

Department of Planning and Environment

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# Planning for a more resilient NSW

A strategic guide to planning for natural hazards

November 2021





# Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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# Part 1 – Overview



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## Introduction

Like much of Australia, NSW is exposed to natural hazards on a recurring basis. Between 2009 and 2019, the state was affected by 198 declared natural disasters<sup>1</sup>. Natural disasters across NSW have claimed more than 550 lives between 1970 and 2015 and affected thousands of people. The impacts of natural hazards also include significant financial and economic costs, with the total economic cost of natural disasters in NSW estimated to be \$3.6 billion per year<sup>2</sup>.

The impacts and costs of extreme weather events are expected to increase as our population grows and areas exposed to natural hazards such as floodplains, the coast and lands adjacent to bushland are urbanised. In the context of a changing climate, natural hazards are also becoming more frequent and intense, making them increasingly unpredictable.

Natural hazard resilience is the collective responsibility of all levels of government, business, the non-government sector, communities and individuals. Together with hazard and emergency management responses, strategic land-use planning is one of a suite of tools and approaches that can help address risk associated with natural hazards.

The NSW planning system plays an important role in limiting exposure of development to natural hazards and climate change by adopting a risk-management approach to strategic planning. While it isn't practical for strategic planning to eliminate all risks from natural hazards, strategic planning can help limit how vulnerable communities are to natural hazards and how frequently they are exposed to these types of risks. Risk avoidance, reducing growth in risk, and risk reduction are a fundamental subset of overall sustainability<sup>3</sup>.

An effective strategic land-use planning system considers natural hazards early and avoids creating expectations for development that are not suited to current or likely future natural hazards. As identified by the Royal Commission into National Natural Disaster Arrangements<sup>4</sup>:

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‘Land-use planning decisions have far-reaching and long-lasting consequences as to how exposed and vulnerable the community will be to future natural hazards. Where land-use planning decisions do not effectively incorporate natural hazard risk, future impacts of natural disasters will be higher.’

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<sup>1</sup> Office of Emergency Management (2019), Natural Disaster Declarations, accessed 13 December 2019 at [www.emergency.nsw.gov.au/Pages/publications/natural-disaster-declarations/2009-2010.aspx](http://www.emergency.nsw.gov.au/Pages/publications/natural-disaster-declarations/2009-2010.aspx)

<sup>2</sup> Deloitte Access Economics, 2017, Building resilience to natural disasters in our states and territories Accessed 13 December 2019 at [deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html](http://deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html). This figure is conservative as the modelling that underpins it does not include consideration of climate change impacts on the frequency, severity and duration of extreme weather events, or chronic climate changes.

<sup>3</sup> AIDR Land Use Planning for Disaster Resilient Communities 2020

<sup>4</sup> The Royal Commission into National Natural Disaster Arrangements, 2020, Report to the Governor-General, p. 70, accessed 24 November 2020, [naturaldisaster.royalcommission.gov.au/publications/royal-commission-national-natural-disaster-arrangements-report](http://naturaldisaster.royalcommission.gov.au/publications/royal-commission-national-natural-disaster-arrangements-report)

For more background information that has informed the development of this guide, refer to Appendix A.

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## Purpose and scope of this guide

The Department of Planning, Industry and Environment (the Department) has developed this guide and a supporting resource kit to help planning authorities and councils make decisions that more effectively consider natural hazard risk and build sustainable, hazard-resilient communities.

The guide aims to inform the consideration of natural hazards in the preparation of:

- regional and district plans
- local strategic plans and community strategic plans
- planning proposals
- other strategic planning activities that relate to land-use planning.

Figure 1 outlines where the guide and resource kit (collectively known as the Natural Hazards Package) fit into the planning framework.

Figure 1. Natural Hazards Package and the NSW Planning Framework



This guide is not intended to be a technical document and does not replicate or replace the existing legislation, statutory functions and policies that deal with natural hazards or emergency management. It is intended to prompt consideration of relevant natural hazards in an integrated and multi-disciplinary way.

This guide considers the natural hazard risks that have historically most affected NSW<sup>5</sup> and those that have the potential to in the future. Planning authorities, land-use planners, consultants and applicants should use the guide when preparing strategic plans and proposals.

By considering natural hazards in strategic land-use planning, we are creating more resilience in the community, building economic stability, protecting valuable assets, integrating environmental principles and balancing these with housing and industry demand.

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‘The safety and protection of human life and wellbeing of communities, and the wider systems that support them in their various forms, is the core objective of land-use planning for disaster resilient communities.’<sup>6</sup>

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In this guide we:

- discuss, at a high level, the connection to existing policies, legislation, guidelines, responsibilities and science
- identify the natural hazards relevant to NSW that should be considered in strategic planning activities
- set out 8 guiding principles to inform land-use planning decisions and manage natural hazard risk (see ‘Part 3 Guiding principles for strategic planning’)
- explain key concepts related to natural hazard risk management.

The purpose of this guide is to improve the way we use strategic land-use planning to build long-term resilience to natural hazards in our communities. Multidisciplinary collaboration with experts in specific natural hazard risks and emergency managers is a critical part of this. These professionals can provide valuable insights, up-to-date scientific research and expert advice on natural hazards to support state government agencies and councils as they engage in strategic planning activities.

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<sup>5</sup> NSW Department of Justice, 2017, State Level Emergency Risk Assessment

<sup>6</sup> AIDR, 2020, Land Use Planning for Disaster Resilient Communities, Australian Disaster Resilience Handbook Collection



Terms such as disaster, natural hazards and resilience are used throughout this guide. Their definitions are as follows.

**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 human, material, economic or environmental losses and impacts.

**Natural hazard** – A natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

**Resilience** – The ability of a system, community or society exposed to hazards 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 through risk management.

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## Relationship to other risk and planning frameworks

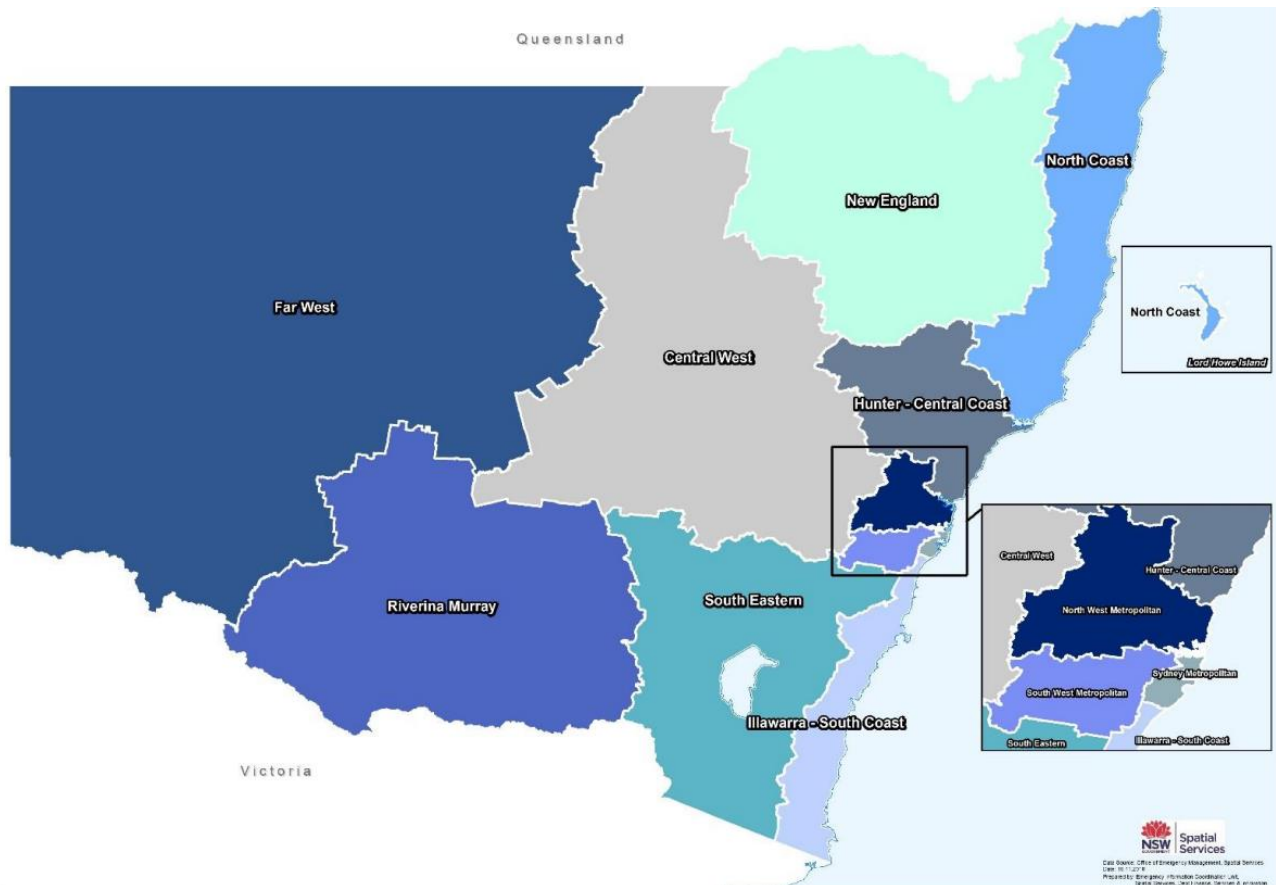
The *NSW State Emergency and Rescue Management Act 1989* establishes the emergency management framework for NSW. This Act provides the legislative basis for the coordination of emergency prevention, preparedness, response and recovery operations for any emergency that has the potential to impact any part of NSW.

The Act establishes the State Emergency Management Committee and requires the development of a State Emergency Management Plan. The State Emergency Management Plan coordinates agencies responsible for the prevention, preparedness, response or recovery of a suite of hazards, including defining each agency's responsibility. The plan is also supported by sub-plans for specific emergencies.

Similar plans are prepared for 11 regions across NSW as shown in Figure 2. The arrangements to prepare a plan and sub-plan are also established at the local level through local emergency management committees, where agency representatives can put procedures in place for the hazards that could affect their community.



Figure 2. Emergency management regions<sup>7</sup>



It should be noted that the regions in Figure 2 are based on emergency management arrangements and may differ to how regions are identified elsewhere in the NSW planning system.

Additionally, within NSW, a detailed framework is in place that deals with natural hazard risks and emergency management. Several state government agencies and local councils have statutory roles in natural hazard risk and emergency management. Examples of existing frameworks include:

- NSW flood risk management,
- bushfire management,
- coastal management and
- emergency risk management.

Incorporating local Aboriginal knowledge into the management of land for natural hazards should also be considered.

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<sup>7</sup> NSW State Emergency Management Plan, December 2018, accessed on 12 October 2021  
<https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>



*Photography: John Lugg/NSW Department of Planning, Industry and Environment*

Read this guide in conjunction with NSW Government policies such as Planning for Bushfire Protection, Bushfire Risk Management Policy, the NSW Flood Prone Land Policy, Coastal Management Manual, NSW Health Heatwave Plan and others, which provide hazard-specific guidance for minimising community exposure and vulnerability to natural hazard risk.

