damage. While some cooler areas might benefit from reduced frost damage and increased growth rates, the overall outlook for forestry is challenging.

4. Fisheries and aquaculture

Some fisheries and aquaculture are expected to experience declining productivity due to climate change. Increased marine temperatures, ocean acidity and storm activity negatively affect marine environments, with varying impacts across regions. Wild catch fisheries and aquaculture are particularly vulnerable, although some aquaculture systems might be less affected depending on management practices.

5. Livestock

The livestock sector is facing significant challenges from climate change, particularly due to changes in temperature and rainfall. Heat stress in cattle and sheep, driven by increasing temperatures and more frequent hot spells, is likely to reduce productivity and negatively affect animal welfare. Additionally, the availability of feed is impacted by these climatic changes, further stressing livestock operations.

Future agriculture opportunities should consider diversifying crops and livestock to include species well-suited to the specific regional conditions.

6. Biosecurity

Biosecurity pressures are increasing as climate change influences the complex interactions between primary industries, the environment, transport, trade and other activities. Higher temperatures and changing precipitation patterns can lead to the spread of pests and diseases, threatening crops, livestock and ecosystems.

7. Farming communities

Farming communities are at the frontline of climate change impacts. Water security is a major concern, with increased competition for water having the potential to impact agricultural productivity, community livelihoods, and effective response to extreme hazard events. Increasing heat will make it harder for outdoor workers. Additionally, supply chains face significant disruptions from extreme weather events, affecting jobs and the movement of goods, leading to food shortages and spoilage. These changes are likely to result in localised food insecurity and migration away from high-risk regions, with impacts on social cohesion and community structures.

Notable insights

Current/near-term

- **Producers** continue to manage year-to-year rainfall variability and plan for **potentially more extreme wet or dry events**.
- **Agricultural businesses** will experience **cost pressure** from disrupted supply chains, rainfall uncertainty, water irrigation issues and biosecurity management pressures. **Irrigated agriculture is vulnerable to changes in rainfall**. While covering less than 1% of agricultural land, irrigated agriculture contributes over 25% of total agricultural value and consumes more than 60% of Australia's annual water use.

Future

- **Growing season rainfall for cropping** will likely **reduce in the southwest of Australia** (Figure 7). Dry years can reduce yields by 40% compared to average rainfall conditions. All cropping regions are expected to see temperature increases and an increased risk of crop heat stress.
- **Australian forests** will be at greater risk of fire with an **increase in the number of days when the Forest Fire Danger Index exceeds 50** (severe rating) projected across most forested areas in Australia. However, changes in temperature in cooler areas may increase yields. For example, warmer conditions are likely to improve forestry conditions in Tasmania and the Victorian highlands.
- **Ocean primary productivity** is projected to **decline with increases in marine temperatures** along eastern Australia and, to a lesser extent, southern Australia. In contrast, it is expected to increase in northwestern Australia and around Tasmania and other islands within the Exclusive Economic Zone.
- **Rising temperatures and an increase in extreme rainfall events** are likely to **change the profiles of biosecurity threats**, through reduced effectiveness of herbicides and pesticides, reducing aquaculture productivity and increasing plant and animal susceptibility to disease and pests.
- The number of cattle heat stress days is projected to increase in most regions of Australia. By a global warming level of **+3.0°C, over 61% of Australia** (compared to 44% currently) will experience **at least 150 days per year above the heat stress threshold** for **European beef cattle. Over 54%** of Australia (compared to 27% currently) **will experience >30 days per year above the heat stress threshold** for **tropically adapted beef cattle.** In the major regions supporting dairy cattle populations (Victoria and coastal NSW), it is projected that **by a global warming level of +3.0°C, dairy cattle will continue to experience <90 days** above the heat stress threshold.
- **Heat stress in sheep** is expected to increase in frequency and area. Heat stress during the week of mating can **decrease lambing rates by 3.5% for each additional day ≥32.2°C**. In contrast, a decrease in cold exposure at lambing may reduce mortality.