There may also be committees that address specific hazards. These committees could provide technical input into strategic planning in its early stages. An example of this are bushfire management committees that identify risk and mitigation activities for bushfires. We encourage councils to seek out the guidance of these committees in addressing hazards and understanding risk relevant in their local area.

At the state level, Resilience NSW has also developed several key documents that look at strategic planning. These include the NSW Critical Infrastructure Resilience Strategy in conjunction with NSW Emergency Risk Management Framework and the NSW 2017 State Level Emergency Risk Assessment. These documents look at risk and mitigation measures broadly in NSW and can be useful to help inform decision making at the strategic level.

A detailed list of resources is available in the resources kit.

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## Natural hazards covered in this guide

This guide refers to natural hazards identified as posing a high or extreme risk to NSW<sup>8</sup> and those considered to pose a risk with climate change. These hazards include (but not limited to):

- bushfire
- coastal hazards
- cyclones
- drought
- earthquake
- flood
- heatwave
- landslide
- severe thunderstorm (including east coast low)
- tornado
- tsunami.

The terms are explained in Appendix B. Key natural hazard risk management terms are summarised at Appendix C.

Figure 3. Natural hazards within scope for this guide



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<sup>8</sup> State Level Emergency Risk Assessment (NSW Office of Emergency Management, 2017)

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## What about climate change?

It is necessary to include climate change predictions when dealing with future risk. Use these predictions when considering strategic land-use planning studies. While this guide does not identify climate change as a standalone natural hazard, it acknowledges that climate change is increasing a wide range of natural hazard risks by altering their frequency and intensity, affecting our vulnerability to natural hazards and changing exposure patterns.

Australia's national climate projections at [www.climatechangeinaustralia.gov.au](http://www.climatechangeinaustralia.gov.au) indicate that over coming decades Australia will experience:

- further increase in temperatures, with more extremely hot days and fewer extremely cool days
- ongoing sea level rise
- further warming and acidification of the surrounding oceans
- more frequent, extensive, intense and longer-lasting marine heatwaves, which may lead to more frequent and severe bleaching events on the Great Barrier Reef and potentially the loss of many types of coral throughout all tropical reef systems globally
- a decrease in cool-season rainfall across many southern regions, with more time spent in drought
- more intense heavy rainfall, particularly for short-duration, extreme rainfall events
- an increase in the number of high fire weather danger days and a longer fire season for southern and eastern parts of the country
- fewer tropical cyclones but a greater proportion of high-intensity storms, with ongoing large variations from year to year.

For further information, refer to the [NSW Climate Change Policy Framework 2016](#).

While the natural hazards identified in NSW are based on current risk, climate change may increase the risk to these natural hazards in locations that may not have previously been at risk. You should consider this when undertaking strategic land-use planning.





## Issues that are beyond the scope of strategic planning and this guide

This document provides guiding principles for how public authorities and councils can more effectively integrate the consideration of natural hazards in strategic land-use plans.

We acknowledge that strategic planning is just one of many elements that contribute to effectively managing current and future natural hazards risk. One of the objectives of this guide is to encourage a multi-disciplinary dialogue on how these elements interact with strategic planning. For example, the comprehensive statutory frameworks for managing emergencies and specific hazards such as bushfire, flood and coastal hazards play important roles in managing risks from natural hazards.

This guide also recognises that strategic planning has a more limited role in managing risks associated with existing development unless some form of urban renewal is envisaged for those areas.

While the science and research of natural hazards is beyond the scope of this guide, strategic planning needs to be informed by the science and research related to the occurrences and exposure of communities, assets and infrastructure to natural hazards and how the profile of the natural hazards may be impacted by climate change and natural weather patterns such as El Niño southern oscillation which tends to bring below average rainfalls.

Building regulation is beyond the scope of this guide. Building regulation works with land-use planning to assess development proposals and deliver buildings that are more resilient to natural hazards. The National Construction Code is administered at the federal level and subject to regular revision to ensure buildings are constructed to a standard appropriate to their context. Together with various national and international standards, building regulations address natural hazards such as bushfire, flood, cyclone, and earthquake.

Disaster response is also beyond the scope of this guide, except where it relates to hazard mitigation that should be accounted for during strategic planning activities. In terms of specific natural hazards, some risks such as poor air quality generated by drought-driven dust storms or smoke from bushfires, are remote from the source, making it difficult to manage through strategic planning. Other examples include contamination and acid sulphate soils, which can cause problems following a disaster such as a bushfire or flood. For this reason, this guide does not capture these hazards. They are more effectively managed using other tools.

# Part 2 – Understanding natural hazards risk and risk management



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## Understanding natural hazard risk

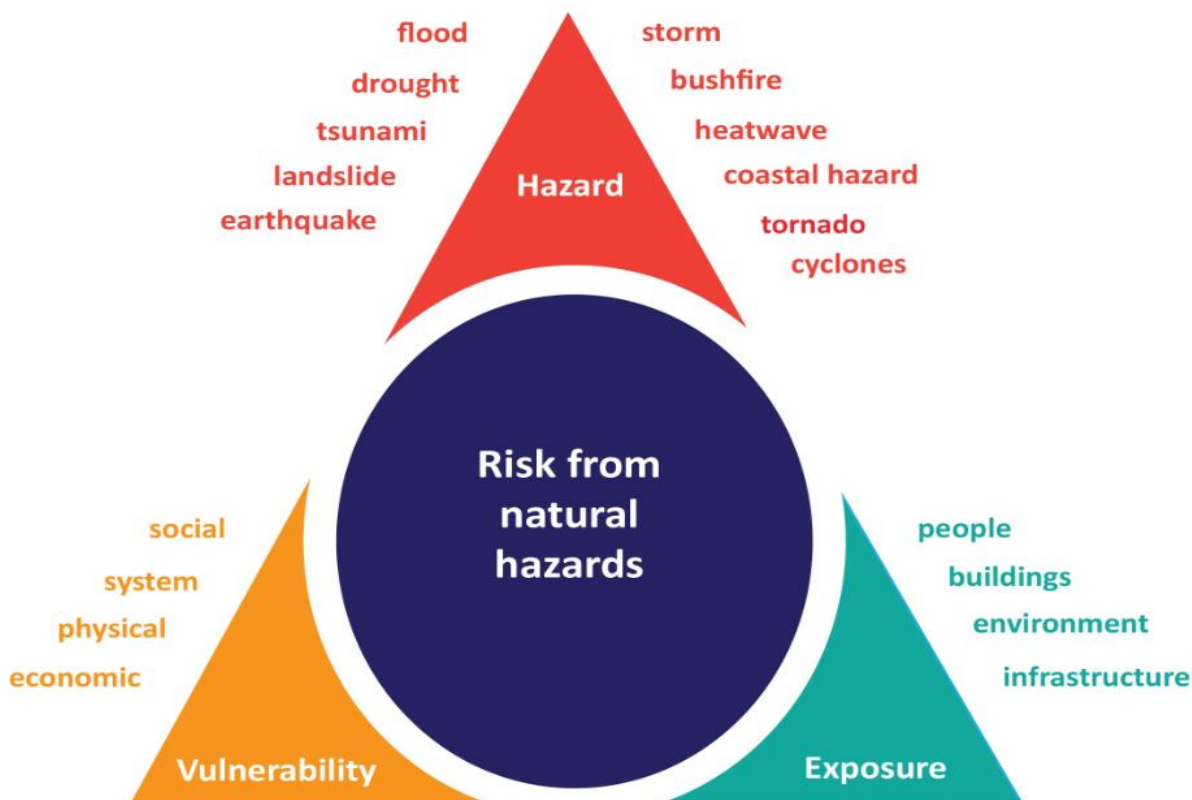
A natural process has the potential to turn into a natural hazard risk when 3 elements interact:

- there is a presence or probability of a **natural hazard** (such as those described in Appendix B)
- people and/or property are **exposed** to the hazard
- the characteristics of a community make it **vulnerable** to the damaging effects of the hazard.

You reduce the risk by decreasing the contribution from one or more of these 3 components while not increasing others or increasing them to a lesser extent. Sustainable development seeks to reduce long-term risk to people and property from natural hazards. Even where little can be done to reduce the probability of natural hazards, it may be possible to reduce the exposure and/or vulnerability of a community to those hazards, and hence the risk.

The concept of a natural hazard risk is depicted in Figure 4, which provides an example of how hazard, vulnerability and exposure contribute to risk.

Figure 4. Example of a natural hazard risk triangle



For these reasons, strategic planning plays a significant role in shaping future growth, development, and community resilience. Strategic planning that effectively considers the impacts of natural hazards at an early stage in decision-making limits exposure and vulnerability to risk. It does this through appropriate zoning and development controls that consider the constraints that natural hazards place on land. You need to consider all hazards prior to zoning or rezoning land to avoid creating the perception that the land is suitable for purposes that are incompatible with existing or likely future constraints on the land.



Appropriate zoning and development controls manage the impacts of:

- development on natural processes including natural hazard impacts
- development on the risks of natural hazards to the existing community
- these hazards on future development and its users
- response and recovery activities from these hazards on emergency management.

Decisions relating to what land uses or development types are permitted in an area can influence our exposure to natural hazards. For this reason, land-use planning is an essential aspect of hazard risk reduction. In NSW for instance, if we allow more people to live in floodplains, they are more likely to be exposed to floods and their consequences. And if more people live in bushland areas, they are more likely to be exposed to bushfires.

Although it is unrealistic to plan communities that are entirely risk-free, strategic planning is a key tool in helping to take account the significant variation in natural hazard risks. Strategic planning strives to achieve compatibility of land use with natural hazard risk and ensure development outcomes that limit the frequency of exposure to natural hazards.

There are many aspects of vulnerability arising from physical, social, economic, and systemic factors. Planning authorities can make decisions now that will reduce the vulnerability of communities and buildings exposed to hazards in the future. For example, they can undertake a social impact assessment when preparing strategic land-use plans for their communities to assess vulnerability to and prepare for hazard events. They should develop these plans by working with natural hazard experts and emergency support agencies to understand the natural hazards relevant to the community and their potential consequences. Planning authorities can also develop a framework for understanding climate change vulnerability and preparing to prioritise climate change adaptation initiatives.

There is also value in land-use planners making themselves familiar and liaising with local council representatives on their local emergency management committee to understand the perspective of emergency services and response agencies when identifying natural hazards and preparing strategic plans.

## Vulnerability to natural hazards

Vulnerability is integral to understanding the true extent of natural hazard risk and can be divided into 4 main areas:

**Physical vulnerability** – potential for physical impact on people as well as the built environment. Physical vulnerability of people is influenced by, among other things, age, health, and mobility. Physical vulnerability of buildings and infrastructure is influenced by building standards and construction techniques. These, in turn, also influence the physical vulnerability of people to injury in the event of building damage or failure.

**Social vulnerability** – potential for communities to experience social losses such as disruption of social interactions, loss of identity and family breakdown. Relevant factors include a population's age, income, social capital (i.e. strength of social networks), as well as physical and mental wellbeing.

**Economic vulnerability** – potential for economic losses including direct tangible costs such as physical damage to buildings and their contents, indirect tangible costs following an event such as business disruption and clean-up, and intangible costs such as death and injury, loss of memorabilia, or loss of environmental assets.

**System vulnerability** – potential for loss of critical infrastructure systems such as electric power stations, water treatment plants or telecommunication hubs.

**Environmental vulnerability** – potential for loss of biodiversity and other ecological values.

Source: Geoscience Australia

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## Acceptable risk

Acceptable risk is a term used by government to identify what is a tolerable degree of risk. However, this degree of risk can differ from that accepted by the community. The need to treat risk from natural hazards depends on whether the current level of residual risk is acceptable to the broader community

In cases where there is no defined standard, the level of risk that is acceptable will need to be determined through consultation with state and local government, experts such as hazard experts, risk and emergency managers and the community. Hazard experts can often take some time developing scientific modelling and data to determine exactly what the level of acceptable risk is and interpret that to calculate the residual risk. Members of the community should be involved in these projects as they will take on the long-term risk that may impact their lives and homes, future generations and the wider community.

Acceptable risk is a risk management decision that involves:

- balancing risk from natural hazards
- the costs of living with this risk
- the benefits of occupying the at-risk areas (such as the floodplain, bushland, or coastal areas)
- consideration of a reasonable level of service to the community.



Photography: Peter Taseski/NSW Department of Planning, Industry and Environment

Identification of an acceptable level of risk should consider the best available hazard information, including past events and the full range of natural hazard events. It should consider relevant standards and guidance from government and industry as well as economic costs associated with insurance. Consideration should also be given to climate change and future risk projections– refer to the Resource Kit for further information.

In the absence of an agreed level of acceptable risk, the state government and councils should look at the hazards that pose a risk to them and how the strategic land-use planning can facilitate appropriate development.

Risk analysis is a systematic approach to developing an understanding of the nature, drivers, and level of risk to rank the relative seriousness of risks – see for example *ISO 31000:2018, Risk management – Guidelines or using worst case scenario modelling*. Risk analysis may involve a combination of quantitative and qualitative measures. It can be used to inform decisions on both the acceptability of the residual risk and the effective and efficient use of resources to better understand and manage risk to the existing and growing community.

There can be instances where adopting the general standard for development controls results in a residual risk that continues to be intolerable to the community. In these circumstances, additional localised development constraints may be warranted to reduce residual risk further. Examples of situations where this can arise include where:

- certain community groups and the types of development they inhabit are more vulnerable and may include additional constraints for example aged care, childcare or those who do not speak English as a first language.
- key community infrastructure such as power supplies, communication centres, evacuation route capacity, emergency response headquarters and evacuation centres require additional protection.
- the consequences of the same magnitude of flood can vary greatly between locations.

# Part 3 - Guiding principles for greater resilience



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## What is ‘disaster resilience’

As natural hazard risk increases, the capacity of communities and systems to be resilient is challenged. The United Nations Office of Disaster Risk Reduction (2017) defines resilience as:

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...‘the ability of a system, community or society exposed to hazards 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 through risk management.’

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Disaster resilience is the ability of individuals, communities, organisations and states to adapt to and recover from shocks or stresses associated with natural hazards without compromising long-term prospects for development. Disaster resilience is a long-term outcome that requires continuing commitment and is the collective responsibility of all levels of government, business, the non-government sector and individuals.

This guide identifies 8 guiding principles to support communities to be more resilient to natural hazards through strategic land-use planning:

- 1. Be strategic, consider risks from natural hazards early**
- 2. Protect vulnerable people and assets**
- 3. Adopt an ‘all-hazards’ approach**
- 4. Involve the community in conversations about risk and values**
- 5. Plan for emergency response and evacuation**
- 6. Be information driven and evidence based**
- 7. Plan to build and rebuild for the future with a changing climate**
- 8. Understand the relationship between natural processes and natural hazards**

Each of these principles requires multi-disciplinary collaboration. Strategic planning calls for engagement and collective decision-making across state and local government, including risk and emergency managers and asset owners, to manage risk in communities.



Photography: Rosie Nicolai/NSW Department of Planning, Industry and Environment

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## Guiding principles for strategic planning

These guiding principles are intended to support plan-making authorities and other agencies involved in strategic land-use planning to make decisions that more effectively consider natural hazard risk to build sustainable hazard-resilient communities.

### 1. Be strategic and consider risk from natural hazards early

Adopt a risk management approach in identifying risks from natural hazards and how these may change in response to future development and climate change. Strategic land-use plans should address how to increase the resilience of communities under increased threat by considering the exposure and vulnerability of development to existing and likely future risk. Importantly, strategic plans should consider cumulative risk over the long term and address both new development and legacy issues associated with existing development as these have distinct considerations.

Councils and state government agencies already undertake valuable work in climate change risk assessment as well as coastal management, flooding and bushfire hazard management. Strategic planners must draw on this work and the expertise of hazard and emergency managers to help them prioritise their objectives. For example, protection of life and prioritising community wellbeing may be a fundamental objective in planning or renewal programs in a community. These plans can, in turn, inform investment, infrastructure and capital works planning such as councils' integrated planning and reporting framework under the NSW *Local Government Act 1993*. Consider establishing relationships with the local emergency management committees and bushfire management committees to determine how strategic planning and emergency management can integrate to build resilience in the communities.



By considering natural hazards early, we can plan our settlements to avoid unacceptable natural hazard risk. Being informed about natural hazards can limit inappropriate development in areas due to natural hazard constraints. Having a good understanding of existing natural hazard risks also helps planners anticipate where new development will likely increase risks to existing development, the community or its emergency response capability. This may mean, in some cases, avoiding increasing or intensifying development in areas of known hazards. Redevelopment also provides some ability to limit the growth in risks or potentially mitigate existing risk in the long term.

Consider hazards, exposure and vulnerability and the affects that climate change could have on these aspects. Climate change has the potential to increase the frequency of hazards, create greater exposure and increase vulnerability to the impacts. Weather patterns such as the El Niño–Southern Oscillation, The Indian Ocean Dipole and The Southern Annular Mode can also impact frequency and longevity of risk to natural hazard over different time periods. Furthermore, these risks could change over time as assets also age.

## Key considerations

- Are all relevant natural hazards identified in regional and district plans?
- Are all relevant hazards identified at the regional scale captured by local strategic planning statements with the appropriate level of detail that reflects the local context?
- Do strategic land-use plans appropriately reflect the best available natural hazard information including hazard studies and risk management plans?
- Have any gaps in natural hazard information been identified? Has filling these gaps been prioritised, especially for areas likely to be impacted by natural hazards and that have development or redevelopment plans?
- Do development controls and guidance provided in the relevant local environmental plan and development control plans need to be amended to address relevant natural hazard risks, build resilience and reflect the outcomes of strategic planning processes?

## Case study: Greening our city Premier's priority (to plant one million trees by 2022)

Enhanced tree canopy helps store greenhouse gases and reduce urban heat effects by creating shade. While some areas of Greater Sydney, such as Hornsby local government area, have tree canopy cover greater than 50%, other areas have far less (Fairfield has just 13%).

In 2018, the Department announced the Five Million Trees for Greater Sydney program with the aim to plant 5 million trees by 2030. In 2019, the Premier nominated the planting of one million of the 5 million trees by 2022 as part of the 'Greening our city' Premier's priority. This program aims to increase canopy cover across Greater Sydney to 40% by 2036 (Objective 30 of the Greater Sydney Region Plan). The Department's Greening our City Grant has already awarded \$9.9 million to 28 projects across 23 local government areas in the 2021 allocation.

Trees can represent a bushfire risk and there is a risk from tree fall during severe storm events.

Strategic planning activities pose unique opportunities and challenges. New tree plantings could be done in those areas of the local government area most vulnerable to heat waves to mitigate against this hazard. Conversely, by greening an urban area, new tree plantings could compromise an existing fire break or impact on critical infrastructure such as a power facility.



Prioritising breadth of collaboration with subject matter experts at the early stage of planning will help ensure you consider all aspects of risk. Public agencies such as the NSW Rural Fire Service and the NSW National Parks and Wildlife Service can provide advice on the risks and management considerations of increasing tree canopy coverage. Councils can also consult existing published materials, for example, *Planning for Bushfire Protection* (NSW RFS, 2019).



Photography: NSW Department of Planning, Industry and Environment

## 2. Protect vulnerable people and assets

Risk from natural hazards is determined by a community's level of exposure and vulnerability to current and likely future hazards. Strategic planning, together with other risk treatment options, can support more resilient communities by identifying and delivering the physical infrastructure and socio-economic support systems that help to reduce the community's vulnerability to current and future hazards.

A person's vulnerability is influenced by a range of social and physical factors. These include age, gender, income group, disability, isolation, cultural and language differences as well as access to social safety nets, which greatly affect a person's ability to anticipate, prevent and mitigate risks. We need to plan for transient and ageing populations as well as populations for whom English is a second language. When preparing strategic land-use plans, you should consider whether trends, such as population growth and climate change, will influence the exposure and vulnerability of a settlement over time and what new considerations or measures this might give rise to.

Vulnerability is a highly complex concept that has a high level of variability between communities over time. It can be different for families, businesses, the self-employed, students and a range of other groups within communities. Understand the social vulnerability in your community to effectively plan for hazard risk now and into the future. Socio-Economic Indexes for Areas (SEIFA) is a product developed by the Australian Bureau of Statistics that ranks areas in Australia according to relative socio-economic advantage and disadvantage. The index can be used to identify areas in a community that may have certain aspects of vulnerability.

Strategic land-use plans should also identify vulnerable infrastructure assets and consider how they can be protected. Plans should consider whether there is, or will be, adequate essential infrastructure, such as roads, water, energy, telecommunications, waste management and evacuation capacity, to serve both existing and planned future settlements.

Strategic planners should undertake this analysis in collaboration with lead agencies for relevant hazards, asset owners, and other responsible agencies and consider their advice on hazard information and risk management plans. Discussions should factor in a range of scenarios, such as considering what would happen if multiple, concurrent or consequent natural disaster events were to occur (see also guiding principle 3).

By considering all the elements of vulnerability, we are increasing the community's physical and economic resilience over time.

## Key considerations

A vulnerable community is one that is susceptible to the impacts of a hazard based on physical, social, economic and environmental factors. Communities of greater vulnerability may have one or more of the following characteristics:

- changes in population
- significant numbers of older or young persons
- lower socio-economic groups
- are regional or remote from emergency services
- people with mobility issues
- people with language barriers
- isolation during and after a hazard event
- infrastructure located in areas of high risk or that will fail/must cease operating when an event occurs.