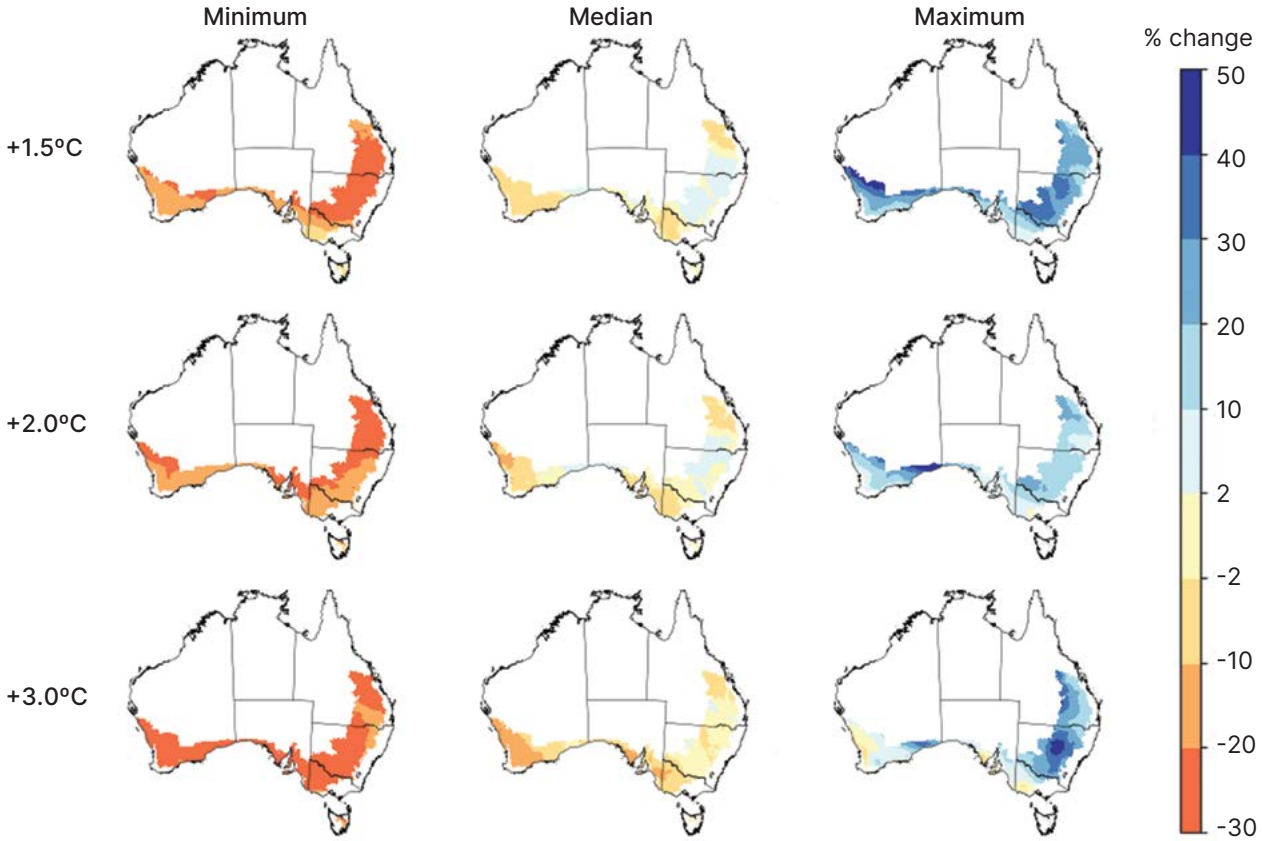


Figure 7: Projected change in winter cropping growing season (April to October) rainfall calculated from the baseline period (2001-2020).

Cross-system risks

Four priority cross-system risks were assessed in the second pass:

- coastal communities and settlements
- governance
- supply chains
- water security.

This section provides the Australian Climate Service analysis and observations across each of these cross-system risks. Risks to Coastal communities and settlements have been captured in the previous section.

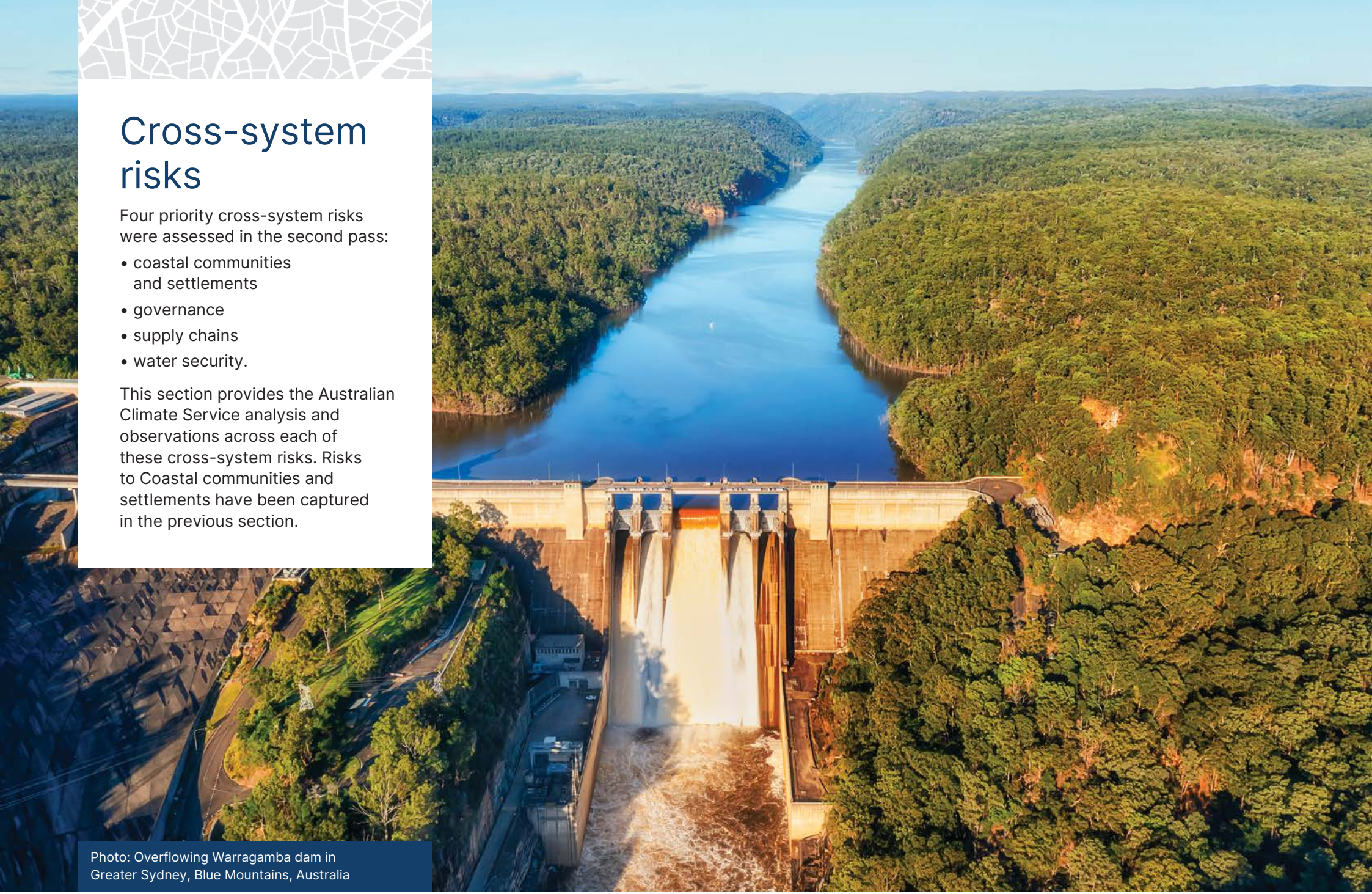


Photo: Overflowing Warragamba dam in Greater Sydney, Blue Mountains, Australia

Governance

Governance refers to how decision-making is organised in society and includes all stakeholders, systems, structures, functions, and processes across private industry, civil society, as well as federal, state, and local government levels.

The pace at which the climate is changing and impacts are emerging is potentially at odds with the need to enable more effective and faster adaptation.

Successful adaptation relies on governance structures and processes that help identify and understand complex climate change risks, generate innovative adaptation options, anticipate and avoid response risks, accelerate positive adaptation action, and track and adjust to outcomes

The National Climate Risk Assessment presents an opportunity at a national level to guide and support national, state and local action through:

Priority cross-system risk analysed in the National Assessment: Risks to adaptation from maladaptation and inaction from governance structures not fit to address changing climate risks.

Areas of focus for effective governance response to climate change

- **Effective resource allocation:** Addressing sources of disadvantage will reduce vulnerability to climate risks and impacts and generate far-reaching co-benefits in multiple systems. Inadequate volume, or inequitable distribution of resources has the potential to undermine confidence and create mistrust.
- **Coordination and collaboration:** Sustained engagement with diverse stakeholders, decision-makers and those in vulnerable circumstances has the potential to reduce risk cascades and enable effective adaptation.
- **Roles and responsibilities:** Clear roles and responsibilities in dynamic and complex environments, such as those generated by climate change, help enable timely action at key intervention points. There are opportunities to clarify ownership around systemic and novel risks and the roles of public, private and civil society actors in adaptations, especially before, during and after disaster response periods. Areas of focus that could improve adaptation preparedness include land-use planning, emergency management, social policy, climate-informed agriculture, community development, and environmental management.
- **Climate management frameworks:** Regular review and adjustment of policies and regulatory tools that address emerging risks, particularly those that are multi-scale, multi-dimensional and interconnected, ensures that policies remain relevant, proportionate and effective in the face of evolving climate impacts.
- **Risk management:** Embracing multi-system approaches to climate adaptation plans and strategies prevents siloed thinking and promotes coordinated and shared action. This involves strengthening risk management across systems, developing strategies and policies that acknowledge uncertainties, complexities and systemic issues, as well as gathering and interpreting information for adaptive learning.

Supply chains

Increases in the severity and frequency of extreme weather events, including floods, heatwaves, bushfires, and storms may adversely impact critical and essential supply chains.

Damage and disruptions to energy sources, buildings and transport infrastructure can impact telecommunications, banking facilities, the transport and storage of materials and the supply of fuel, food and medication.

Disruptions not only affect the economic activities of businesses but also the day-to-day lives of consumers and workers, highlighting the interconnectedness of the supply chain infrastructure.

Key hazards that affect supply chains

- Riverine flooding
- Tropical cyclones

Priority cross-system risk analysed in the National Assessment: Risks to supply and service chains from climate change impacts that disrupt goods, services, labour, capital and trade.

Key risks

- Future supply chain exposure from point of production through to communities and the market is strongly driven by how the population size and distribution will change. Figure 8 shows how projected changes to freight may change under a moderate growth 2090 population scenario, and shows that the rate of freight growth differs significantly between states and territories.