These communities need detailed analysis and planning to identify ways to increase their resilience to hazard events. Make sure you consider all the factors.

### **Case study: Challenges for vulnerable communities and assets during the 2019–20 'black summer' bushfires**

During the black summer bushfires, areas of NSW's south coast became isolated for periods up to 3 weeks due to the closure of the Princes and Kings highways.

Road closures prevented people from evacuating dangerous areas, left tourists displaced, and locals isolated. The closures also put pressure on supplies of fuel and food. Some businesses closed as they were unable to restock, contributing to distress in the community. People could not get

essential supplies. Woolworths in Bermagui, for example, was closed between 2 and 7 January due to resupply challenges and power outages.

Lessons from past events can help plan-making authorities identify vulnerable assets and communities and plan for risk reduction. Key road corridors, for example, can be upgraded to a higher standard of resilience so they are able to remain open or be cleared and reopened more quickly to enable more efficient evacuation and transportation of essential services and supplies. Likewise, community bushfire shelters could be placed in strategic parts of the local government area, such as in areas of socio-economic disadvantage, where vulnerable people face barriers to evacuation, including language barriers and mobility issues.

Urban planning policy and landscape design principles and practices can be leveraged to create buffers between flammable areas and urban zones. This coupled with bushfire risk modelling can identify the most suitable places to build.

Applying these principles and practices strengthens resilience to natural hazards and mediates the risks posed to vulnerable communities.



*Photography: Ian Dicker/NSW Department of Planning, Industry and Environment*



### 3. Adopt an 'all-hazards' approach

An all-hazards approach to land-use planning requires careful consideration of all hazards when developing strategic land-use plans in collaboration with relevant natural hazard and emergency managers. It also involves using the best available hazard information, which may come from a range of sources and should incorporate both natural and human made hazards.

NSW emergency management arrangements commit to an all-hazards, all-agencies approach that includes coordination and information sharing across prevention, preparation, response and recovery phases. The all-hazards approach is based on the principle that operational systems and methods that work for one hazard are likely to be effective for others. However, it does not prevent the development of specific plans and arrangements for hazards that require specialised approaches.

Planning authorities must consider the risks of each relevant natural hazard on its own, as well as combined with relevant coincident events. Authorities should also consider compounding and cascading events.

An example of a coincident extreme event includes a storm event that generates both a storm surge and heavy rainfall leading to flooding. The storm event is worse than if no storm surge was present.

Compound extreme events can describe combinations of extremes of varying duration, such as a drought period intersecting with a prolonged heatwave or record high daily temperatures – an occurrence that typically results in large impacts on agriculture, human health, fire weather and infrastructure.

An example of cascading events is an earthquake that triggers a tsunami or a landslide.

Weather patterns such as the El Niño and La Nina can also contribute to such events.

We encourage plan-makers to consider other known hazards beyond natural hazards, including things that may become hazardous following a natural disaster event such as large energy storage systems, critical or sensitive infrastructure, or buildings containing asbestos. Consider other hazards caused by natural hazard events, such as air pollution, water and soil contamination. Considering all these factors will help ensure risk assessment and mitigation strategies are adequate and can aid in planning the recovery process (see also guiding principle 7).

Strategic planners should consider both the likelihood and consequences of the full range of natural hazard events to ensure the strategic planning response is proportionate. Where there are multiple hazards, and where mitigation measures may help one and exacerbate another, planners should determine the appropriate balance of risk from each. Strategic planning does not aim to eliminate all risk to the community – this is not always possible or practical, particularly for existing settlements. Rather, sound planning seeks to understand and account for community and infrastructure vulnerability and minimise the consequences of natural hazards.

## Key considerations

- What are the natural hazards relevant to my local government area?
- What areas do the natural hazards affect and how do these effects vary?
- What are the likely consequences of coincident, compound or cascading events?
- Would a settlement, its physical infrastructure and its formal and informal socio-economic supports withstand such an event? What contingencies need to be put in place?
- How will climate change influence existing natural hazard risk over time?
- Has the interaction of risk from natural and other known hazards been considered and/or mapped to ensure strategic planning considerations are adequate?
- Do strategic plans respond proportionately to the likelihood and consequences of hazards?

## Case Study: Impact of coincident natural hazards on energy security in NSW

The Australian Energy Market Operator (AEMO) now identifies climatic conditions as the most important input into forecasting demand and supply of electricity generation.

NSW electricity demand peaks in the summer months as households switch on air conditioners to cool their homes. Hot temperatures trigger an increased demand for power but also impact supply as generators, power lines, and transformers fail or operate at suboptimal levels. In the context of a warming climate and increased frequency of extreme heat events, NSW's electricity network is under pressure and the risk from extreme demand peaks or equipment failure is heightened.

Other climatic events such as bushfires, lightning strikes and high winds can also directly impact generators and transmission networks as well as limit the transmission network power transfer capability. Drought increases the likelihood and severity of dust storms, generating dust particles that impact the operation of photovoltaic solar systems and transmission lines. Drought can also lead to shortages of water, which impacts the output of hydro generation. Hydroelectricity relies on water for fuel. Thermal electricity also uses water in cooling.

All this can lead to heightened risk of load shedding events, where AEMO directs power companies to switch off customers' power supply to protect the system.

An all-hazards approach to strategic planning can help identify the natural hazard risks to a local government area and possible mitigation options. For example, placement of sea walls, flood banks, or protection of natural assets such as mangroves, can mitigate against flood risk. Likewise, urban greening programs and good urban design strategies such as green walls and roofs can help protect against the heat island effect.

Energy assets can be protected using measures such as reinforcing above-ground poles to protect against bushfire and strong winds, burying transmission and distribution lines underground in key areas, and using landscape features to provide natural protection from hazards for energy infrastructure.



Photography: Salty Dingo/NSW Department of Planning, Industry and Environment

#### 4. Involve the community in conversations about risk and values

Risk preferences are inherently local as it is the local community who will bear the risk in the long term. Making difficult decisions can either paralyse a community or create the collective will to create change (see also 'Acceptable risk' in part 2). The ability to provide a series of data-driven facts and to create an environment in which discussion of these facts and their consequences can take place makes change more likely (see also guiding principle 6).

Planning authorities need to regularly engage residents, businesses, healthcare professionals, community services, community leaders, educational institutions, and other relevant stakeholders in strategic planning and how it relates to natural hazard risk. This develops a community's civic engagement and facilitates better informed community discussions and a partnership approach to decisions about acceptable risk, community values, building resilience and shaping future settlement patterns.

Managing risk is the responsibility of everyone, including individuals. We need to avoid creating expectations for development that is not suited to current or future natural hazards, or that will create legacy issues for future generations. You need to communicate this message through engagement with the public so that individuals can prepare their own properties and improve their resilience in contributing to their overall community responsibility.

Strategic planning decisions should be transparent in how they incorporate natural disaster risk identified through hazard studies and risk management plans and including advice received from combat agencies and lead agencies for relevant hazards. The NSW Emergency Risk Management Framework establishes procedures to consider hazards at the state, regional and local level. This is

documented in emergency management plans covering prevention, preparedness, response and recovery. Use these documents when preparing strategic plans.

The strategic planning processes should apply a consistent risk management framework. You should set out how you will address trade-offs between managing natural disaster risks and other competing objectives. The process should reflect a clear understanding of community values and the degree of risk acceptable to the community.

Involve residents and other community partners in planning for natural hazards such as where to build, what to build and how to build. Include matters the community values and discuss how to protect what is critical to the functioning of the community. While what people see as critical can vary across communities, infrastructure such as telecommunications, power, water, sewerage treatment plants, roads and bridges are areas most communities' value. Other matters of value to communities may include environmental or cultural assets, economy-stimulating businesses or community facilities.

Protecting human life is the key priority, with critical infrastructure and other assets following. This hierarchy of value can help inform the values within a community and how they priorities risk mitigation measures.

The process of determining risk priorities should be a continuation of community engagement by hazard and emergency managers as they develop risk management procedures and plans. Clearly communicate the link between hazard studies, risk management plans, and strategic land-use plans to the community.

## Key considerations

- Has local knowledge about impacts from natural hazards, including learnings from past events, been captured, especially in communities that face unique challenges such as remoteness?
- Have local Aboriginal groups been consulted regarding Indigenous knowledge systems and land management practices?
- Have partnerships been established to promote regional-scale coordination for natural hazard risks and infrastructure networks that are regional in scope?
- Have natural hazard risks that may originate in other jurisdictions or cross local government boundaries been considered, such as flooding flow-on impacts or bushfire paths?
- Have combat agencies including Ambulance NSW, Fire and Rescue NSW, NSW Police Force, NSW Rural Fire Service, NSW State Emergency Service as well as natural hazard lead agencies been consistently involved in land-use planning to ensure collective decision making that considers the best available natural hazard information?
- Have key stakeholders such as community organisations, business enterprise and vulnerable groups been engaged and accounted for?
- Have key decision-makers, particularly elected representatives of councils, been adequately and accurately informed and briefed throughout the strategic planning process?

## Case Study: West Dapto Vision

West Dapto, within Wollongong local government area, is the fastest-growing residential area in NSW outside the Sydney metropolitan region. Around 56,500 people and 19,500 homes are expected in the coming decades. Wollongong Council is undertaking strategic planning for the area,



including setting planning controls, approving development and designing new infrastructure such as roads, sports facilities, public spaces and stormwater structures.

The West Dapto Vision (Wollongong City Council, 2018) represents the council's long-term strategy for the area and has been informed by extensive community consultation. The plan builds on its 2008 predecessor, bringing forward lessons learned including updated modelling data. The West Dapto Vision will feed into all planning decisions such as rezoning proposals, development applications, and amendments to the local environmental plan.

Stormwater and floodplain hazard management represents a key component of the plan. Ten guiding principles form the water management vision. These include integrating stormwater with the natural environment and preserving floodplain function and natural corridors.



*Photography: Don Fuchs/NSW Department of Planning, Industry and Environment*

In the West Dapto Vision, council has used the strategic planning process to plan for certain natural hazard events (such as floods) by identifying riparian corridors and using green infrastructure to mitigate risk. The plan aims to integrate floodplain and stormwater management into every aspect of the planning process, including urban design. Identifying suitable areas on which to build and considering natural hazards through strategic placement of infrastructure such as bridges that have the potential for flood cuts, represent a strategic planning approach to natural hazards management. This early identification ensures the road connection will be unaffected by flooding events up to and including the 1% annual exceedance probability.

Further, a 4-phase approach to engagement, guided by a community engagement and communications strategy, ensured the views and knowledge of key subject matter experts and decision makers (such as Transport for NSW) and community members were incorporated.

## 5. Consider emergency response and evacuation

The elimination of all-natural hazard risk from our communities is rarely, if ever, possible, particularly in existing settlements. Strategic land-use plans must consider emergency responses including evacuation. This serves to prioritise the protection of life and minimises demands on emergency responders. It also reduces the complexity of the emergency response to ensure combat agency personnel are not placed at avoidable risk.