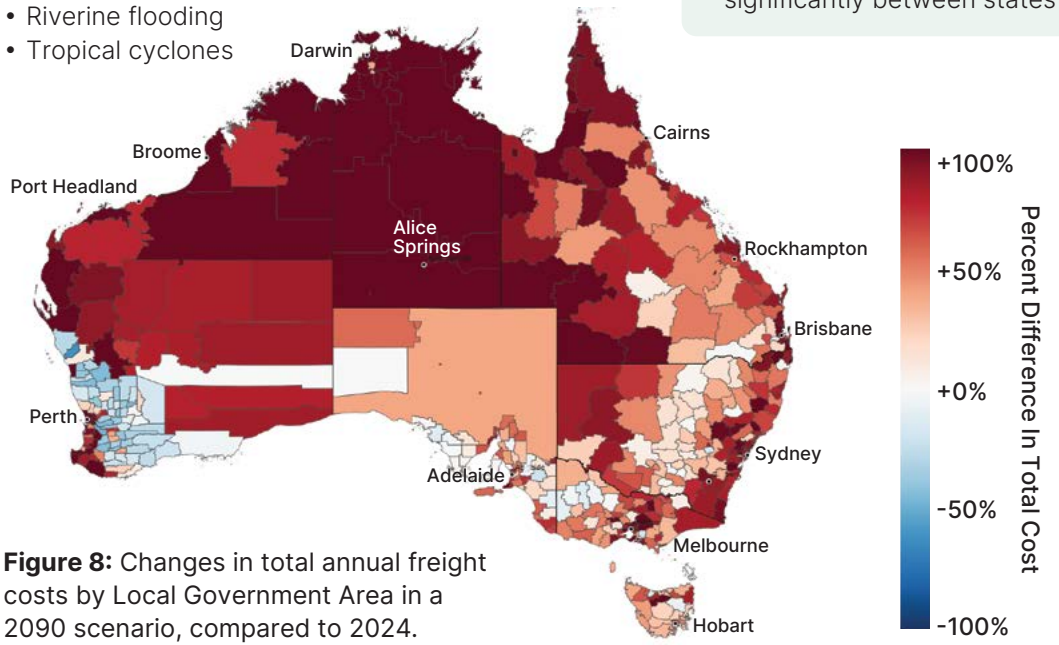


Figure 8: Changes in total annual freight costs by Local Government Area in a 2090 scenario, compared to 2024.

- Three case studies were selected based on identified supply chain vulnerabilities to illustrate the potential impact of future extreme weather events. The case studies used the footprint of historical events projected into a future climate.

– **A major flood, based on the flooding across Victoria and NSW in October 2022, covering a broad geographic dispersed area.** The value of blocked freight would rise from $4.9 billion in the current climate to $9.3 billion in 2090. Health-related freight (e.g. medicines), although not the largest impacted sector in terms of tonnes, would have the largest percentage increase in the value of freight blocked and requiring re-routing, suggesting this is a vulnerable commodity for extreme events.

– **A severe tropical cyclone following the path of tropical cyclone Jasper 2023.** Direct impacts remain largely confined to north Queensland; however, greater shortages of food products would be experienced in major distribution centres across Australia for both 2050 and 2090, particularly those products grown in northern Queensland. This highlights that local impacts can reverberate across Australia.

– **Disruption to the critical east-west supply corridor modelled after the February 2022 flood event that cut the Eyre and Stuart highways.** Modelling of a more severe version of this event in 2090 resulted in a detour increase of 730 km on average, with some detours as high as 3,200 km. The most impacted Local Government Areas were Indigenous and remote communities.

Water security

Australia faces severe risks to water security from climate change. Projected widespread declines in rainfall and streamflow, a more variable climate, and mega-droughts not seen since European settlement will coincide with warming that raises evaporation, reducing soil moisture, runoff, and groundwater recharge. Increased severe floods and bushfires will further degrade water quality, straining already limited water sources.

Every region faces serious future water security challenges, with natural environments expected to endure the most severe impacts. Effective water management is one of few adaptation measures to mitigate ecosystem function risk. Water scarcity will threaten primary industries by reducing productivity and profitability, posing risks to food security and regional economies. Remote communities, with limited alternative water options, will struggle to maintain water assets in the face of climate extremes, compounded by the decline of ecosystems essential for clean water.

Key hazards that affect water security

- Changes in seasonal rainfall
- Extreme events (bushfires and floods)
- Changes in drought and aridity

Priority cross-system risk analysed in the National Assessment: Risks to water security that underpins community resilience, natural environments, water-dependent industries and cultural heritage.

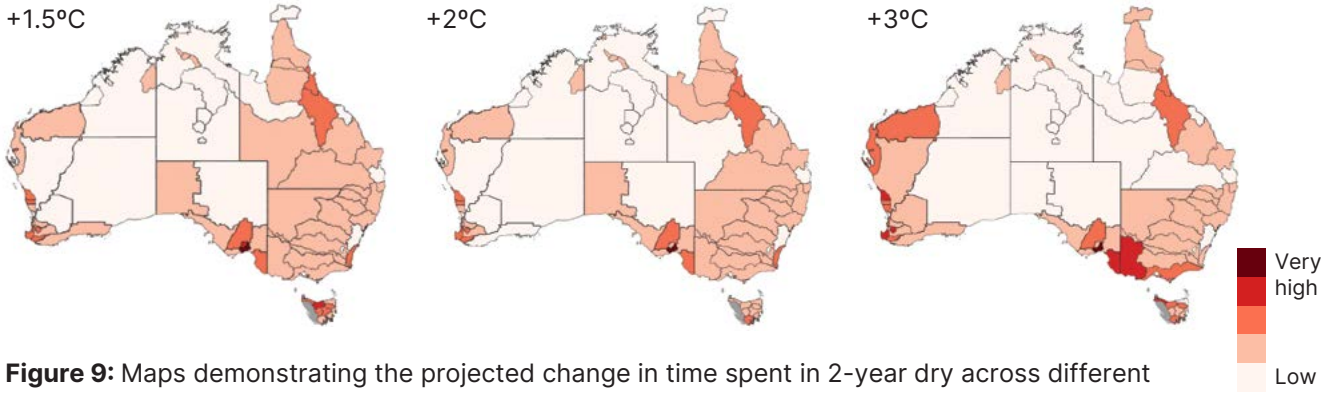


Figure 9: Maps demonstrating the projected change in time spent in 2-year dry across different global warming levels. While 24-month dry is a useful way to compare across many regions nationally, some regions will be more sensitive to other definitions of drought. Therefore, operational planning purposes would use risk indicators based on system-specific sensitivities and risks.

Key risks

- Our water security depends almost exclusively on the ability of natural ecosystems' ability to regulate and clean water. The expected increase in future drought in some areas may push freshwater ecosystems beyond resilience, increasing ecological risks, particularly where water is fully allocated or poorly managed during low-flow periods. Projected aridification across Australia will impact river morphology, connectivity, and water quality, affecting all water users.
- Cities and large towns are investing in climate-resilient water sources, though geographic, economic, and regulatory hurdles present serious challenges. Remote communities, highly vulnerable to drought and drying, rely heavily on local rainfall and groundwater, facing challenges with shortages of skilled management and sustainable supply, and high operating costs of water infrastructure. While some regional towns plan for growth, they are challenged by less reliable water availability. Others face declining populations and high water-asset renewal costs, raising financial sustainability concerns.
- More intense rainfall events can cause blackwater events, increasing sedimentation, affecting downstream ecosystems and reducing the quality of drinking water. Projected impacts include damage or loss of nationally and internationally important wetlands.
- Projected increased water security challenges will impact agriculture through increased water competition, which may result in reduced water allocations. Perennial crops and livestock are particularly vulnerable, while annual crops may adapt more readily.
- Water quality risks from salinity, algae, bushfires, and increased rainfall variability will further challenge agricultural productivity.

Information to inform adaptation

Detailed analysis of climate risks reveals how and where society, the economy, and the environment will evolve, allowing proactive planning for a safe, adaptive and prosperous Australia that is resilient and prepared for climate change and natural hazards. The Australian Climate Service provides information to inform adaptation.

Photo: Apartment block with hanging gardens in Sydney, NSW, Australia. Source: Ellas Bitar

Adaptation stocktake

This section provides information on current adaptation to inform the development of the Australian Government's National Adaptation Plan.

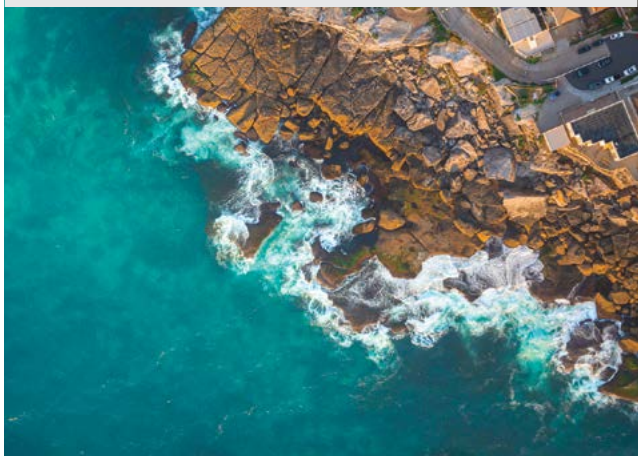
Key analysis

Given the rapid nature of the first National Assessment, the effectiveness of adaptation policy and actions was not assessed. The following analysis provides high-level information about what supports and contributes to effective adaptation policy and actions.

- **Adaptation planning and policy in Australia is progressing across local, state and federal levels.** South Australia and Queensland have the highest number of adaptation policies and plans, though there are different approaches to mainstreaming adaptation, which makes comparison across jurisdictions difficult.
- **Planning and policy do not necessarily translate to adequate adaptation action or effective adaptation.** Despite progress to date, there remains an adaptation action shortfall in every system, risk category, jurisdiction, and region across Australia.
- **Adaptation effectiveness is challenging to track systematically and nationally.** However, the stocktake of adaptation policies and actions offers valuable insights. Policies and plans indicate progress towards adaptation and institutional preparedness, with the diversity in policies and laws across regions reflecting varying levels of readiness.
- **Adaptation efforts identified in the stocktake primarily focus on knowledge-building (40%) or institutional (34%) adaptation actions.** Adaptation plans and policies commonly focus on addressing specific hazards across multiple systems.
- **Effective adaptation, particularly for climate risks that cascade across boundaries, requires collaborative governance and consultation across systems, borders, and scales.** The complex nature of climate risks requires coordinated consultation and action to avoid transferring risk to others and other maladaptive outcomes.
- **Adaptation needs to be effective at local scales.** Inadequate participation and consultation, role ambiguity between various government levels and agencies, and inadequate or inequitable distribution of resources to manage emerging risks, will all challenge the speed and effectiveness of adaptation.
- **Trust in government and institutions is important.** The perception of inadequate responses to climate risks could reduce trust in authority/institutions, making it harder to adapt. Ongoing collaboration and local consultation may help mitigate this risk.

What is climate adaptation?

Climate adaptation is the process of adjusting to current or likely climate change and its effects. The goals of climate change adaptation are to increase Australia's capacity to anticipate and respond successfully to climate change. This includes taking action to reduce climate risk, strengthen resilience and enhance wellbeing.



Key resources and additional information

This section provides information on additional technical information that is available to support the findings in this report. Information is also provided on future research opportunities.