For example, if the community has several transportation pinch points that make an emergency response difficult under ideal conditions, the plan needs to consider the implications to the population if these existing pinch points are put under additional pressure during a disaster event. The council could consider identifying potential alternate routes to strengthen the road network.

Evacuation needs are addressed in emergency management planning via the lead agency or, where relevant, the local emergency management committee. Evacuation needs may be different for different hazards as they affect areas in different ways and may have substantially different response times. The combat agency is responsible for the emergency management strategy including evacuation.

Planning authorities should prepare strategic land-use plans in consultation with the relevant local emergency management committees and consider evacuation routes that take into account vulnerable communities, seasonal changes in population density, location of evacuation centres and other community facilities that can be mobilised following a disaster event to assist with the recovery process.

The location of key community infrastructure such as power supplies, communication centres, emergency response headquarters and evacuation centres may also require additional protection. This needs to be carefully considered in terms of the asset's accessibility, servicing, and proximity to high-risk areas to ensure that they are fit for purpose in emergency response and recovery. We encouraged land-use planners to establish relationships with their representatives on their local emergency management committee to better understand key considerations and ways land-use planning can alleviate pressure through strategic plans.

### Key considerations

- Have long-term population trends such as increases in populations of the very young, elderly or those with language barriers been considered?
- Have shorter-term changes such as seasonal traffic flows and transient populations like itinerant workforces and tourists been considered?
- Has the location of evacuation centres and other key community infrastructure been considered?
- Are there pockets of increased density or intensity of development that may require specific evaluation planning?
- Is more than one transit route provided in different directions to ensure people do not become trapped in a locality?
- Is the road capacity able to handle the amount of traffic generated during an evacuation of proposed and existing development in the locality?



## Case Study: Wilton 2040 Plan

In 2018 the Department released the Wilton 2040 Plan to outline how the area was going to sustainably grow as a community over the next 20 to 30 years. Wilton growth area is proposed to accommodate 15,000 homes to accommodate 40,000 residents, 15,000 local jobs and supported by a range of community infrastructure.

Wilton is flanked by national park to the south and east with smaller valleys of bushland along the creek and river system. Future new urban areas of Wilton adjoining conservation areas require additional planning of appropriate evacuation routes for future residents in case of bushfire emergency.

As part of the master planning, the Department, the NSW RFS, RMS and Wollondilly Shire Council are working together with consultants to develop an Evacuation and Access Study that will help identify and mitigate risk for evacuation of the area through the different stages of development. This study will ensure the road network can accommodate appropriate evacuation volumes, and that road network and bushfire defences are adequate for the population proposed at all stages over the next 30 years. It will also identify suitable facilities that could become safe refuges in the event of an emergency. This forward thinking and multiagency approach supports Wilton developing as a resilient community and responds to the hazards that pose a risk.



*Photography: NSW Department of Planning, Industry and Environment*

## 6. Be information driven and evidence based

Using and sharing high-quality data, evidence and information is a prerequisite for incorporating natural hazard risk into strategic planning and, ultimately, good planning outcomes. Examples include natural hazard risk and settlement vulnerability mapping in land-use planning decision-making and analysis of previous natural disaster events.

Strategic land-use plans informed by the best available natural hazard information and multi-disciplinary expert advice can also identify information gaps that a council (and consent authorities)

needs to address to inform future planning decisions. This may include economic and social impact modelling for natural hazard events and evaluation of critical infrastructure exposure to natural hazards.

Governments at all levels must prioritise making critical information easily understandable and readily accessible on multiple platforms before, during, and after an event. Accurate mapping of hazards for all areas of the impact zone provides more detailed information on the risk of both current and future hazards. Councils should use climate change data including information on representative concentration pathways to determine the future risk to natural hazards.

We have provided links to appropriate resources in the resource kit to assist in accessing the latest available data.

Hazard mapping products and data sets need to be updated regularly and be available in easily accessible formats. Community risk and vulnerability profiles are subject to change not only seasonally but for a range of other socio-economic factors over time. Coastal settlements, for example, are susceptible to an influx of tourists and the uncertain impacts of climate change. In the southern highlands and southern inland forests, the combined impacts of heat, drought, water security, narrow economic focus and changing community resources lead to a constantly evolving risk profile, with a particularly pronounced bushfire risk.

Plan-making authorities should keep their strategic plans current through periodic evaluations and reviews. When new data becomes available, strategic planners should consider how this data informs strategic land-use plans and triggers specific decisions. For example, data may inform an assessment of long-term viability of certain infrastructure, which may need to be reinforced or relocated in the future. The trigger may be when sea level rise achieves a certain height.

We encourage strategic planners to consider and address the potential impacts of development or hazard behaviour in one local government area on another. Where this potential exists, councils should collaborate to ensure they effectively understand the natural hazard risks and development impacts and consider them in a coordinated way across council boundaries.

## Key considerations

- Has all relevant hazard information, including hazard studies, risk management studies and risk management plans, been considered?
- Are hazards identified in a relevant environmental planning instrument or development control plan?
- Were the relevant hazard, risk and vulnerability studies prepared by an appropriately qualified expert?
- Has historical data been used?
- Has any relevant scientific modelling, such as relating to sea level rise and climate variability, been published?
- What is the advice for best-practice principles such as those identified in the resource kit?
- Have you considered Aboriginal knowledge systems and land management practices?

## Case study: Urban heat in Parramatta local government area

The Greater Sydney region is recording an increasing number of days reaching temperatures of 35 °C and over.

The City of Parramatta identified urban heat as a key priority in its *Environmental Sustainability Strategy 2017*. The council aims to improve liveability by cooling the city and protecting its people and communities from heat stress.

Council's Heat Vulnerability Index guides the protection of established tree canopy via the *City of Parramatta Local Strategic Planning Statement 2020* and has also informed council's contribution to projects seeking to improve water quality and make Parramatta River swimmable.

Council also has prepared city heat maps to provide its community with accessible data illustrating how the urban heat island effect impacts their local area throughout the day.



Photography: Salty Dingo/NSW Department of Planning, Industry and Environment

## 7. Plan to build and rebuild for a future with a changing climate

We must look at how we prepare for natural hazards by building to the most up-to-date standards and building regulations. We need to build resilience into our buildings and structures. When building new assets or replacement assets, look at building better or in more appropriate locations that will result in less risk and more resilience for the life of the asset.

When a natural disaster event results in significant impacts on the community, and there is a need to rebuild, we must consider how we can do this appropriately. There is an understandable desire to rebuild in place as quickly as possible following a disaster event. However, this is not always in the long-term interest of a community or region where an existing hazard is likely to recur or intensify over time.



The protection of life is a fundamental objective of land-use planning. The goal of an all-hazards planning process in preparation for and in the aftermath of an event is to enhance community resilience. Strategic land-use plans should provide for recovery in a way that enhances future resilience and does not simply replace what existed unless there are overarching safety or economic considerations that necessitate this approach.

For example, to prevent or mitigate the effects of any future disasters, strategic plans can identify where communities would need to be built to contemporary and more resilient standards. This could also factor in the lifespan of the developments that will occur in these areas and the likely impacts the areas will experience during that time.

Consider climate projections and the latest forward thinking on natural processes. For example, flood levels may change over time, revegetation could occur that will alter the local circumstances, and more development could cause heat island impacts. You need to consider all these matters in the development of strategic plans.

Whether councils should mitigate these risks will depend on the exposure of the community, the scale of impacts and their frequency of occurrence. Significant investment in this work may not be warranted in some communities. Relevant risk management processes for specific natural hazards may identify appropriate, practical and feasible mitigation actions that can address risk at the location and allow building and rebuilding to occur to more contemporary building standards. However, where natural hazard risk assessment identifies areas where structures may be destroyed in a disaster event and should not be rebuilt as the risks cannot be effectively managed, it may be appropriate to reflect this in strategic land-use plans by identifying areas where strategic retreat options should be considered.

Before disaster strikes, strategic planning at the local level should use information from hazard studies to identify areas of existing development that may become increasingly exposed or vulnerable to natural hazards over time and increasingly exposed to unacceptable levels of risk. Approaches to recovery will require effective and extensive community consultation, dovetailed with other community plans, that can rapidly be implemented after an event.

Ultimately, this may result in a move away from existing development patterns, changes or upgrades to infrastructure, financial and other support, and long-term resettlement visions for the community.

Consider the recovery phase and the capacity of waste infrastructure to support clean-up efforts. Strategic planners can play a part in promoting disaster recovery that enhances long-term community resilience. Planners can work with the community to learn from disaster events and encourage community participation in strategies for building back better with avoidance and risk mitigation measures in mind.

## Key considerations

- Ask the key questions:
  - How do we adapt to reoccurring events?
  - What lessons have we identified from previous events?
  - How do we recover better, stronger and more resilient from events so that the next and subsequent events are less disruptive and damaging?

- Have you identified the anticipated risks and systematically scoped out land-use planning issues that will likely need to be rectified after the disaster, identifying recovery options?
- Have you used the expertise of any lead natural hazard management agencies and disaster recover agencies to help inform future options?
- Have you actively involved the community and considered local intelligence to develop post-disaster settlement recovery options and inform future land-use planning directions?
- Were any reviews of land-use and building policy/regulation conducted following an event to identify areas that need improvement or redress?

### **Case Study: Tweed Shire Industry Central Land Swap project**

Following unprecedented floods cause by ex-tropical Cyclone Debbie in 2017, Tweed Shire Council established the Industry Central Land Swap project to assist businesses located within the high-risk flood zone of the South Murwillumbah industrial precinct to relocate to a council-owned site located above the 1-in-100-year flood level.

Under the deal, council will prepare the site for development including subdivision and infrastructure works such as roads, water and sewer. Landowners were invited to enter an expression of interest and, if successful, would have up to 10 years to relocate.

Infrastructure and buildings on vacated properties will in most cases be removed. Those allotments would be rezoned to allow for public open space or other community purposes. By removing impediments from the floodplain, impacts from future flood events will be reduced.

This was a strategic solution to mitigate against natural hazard risk and create resilience for local businesses and the broader economy.

This kind of strategic planning approach represents an opportunity to future-proof a community. If a council has identified a need to take action to protect an area from flood risk, it could be worth over-engineering a response to account for climate change.



*Photography: Don Fuchs/NSW Department of Planning, Industry and Environment*



## 8. Understand the relationship between natural processes and natural hazards

Development doesn't exist in a vacuum, so it's important to understand the environmental context in which our settlements exist or may exist in the future.

Many environmental assets and natural processes have a beneficial impact on settlements and communities. Coastal communities, for example, benefit socially and economically from their proximity to beaches and their dramatic and dynamic oceanic processes. We can help coastal communities mitigate some of the risks associated with development in coastal areas by, for example, protecting vegetated beach dune systems. Coastal dunes help to provide a buffer against coastal hazards such as wind erosion, wave overtopping and inundation during storm events. They also provide a source of sand to replenish the beach during periods of erosion caused by salt and sand-laden winds.

Flood can have a devastating impact on communities. But floods are natural processes and different areas of a floodplain provide many beneficial functions. Some areas convey and store floodwater during flood events. Siting development in areas away from important flood functions and considering the other constraints that flooding can place on land in strategic land-use planning decisions can make our settlements more resilient to the impacts of flood.

Floods also provide water to flood dependent ecosystems and recharge surface and ground water supplies that support the environment, settlements, agriculture and recreational uses. Floods also prompt significant biodiversity events, such as bird migration and breeding. They also attract tourism to a region after the flood waters have started to subside.

Understanding flood behaviour helps us to build more flood-resilient communities. For example, by protecting the environmental assets (i.e. green infrastructure) that act as natural sinks for floodwaters such as wetlands and riparian corridors, using soft engineering approaches, restoring riparian areas and siting development in areas least susceptible to flood impacts, we can make our settlements more resilient to the impacts of flood.

Strategic planning can increase the resilience of communities and the environment by giving green infrastructure equal status with the built environment, and better integrating the two. An example of this is including tree canopy, green roofs and green walls on new residential developments to cool development and increase resilience to heatwaves. The NSW Government Architect's [Greener Places](#) design framework provides relevant guidance:

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'Well-designed green infrastructure connects vital life support systems for urban environments. It needs to connect with other elements of a well-designed built environment created through urban design processes, involving a range of disciplines from architecture, urban planning, and landscape architecture.'

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Strategic planning can improve our resilience to natural hazard risks through decisions that are supported by an understanding of the social, economic and environmental value of our natural assets and the associated natural processes that do or could occur. By understanding natural processes and natural hazards we can anticipate how new development will be exposed to natural hazards.

Strategic planning should also be advised by Aboriginal knowledge of Country. Aboriginal people across the state maintain a continuing connection to Land and Sea Country, and a deep understanding of the many natural processes that may impact our settlements and how this can be managed. By working with the knowledge of our Traditional Custodians, we can better understand the natural conditions of a place and ensure that development is well-adapted to these conditions.

## Key considerations

- Is the relationship between biophysical features, environmental assets and ‘green infrastructure’ in the landscape, and the natural processes they support, understood?
- Has a holistic view of what social, economic and environmental risks and opportunities may arise from natural processes that occur in the area been adopted?
- Have opportunities to improve resilience by better accommodating natural processes, especially if the landscape has been disturbed in the past, been identified?
- What lessons from past events can help to better account for the natural processes becoming natural hazard risks or disasters in strategic planning?
- Has the integration of green infrastructure with the built environment been prioritised to enhance community and environmental resilience?
- Have Aboriginal knowledge systems and land management practices been considered?

## Case study: Sydney Water

Sydney Water is Sydney’s water supply authority, and it also provides sewerage and drainage systems and services. With such an extensive water management network, there is significant opportunity to create a well-designed network of green infrastructure to guard against flood risk.

Sydney Water’s infrastructure assets include concrete lined stormwater drainage channels and canals spread across a highly urbanised environment. Stormwater infrastructure is a critical part of an overall natural hazard risk management matrix. For example, properly planned and maintained stormwater assets builds resilience against flooding events.

These assets are built into the topography of the landscape, located in areas where water naturally runs. Sydney Water has taken a ‘green infrastructure’ approach when these channels need to be repaired. It has identified that it can achieve better social and environmental outcomes through ‘naturalising’ those assets using natural-looking banks made of rocks and native plants. The project also offers the opportunity to improve public access to those waterways by incorporating bike tracks, footpaths and seating areas.

Channel or canal naturalisation involves the conversion of drainage channels to look more natural and to function more like a natural waterway. In addition to providing recreational amenity and scenic values, naturalised channels with appropriate buffers can improve the ecology of the waterway and mitigate the effects of flood by improving the capacity of the waterway to absorb

water and to slow the flow of storm and flood waters. To date Sydney Water has completed 3.45 kilometres to naturalise banks with a further 7.3 kilometres identified over the next 10 years.



*Photography: Tim Riding/NSW Department of Planning, Industry and Environment*

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# Appendices





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## Appendix A – Background to this guide

### The need for guidance

Throughout much of 2019, NSW experienced prolonged and widespread drought conditions, with 99.9% of the state in drought and up to 54.2% categorised as in ‘intense drought’<sup>9</sup>. During the 2019–20 bushfire season, the Premier announced 3 consecutive states of emergency citing ‘the most devastating bushfire season in living memory’<sup>10</sup>. Now is a time to reflect on how strategic land-use planning can contribute to our resilience to natural hazard risk.

Further, planning for new settlements to accommodate population growth requires informed strategic planning decisions to minimise impacts from future natural disasters. This is especially important in coastal areas, floodplains and bushland areas. People, buildings and infrastructure (and the environment, communities and economies they live in) in these areas will be increasingly exposed to risk. Some of our most disadvantaged communities are already located in at-risk areas.

The social, economic and environmental costs associated with natural disasters are high and increasing. In addition to evident loss of life or property, economic disruption and environmental impacts, disaster events also have ‘intangible’ costs. These include increased family violence, mental health impacts, chronic disease, alcohol and drug use, short and long-term unemployment, changes to school academic outcomes, and crime<sup>11</sup>. Access to insurance is also a critical factor in property owners’ financial ability to support their own recovery.

### Natural processes and natural hazards

Natural processes exist in or are produced by nature (rather than by human beings). Natural processes are vital to our environment and have shaped the NSW landscape.

Many of our natural ecosystems have evolved with fire and several of Australia's native plant species such as banksias depend on bushfires to regenerate. Bushfire clears the forest floor of excess vegetation and enriches it with ash, removing competition and enabling replacement plants to quickly regenerate.

Coastal erosion is another example of a natural process. Natural wave action transports material such as sand and rocks away from our shorelines and creates distinct habitats for shorebirds and marine life, as well as creating natural landmarks.

We derive many important benefits from natural processes. Photosynthesis removes carbon dioxide from the atmosphere and replaces it with oxygen. Flooding creates rich soils full of nutrients brought in by floodwaters.

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<sup>9</sup> DPI, 2019, Combined Drought Indicator, accessed 13 December 2019 at [edis.dpi.nsw.gov.au/](https://edis.dpi.nsw.gov.au/)

<sup>10</sup> NSW Government, 2020, Premier declared third State of Emergency, Media release, accessed 10 January at [nsw.gov.au/your-government/the-premier/media-releases-from-the-premier/premier-declares-third-state-of-emergency/](https://nsw.gov.au/your-government/the-premier/media-releases-from-the-premier/premier-declares-third-state-of-emergency/)

<sup>11</sup> Deloitte Access Economics, 2016, The economic cost of the social impact of natural disasters, accessed on 16 December 2019: [deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html](https://deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html)

Natural processes operate almost continually but we notice them most when they interact with a community that has become exposed or vulnerable to their operation. That is, when the natural process has the potential to affect lives or property and becomes a hazard.

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Natural hazards are ‘shocks caused by a natural process or phenomenon that may cause loss of life, injury, damage and disruption. Natural hazards include bushfires, floods, cyclones, storms, heatwaves, earthquakes and tsunamis<sup>12</sup>’.

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Natural hazards are distinct from anthropogenic or man-made hazards such as radiation leaks and oil spills.

## Natural hazards that are significant for NSW

Natural hazard risk is a concern in many areas across NSW. In the 10 years from 2009 to 2019, bushfires, floods, landslides and severe storms led to the declaration of 198 natural disasters in NSW<sup>13</sup>. Bushfires were the most frequently occurring natural disaster accounting for 121 declarations during this period.

In NSW, many communities have experienced disruption or disaster from natural events. Recent examples include the Hunter and Central Coast flood (2007), Hunter flood (2015), Western floods 2016, Cyclone Debbie (2017), and the 2019–20 bushfires (see further examples below).

NSW communities also face risks from coastal erosion, severe winds, and the potentially catastrophic impacts of earthquakes or tsunamis. Climate change is expected to compound the risks many communities face, especially those on floodplains and along low-lying coastal areas, as sea level and the intensity and frequency of severe storms increase. Prolonged droughts and heatwaves are also expected to become more frequent, driven by a changing climate.

The State Level Emergency Risk Assessment (SLERA) identified nine hazards that pose a significant risk to NSW, each receiving a risk rating of high to extreme. Drought has emerged as a stressor of growing significance for NSW following the Millennium Drought from 2001 to 2010, the present drought that began in mid-2017, and our changing climate.

These hazards and their definitions are summarised in Appendix B.

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<sup>12</sup> National Resilience Taskforce, 2018, National Disaster Risk Reduction Framework, accessed [www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf](http://www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf) on 16 December 2019

<sup>13</sup> OEM, 2019, Natural Disaster Declarations, accessed [www.emergency.nsw.gov.au/Pages/publications/natural-disaster-declarations/2019-2020.aspx](http://www.emergency.nsw.gov.au/Pages/publications/natural-disaster-declarations/2019-2020.aspx) on 16 December 2019

## Managing natural disaster risk

Risk management techniques can be used to reduce the impact of natural hazard risk and manage the consequences when disasters occur. The NSW Government adopts a risk-management approach and a broad risk-management hierarchy of avoidance, minimisation and mitigation consistent with ISO 31000:2018 Risk Management – Guidelines (International Organisation for Standards, 2018). Natural hazard risk management is the organisation and management of resources and responsibilities to reduce the harmful effects of all hazards.

Risk management is not just about responding to an emergency; it begins well before an emergency occurs and continues through to well after the emergency has passed. A comprehensive emergency management cycle comprises the following 4 phases<sup>14</sup>:

- **prevention** – eliminate or reduce the level of the risk or severity of emergencies. It includes identifying hazards, assessing threats to life and property and taking measures to reduce potential loss to life or property
- **preparation** – build the capacity of communities to cope with the consequences of emergencies. It includes arrangements or plans to deal with an emergency or the effects of an emergency
- **response** – ensure the immediate consequences of emergencies to communities are minimised. It includes the process of combating an emergency and providing immediate relief for persons affected by an emergency
- **recovery** – support individuals and communities affected by emergencies in reconstructing physical infrastructure and restoring physical, emotional, environmental and economic wellbeing. It includes the process of returning an affected community to its proper level of functioning after an emergency.

The interaction of the four phases are depicted in Figure 5 below.

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<sup>14</sup> Office of Emergency Management, Key Elements of Emergency Management, accessed at [www.emergency.nsw.gov.au/Pages/publications/guides-factsheets-brochures/emergency-management-arrangements/key-elements.aspx](http://www.emergency.nsw.gov.au/Pages/publications/guides-factsheets-brochures/emergency-management-arrangements/key-elements.aspx) on 14 January 20120

Figure 5. Emergency management cycle<sup>15</sup>



Actions that take place before and after a natural hazard event can significantly impact the scale of the crisis. Research and inquiry findings conclude that early consideration of natural hazards in decisions and investment in resilience – before disaster strikes – is many times more effective in reducing overall loss of life and property than continually responding to emergencies<sup>16</sup>. As identified by the 2014 Productivity Commission inquiry into Natural Disaster Funding (2014, p. 4):

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‘There is a longstanding concern that governments underinvest in mitigation and spend too much on recovery, leading to higher overall costs for the community.