Photo: Aerial view of amazing meandering river among gum trees in Australia

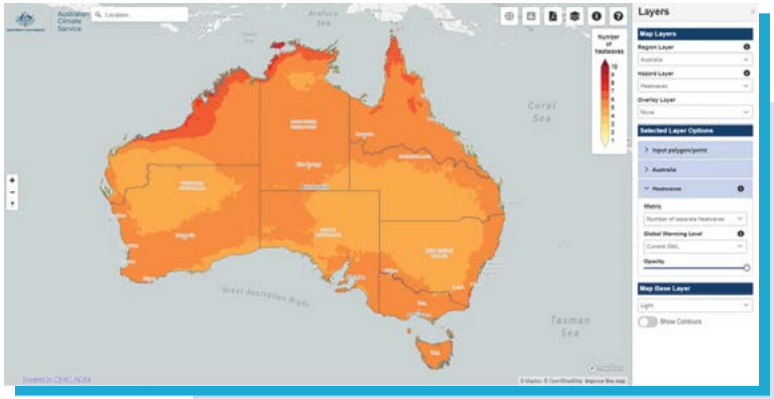
Key resources

Key resources have been developed as part of the National Assessment.

These key resources are supported by additional intelligence and data on the Australian Climate Service website.

Australia's National Climate Risk Assessment: An Overview

Australia's National Climate Risk Assessment Report



Data, information and insights to assist planning and adaptation are available on the Australian Climate Service website: **acs.gov.au**

Australia's first National Climate Risk Assessment has provided foundational building blocks to understand climate risk.

Climate risks are not static. Over time, Australia needs to continue to monitor and build knowledge and capabilities to support adaptation.

Opportunities to improve information for decision-making include:

- **Developing a shared understanding of key outcomes and systems for Australia:** the Australian Climate Service worked with key technical experts for the first National Assessment. To understand different aspects of risk, there is value in engaging with policymakers and decision-makers to build a better understanding of how the most significant impacts may materialise, and our societal tolerance of damage and loss.
- **Better integration of Aboriginal and Torres Strait Islander peoples' perspectives:** respectfully and appropriately engaging with Aboriginal and Torres Strait Islander peoples to learn from their experience and explore risks and responses to the changing climate takes time. Experience, cultural norms, knowledges, and values can differ markedly across communities. These perspectives should be considered across systems, rather than as a system on its own.
- **Economic impacts of climate change:** including impacts on householders and the cost of living. The emerging academic view is that current modelling methodologies are likely to significantly underestimate the economic impacts and do not take into account the potential cascading impacts from the physical damage from climate change to our economy. Transmission of financial risk internationally could also significantly increase the economic impacts of climate change.
- **Climate and hazards:** the maturity of climate and hazard information is varied, with our understanding of some hazards more developed than others. Continued investment in uplifting climate and hazard information would paint a more comprehensive understanding of future climate risk, including developing a greater understanding of future climate and hazard extremes, compound risk, and the possible impacts of reaching climate or ecological tipping points.
- **Exposure and vulnerability:** the understanding of where exposure is concentrated, and how communities and people respond to the impacts of climate change to change exposure and vulnerability, is not mature. A significant body of work is needed to improve methods for estimating future exposure and vulnerability, and potential interaction with behaviour and policy change. This can then be integrated with the climate and hazard projections to improve understanding of current and future impacts of a changing climate.
- **Global climate risks and opportunities:** various national climate risk assessments from international counterparts have identified that climate change impacts may be driven from outside the country. Our biggest trading partners and nearest neighbours will experience the impacts of climate change. This is likely to drive additional risk, which could substantially change the National Assessment.
- **Mitigation and adaptation actions:** decision-makers would benefit from closer alignment between the National Assessment and the discussion and implementation of climate change mitigation options. This information, along with an understanding of adaptation effectiveness, will enable the ongoing monitoring and evaluation of climate risks and impacts, providing a consistent, measurable and comparable evidence base.

National Climate Risk Assessment Glossary

Adaptation (climate): In human systems, adaptation is the process of adjustment to actual or expected climate change and its effects to moderate harm or exploit beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

Adaptive capacity: The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Aquaculture: The farming of marine and freshwater fish, shellfish, aquatic plants, algae and other organisms (DPIRD, 2024).

Biodiversity: The variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within species, between species, and of ecosystems.

Biosecurity: Biosecurity protects our unique biodiversity, promotes food security and minimises the risk of transmission of infectious diseases. Biosecurity is the way we stop the introduction and spread of harmful organisms such as viruses, bacteria, animals, plants, pathogens and insects into our country and how we manage the impacts of those already here.

Black Swan event: An event that is unprecedented and statistically highly unlikely, and therefore effectively unpredictable, but when it occurs, can result in major impacts.

Blackwater event: Blackwater events typically occur after floods wash organic materials into waterways, which elevate the dissolved carbon in the waterways, depleting dissolved oxygen.

Bushfire: Bushfires and grassfires are uncontrolled vegetation fires, referred to internationally as wildfires. These are a natural, essential and complex part of Australian ecosystems, and have been for thousands of years. Bushfires occur when there is plentiful dry vegetation to burn, conducive weather and climate conditions, and an ignition source. Humans frequently contribute to ignition, but dry lightning is a major natural ignition source. Changes to vegetation, drought, heatwaves and fire weather influence the susceptibility to fire.

Carbon sequestration: The process of capturing and storing carbon dioxide from the atmosphere to reduce climate change.

Cascading hazards: Extreme events in which cascading effects increase in progression over time and generate unexpected secondary hazard events of strong impact. The subsequent events tend to be as serious, or significantly larger than the original event and contribute significantly to the overall duration of the hazard's effects.