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<sup>15</sup> Public Safety Canada, Emergency Management Planning Guide 2010–2011, accessed [www.publicsafety.gc.ca/cnt/rsrscs/pblctns/mrgnc-mngmnt-pnng/index-en.aspx](http://www.publicsafety.gc.ca/cnt/rsrscs/pblctns/mrgnc-mngmnt-pnng/index-en.aspx) on 15 January 2019

<sup>16</sup> Productivity Commission, 2014, Natural Disaster Funding Arrangements, Inquiry Report (74), Retrieved from Canberra: [www.pc.gov.au/inquiries/completed/disasterfunding/report/disaster-funding-volume1.pdf](http://www.pc.gov.au/inquiries/completed/disasterfunding/report/disaster-funding-volume1.pdf)

Furthermore, government responses to natural disasters can be ad hoc and emotionally and politically charged, resulting in reactive ‘policy on the run’ and inequitable and unsustainable outcomes.’

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This inquiry identified land-use planning as a potential policy lever for influencing the level of future natural disaster risk. To improve levels of resilience to disaster, we must change how we think and operate as strategic policy makers. This will require long-term behavioural change to recalibrate our ‘response and recovery’ mindset to one of ‘preparation and mitigation’<sup>17</sup>.

## Why planning for natural hazards is essential

Natural hazards are becoming more frequent and intense. Australia is the world’s driest inhabited continent and is considered one of the developed countries most vulnerable to global warming as natural hazards become more frequent and intense.

According to the Bureau of Meteorology and CSIRO, Australia’s climate has warmed by over one degree since 1910 leading to an increase in the frequency of extreme heat events<sup>18</sup>. Sea levels are also rising around Australia, increasing the risk of inundation. There has been a decline in April to October rainfall in the southeast of Australia of around 11% since the late 1990s with 17 of the last 20 April to October rainfall periods recording below-average rainfall. Over time, there has also been an increase in extreme fire weather and the length of the fire season across large parts of Australia (see Figure 5).

These changes affect many NSW communities, particularly those changes associated with increases in the frequency or intensity of heat events, bushfire risk and drought. It is predicted that these changes will continue while new natural hazard threats emerge and there is growing potential for cumulative or concurrent, large-scale natural hazards to occur. Our communities need to plan for and adapt to the impacts of climate change.

In NSW, the bushfire season has extended, starting earlier and finishing later. In November 2019, amid prolonged drought conditions, NSW Rural Fire Service issued a ‘catastrophic’ fire danger warning for greater Sydney for the first time since the introduction of the Forest Fire Danger Index (see Figure 6).

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<sup>17</sup> COAG, 2011, National Strategy for Disaster Resilience, accessed 8 January 2020 at [knowledge.aidr.org.au/media/2153/nationalstrategyfordisasterresilience.pdf](https://knowledge.aidr.org.au/media/2153/nationalstrategyfordisasterresilience.pdf)

<sup>18</sup> BOM and CSIRO, 2018, State of the Climate 2018, accessed [www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2018.pdf](http://www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2018.pdf) on 16 December 2019



Figure 6. Trends from 1978 to 2017 in the annual summary of the Forest Fire Danger Index

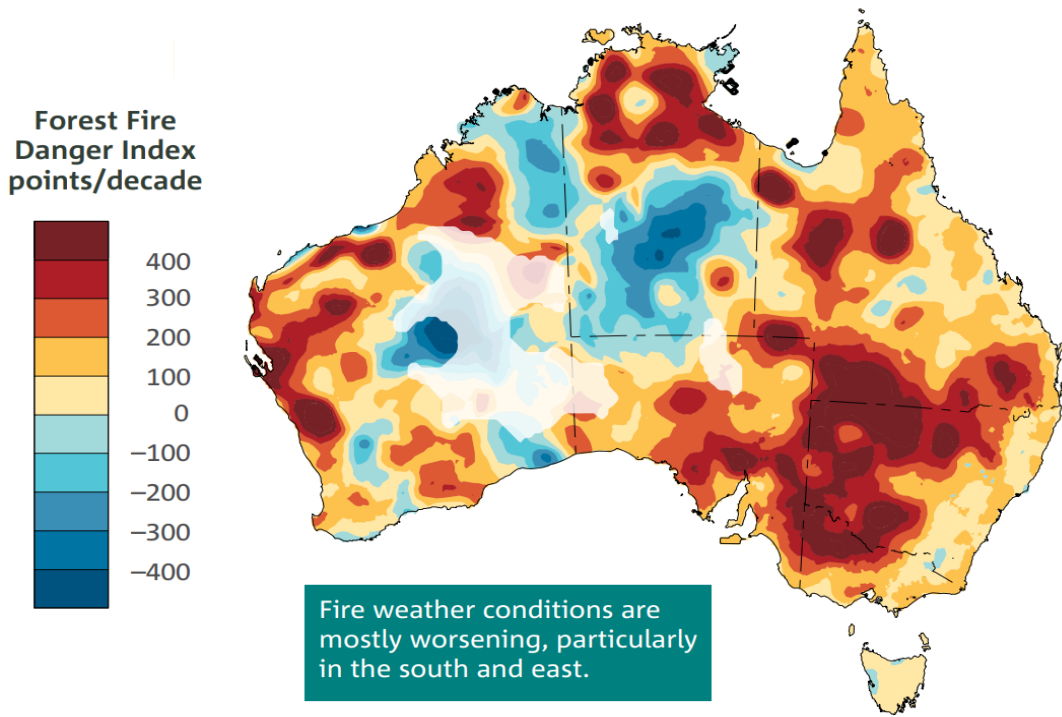
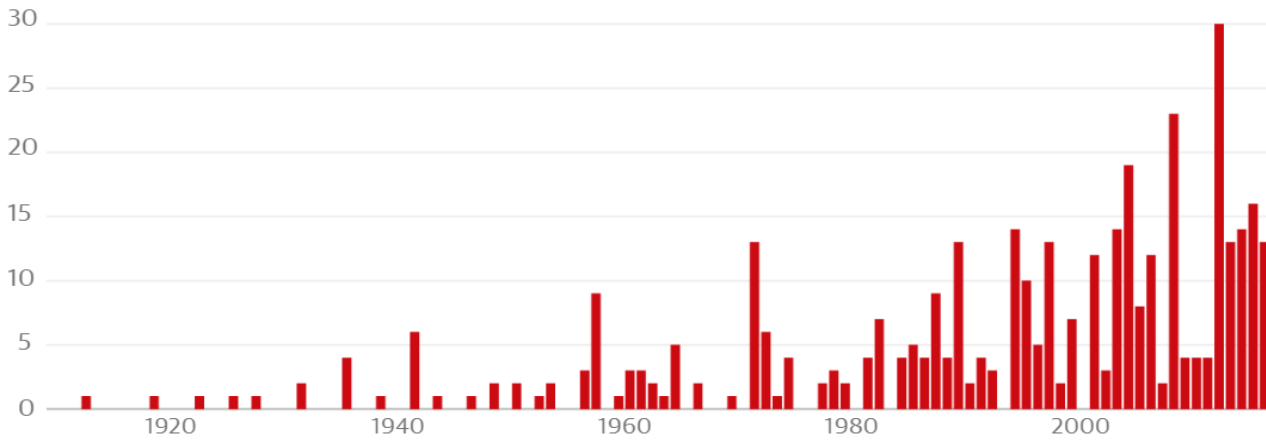


Figure 7. Number of days per year where the Australian area-averaged daily mean temperature is extreme, i.e. above the 99th percentile of each month from the years 1910 to 2017



The frequency of extreme heat events is increasing across Australia. Very high monthly maximum temperatures that occurred around 2% of the time in the past (1951 to 1980) now occur around 12% of the time (2003 to 2017). Similarly, very warm monthly night-time minimums that occurred around 2% of the time in the past (1951 to 1980) now occur around 12% of the time (2003 to 2017). This shift has occurred across all seasons, with the largest change in Spring and is depicted in Figure 7.

## Some populations are becoming more exposed to risk

The Department's 2019 population projections show that NSW will continue to grow, with the population increasing by 2.8 million to 10.6 million people by 2041<sup>19</sup>. The projections tell us people in NSW are living longer and Sydney will see more babies than ever before due to the number of potential mothers living in the city. These trends will lead to growth in our more vulnerable demographic groups who are more at risk when a disaster strikes, including the elderly, infants, and pregnant women.

Based on medium-level growth assumptions, the number of people aged 65 and over in NSW will increase by 70% from 2017 to 2066 while the number of people aged 85 and over will increase by 60%<sup>20</sup>. Importantly, there is growth in regional hubs with border and coastal regions emerging as retirement havens. As settlements expand into areas of higher natural hazard risk such as coastal zones, floodplains and bushland areas, buildings and infrastructure will be increasingly exposed to natural hazards.

In NSW, our overall standard of living has improved yet socioeconomic differences among communities remain and some of our most disadvantaged communities are in at-risk areas (see 8). This overlap of disadvantage and disaster declarations presents a challenge to communities, disaster managers and governments.