Cascading impacts: Cascading impacts from extreme weather/climate events occur when an extreme hazard generates a sequence of secondary events that result in physical, natural, social or economic disruption, whereby the resulting impact is significantly larger than the initial impact.

Cascading risk: Where one event or trend triggers others. Interactions can be one way (e.g. domino or contagion effects) but can also have feedbacks.

Chronic climate impacts: Impacts associated with longer-term shifts in climate patterns (e.g. sustained higher temperatures and changing precipitation patterns) leading to shifts in vegetation types and melting ice sheets leading to sea level rise.

Climate change: A change in the climate that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate threshold: A limit within the climate system beyond which the behaviour of the system is qualitatively changed.

Communicable disease: Diseases that can be spread from person to person.

Complex risk: The diversity of interactions among sectors and systems that can amplify or reduce climate change risks. Interactions can cross sectoral, temporal, spatial and response-option boundaries.

Compound events: The combination of multiple drivers and/or hazards that contribute to societal and/or environmental risk.

Confidence: The robustness of a finding based on the type, amount, quality and consistency of evidence (e.g. mechanistic understanding, theory, data, models, expert judgement) and on the degree of agreement across multiple lines of evidence.

Coral bleaching: When corals are under stress from excess heat, light, or nutrients, symbiotic algae (known as zooxanthellae) are expelled and the corals turn white. Corals can survive a bleaching event, but are under more stress and are subject to mortality.

Critical and essential services: Vital services such as energy, telecommunications, transportation and information technology that ensure community wellbeing and resilience.

Critical infrastructure: Those physical facilities, supply chains, information technologies, and communication networks which, if destroyed, degraded or rendered unavailable for an extended period, would significantly impact the social or economic wellbeing of the nation or affect Australia's ability to conduct national defence and ensure national security.

Decision-makers: Individuals, groups, organisations or entities who make investment, spending, policy, program, legislative, regulatory, resource allocation, planning or lifestyle decisions.

Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.

Disaster risk reduction: The prevention of new, reduction of existing, and management of residual disaster risk. These risk reductions contribute to strengthening resilience and achieving sustainable development. Disaster risk reduction is the policy objective of disaster risk management, and its goals and objectives are defined in disaster risk reduction strategies and plans.

Domestic disaster response: Australia's domestic disaster response is a coordinated structure designed to prepare for, respond to, and recover from natural and human-induced disasters. It operates across all levels of government (federal, state, and local) alongside non-governmental organisations, communities, and private sector stakeholders. The system aims to minimise loss of life, property damage, community and environmental impact from disasters.

Drought: A prolonged period of abnormally dry conditions where there is not enough water available to meet normal use. Drought can occur on multi-week timescales (called flash drought), multi-months (meteorological drought) and on longer timescales of up to several years (hydrological drought).

Ecosystem: A functional unit consisting of living organisms, their non-living environment, and the interactions within and between them. The components included in a given ecosystem and its spatial boundaries depend on the purpose for which the ecosystem is defined. In the current era, most ecosystems either contain people as key organisms or are influenced by the effects of human activities in their environment.

Ecosystem collapse: A change from a baseline state beyond the point where an ecosystem has lost key defining features and functions, and is characterised by declining spatial extent, increased environmental degradation, decreases in, or loss of, key species, disruption of biotic processes, and ultimately, the loss of ecosystem services and functions.

Ecosystem condition: The ecosystem's capacity to maintain its characteristic composition, structure, functioning and self-organisation over time within a natural range of variability.

Ecosystem function: The roles and activities that organisms play within an ecosystem, contributing to its overall health and stability. This includes processes such as nutrient cycling, pollination, seed dispersal, and predator-prey interactions that are essential for ecosystem functioning. Key functions include primary production, nutrient cycling, decomposition, pollination, seed dispersal, and habitat provision. These processes support biodiversity and ecosystem services, such as clean water, fertile soil, and climate regulation.

Ecosystem services: The benefits provided to humans through the transformation of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services such as clean air, water, and food.

Ecosystem transformation: Occurs where the ecosystem's characteristic composition, structure, functioning, and self-organisation have been significantly altered by land use or management practices.

Emergency services: Fire and rescue services, ambulances, police, and the volunteer workforce.

Equity markets (public and private): The equity market, also known as the stock market, is a part of a market economy that facilitates the issuing and trading of company shares. The securities traded in the equity market can either be public stocks listed on the stock exchange or privately traded stocks.

Evapotranspiration: The combined processes through which water is transferred to the atmosphere from open water and ice surfaces, bare soil, and vegetation that make up the Earth's surface.

Exclusive Economic Zone: An area beyond and adjacent to the territorial sea. In the Exclusive Economic Zone, Australia has sovereign rights for the purpose of exploring, exploiting, conserving, and managing all natural resources.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Extratropical storm: Intense low-pressure systems that form outside the tropics, associated with heavy rain and hail, strong winds, large waves, coastal inundation and coastal erosion. Examples of extratropical storms include east coast lows and associated cold fronts.

Flood: The overflowing of the normal confines of a stream or other water body, or the accumulation of water over areas that are not normally submerged.

Food security: A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (United Nations Food and Agriculture Organization (FAO)).

Forest Fire Danger Index: An index that relates to the degree of danger associated with a fire in Australian forests. It is calculated from values that influence fire behaviour, including temperature, wind speed, recent rainfall, and estimated vegetation dryness.

Geopolitics: How political power is reinforced or undermined by geographical arrangements.

Governance: The way that the making of decisions is organised in society. It is 'the way through which multiple and different actors behave, operate, interact and confront each other' to make decisions 'about public affairs, including risks and disasters' (Forino et al. 2018a, p. 1).

Hazard: A natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Hazard proneness: The frequency, probability, or severity of hazards in a general sense. The Australian Climate Service has assessed hazard proneness for 4 of the priority hazards – heatwaves, bushfires, riverine and flash flooding, and tropical cyclones.

Heatwave: Heatwaves are characterised by maximum and minimum temperatures that are unusually hot (top 5% of historical temperatures) over 3 or more consecutive days, compared with the average from 1985–2014. Severe and extreme heatwaves, as defined by Nairn and Fawcett (2015), cause the greatest impacts, and hence are the thresholds for Bureau of Meteorology public warnings.

Horticulture: The agricultural industry that includes fruit, vegetables, nuts, flowers, turf and nursery products.

Impacts: The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure, and vulnerability. Impacts generally refer to effects on lives, livelihoods, health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.

Institutional adaptation: The use of various decision- making and adaptation planning tools to adapt or transform formal institutions, including laws, policies, regulations and planning measures, as well as informal institutions, including agreements amongst groups in society.

Legacy planning: Planning of communities that has occurred in the past, which influences current land use and development decisions.

Maladaptation: Actions that may lead to increased risk of adverse climate-related outcomes, including through increased greenhouse gas emissions, increased vulnerability to climate change, or diminished welfare, now or in the future. Maladaptation is usually an unintended consequence.

Marine heatwave: A period during which water temperature is abnormally warm for the time of the year relative to historical temperatures, with that extreme warmth persisting for days to months. The phenomenon can manifest in any place in the ocean and at scales of up to thousands of kilometres.

Mega-drought: A very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more.

Megafire: A fire complex of over 10,000 hectares.

Mitigation (climate): The process of making climate change less severe by reducing or preventing the flow of heat-trapping greenhouse gas emissions into the atmosphere.

Morbidity: Ill health in an individual, and levels of ill health in a population or group.

Mortality: Number or rate of deaths in a population during a given time period.

Nationally significant: Considered to have significant national and cross-jurisdictional effect, impact or influence.

Ocean warming and acidification: As rising atmospheric carbon dioxide (CO_2) warms the planet, the oceans absorb excess heat and carbon, leading to ocean warming and acidification. This long-term trend can cause more frequent and intense marine heatwaves, changes in biogeochemical cycles, and alterations in ocean currents.

Perennial crops: Crops that have longer lifespans, with some commodities requiring up to 2-8 years to reach maturity. These crops often remain productive for 10 to 30 years.

Pre-industrial temperatures: The multi-century period prior to the onset of large-scale industrial activity around 1750. The reference period 1850–1900 is used to approximate pre-industrial global mean surface temperature.

Primary industries: Broadacre cropping, horticulture, forestry, livestock, and fisheries and aquaculture.

Real economy: The production, purchase or flow of goods and services. This includes real property (i.e. real estate), labour and incomes, and availability and costs of goods and services.

Regional and remote communities: Communities in Australia that are beyond major urban centres, including regional centres, towns, remote communities, mining settlements, small islands and external territories.

Residual risk: The risk that remains even when effective disaster risk reduction measures are in place.

Resilience: The ability to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Response: The National Assessment considers 3 types of response associated with physical risk, including improved management, incremental adaptation, and transformational adaptation.

Risk: The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Risk may change over time and space due to socio- economic changes and human decision-making.

Risk management: Plans, actions, strategies or policies to reduce the likelihood and/or magnitude of adverse potential consequences, based on assessed or perceived risks.

River morphology: The study of the shape of a river channel and how it changes over time. It is determined by various factors, including discharge, water surface slope, water velocity, depth and width of the channel, and riverbed materials. Erosion, transportation, and sedimentation are channel processes reflected in river morphology.

Self-determination: Aboriginal and Torres Strait Islander peoples' right to freely pursue their economic, social and cultural development, and the power to make decisions about their lands, waters and governing systems.

Slow onset hazard: Slow onset hazards, such as sea level rise, evolve gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events.

Social cost: The full costs of an action in terms of social welfare losses, including external costs associated with the impacts of this action on the environment, the economy (GDP, employment) and society as a whole.

Social tipping point: Mechanisms in socio-environmental systems where a small change in the underlying elements or behaviour of actors triggers a significant, abrupt, non-linear and irreversible change in the social system.

Systems: A complex network or networks of interconnecting and related rules, structures and mechanisms that work towards a common goal.

Terrestrial ecosystems: The community of land-based living organisms and the non-living environmental features that support them. They are essential for the provision of services (e.g. food, fuel) and ecological processes for all life on earth.

Tipping point: A critical threshold beyond which a system reorganises, often abruptly and/ or irreversibly (within human lifetimes).

Tropical cyclone: Intense, low-pressure systems that form over warm tropical oceans and generate gale-force or stronger winds, heavy rainfall and coastal storm surges. The severity of a tropical cyclone is ranked in categories from 1 (with sustained winds above 63 km/h) to 5 (with sustained winds above 200 km/h).

Vector-borne diseases: Human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. Vectors are living organisms that can transmit infectious pathogens between humans or from animals to humans.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

References used in this report can be found in the *Australia's National Climate Risk Assessment Report*.

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