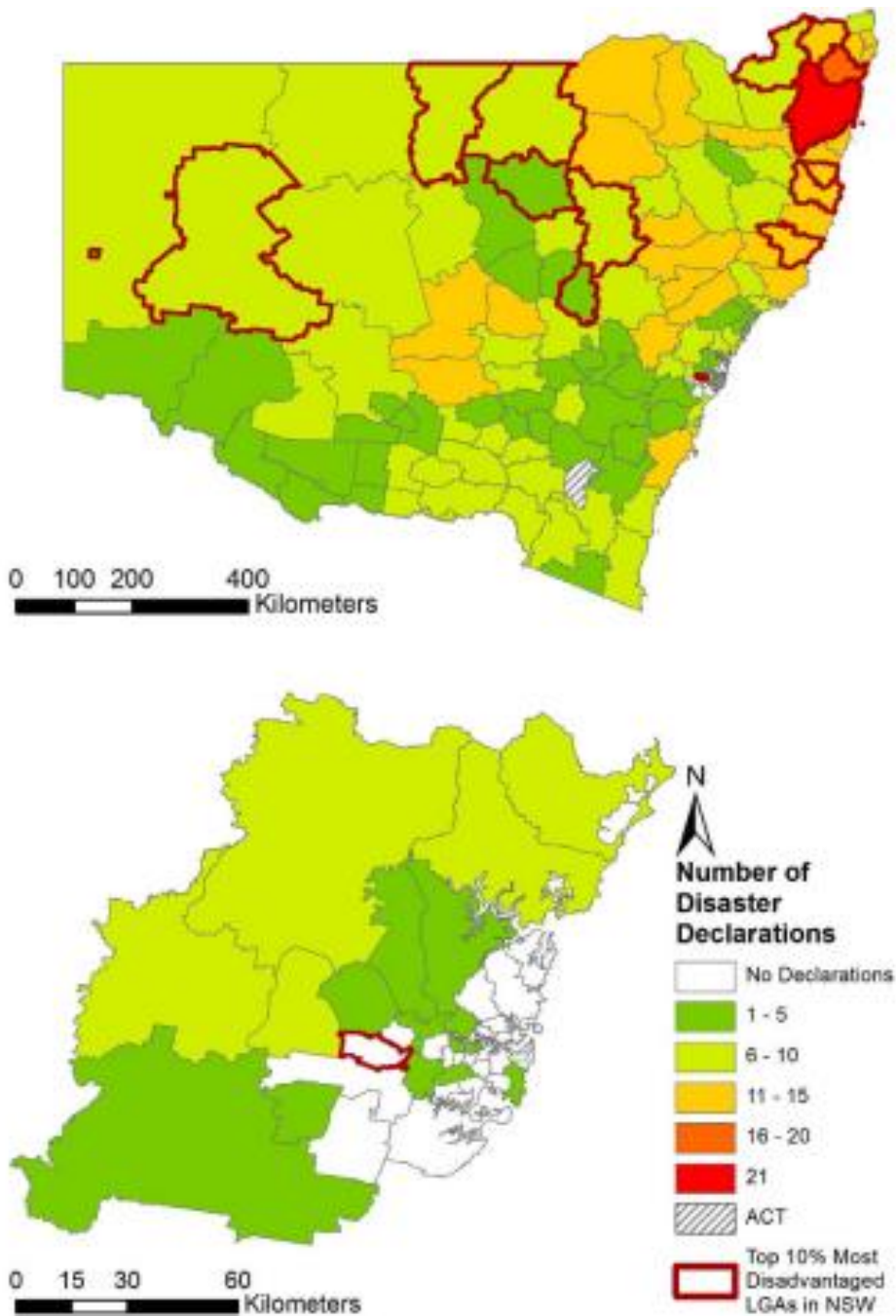
Analysis of natural disaster declarations in NSW in the period 2002 to 2014 identified northern NSW as a high proportion of declarations, which includes some of the state's most socio-economically disadvantaged communities (see Figure 8). Some 43% of the most disadvantaged local government areas in NSW were found in the NSW disaster declaration clustering.

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<sup>19</sup> DPIE, 2019, Population Projections, accessed <https://www.planning.nsw.gov.au/Research-and-Demography/Population-projections> on 16 December 2019

<sup>20</sup> ABS, 2017, 3222.0 - Population Projections, Australia, 2017 (base) - 2066: NSW, accessed at [www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/3222.0Main%20Features62017%20\(base\)%20-%202066?opendocument&tabname=Summary&prodno=3222.0&issue=2017%20\(base\)%20-%202066&num=&view=#](http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/3222.0Main%20Features62017%20(base)%20-%202066?opendocument&tabname=Summary&prodno=3222.0&issue=2017%20(base)%20-%202066&num=&view=#) on 17 December 2019

Figure 8. Total natural disaster declarations by local government area in the period 2002 to 2014



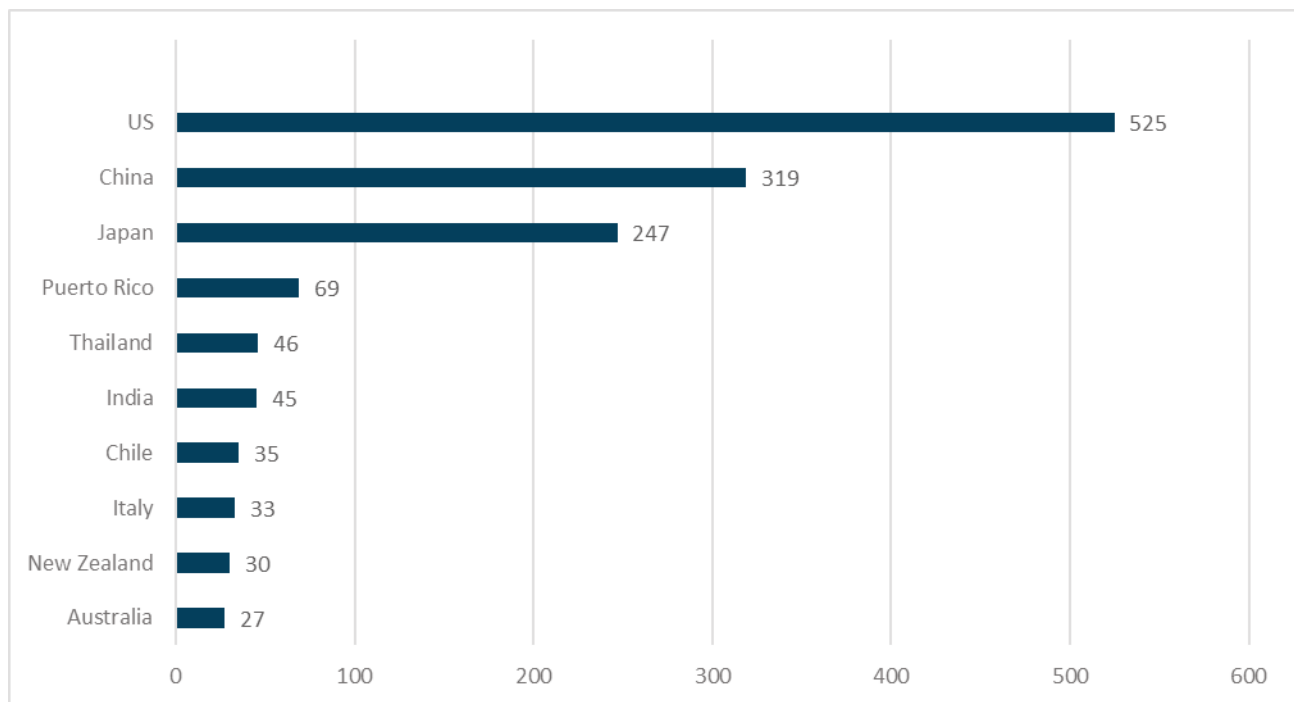
## The cost of disaster is growing

Over the 10 years to 2016, natural disasters cost the NSW economy some \$3.2 billion per year with 49% of the costs attributed to storms and 23% to flooding<sup>21</sup>. Today, based on the history of natural disaster events over the past 50 years, the total economic cost of natural disasters in NSW is estimated to be \$3.6 billion per year. The economic cost of natural disasters in NSW is growing and is projected to reach \$10.6 billion per year by 2050. This forecast does not account for the effects of a changing climate, which are expected to magnify these costs.

In addition to the tangible costs of natural disasters such as loss of life or property, there are many 'intangible' costs of natural disasters. These include increased family violence, mental health impacts, chronic disease, alcohol and drug use, short and long-term unemployment, changes to school academic outcomes, and crime. Intangible costs were found to be at least equal to, if not greater than, tangible costs<sup>22</sup>.

The 2018 International Federation Red Cross and Red Crescent Societies' World Disasters Report found Australia's damage bill over the past decade came in at \$37 billion (or \$US27 billion). This places Australia 10th in the world in terms of economic damage caused by natural disasters (see Figure 9 and 10).

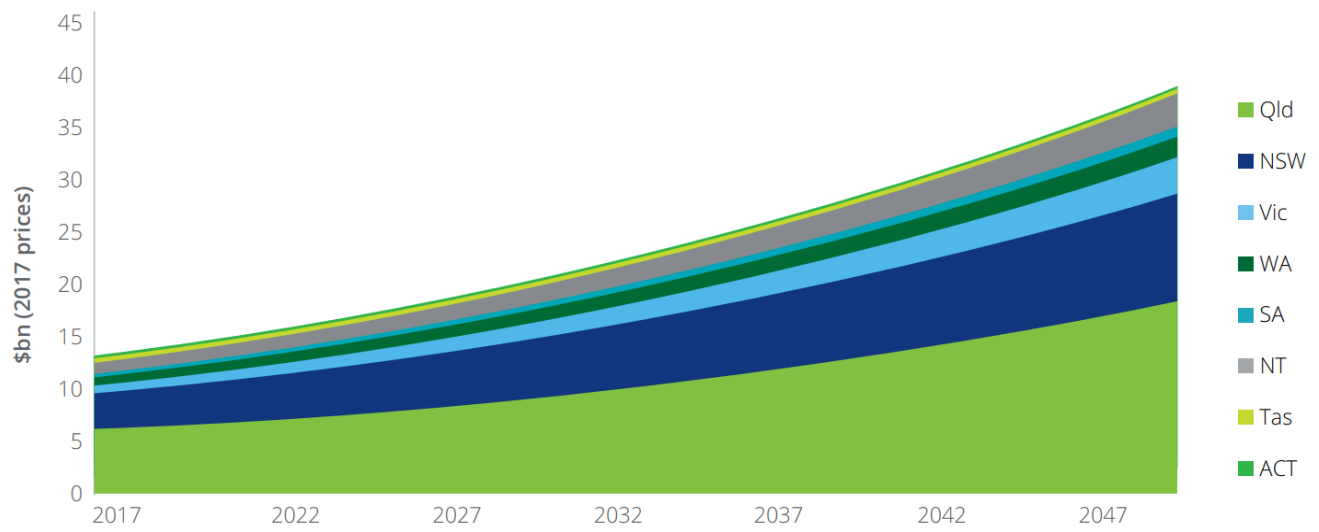
Figure 9. Estimated cost in \$US billion for natural disasters across the globe 2008–17



<sup>21</sup> Deloitte Access Economics, 2017, Building resilience to natural disasters in our states and territories, accessed [deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html](https://deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html) on 16 December 2019

<sup>22</sup> Deloitte Access Economics, 2016, The economic cost of the social impact of natural disasters, accessed on 16 December 2019: [deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html](https://deloitte.com/au/en/pages/economics/articles/building-australias-natural-disaster-resilience.html)

Figure 10. Forecast of the total economic cost of natural disasters across Australia 2017-50





## Policy context

This guide is consistent with key policy documents that have emerged in recent years as summarised in Table 1 below.

Table 1. Relevant policy documents

Policy	Purpose	Relevance
The Sendai Framework for Disaster Risk Reduction 2015–2030 (United Nations Office of Disaster Risk Reduction)	Aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the 15 years to 2030	The Sendai Framework guides Australia's approach to disaster risk reduction both domestically (led by the Department of Home Affairs) and as support provided through the Australian aid program to assist other countries to reduce disaster risk.
The National Strategy for Disaster Resilience (COAG 2011)	Acknowledges the increasing severity and regularity of disasters in Australia and the need for a coordinated, cooperative national effort to enhance Australia's capacity to withstand and recover from emergencies and disasters	The strategy provides the basis for governments to shift from the traditional emphasis of response to and recovery from emergencies to one which emphasises the need for a greater focus on prevention, mitigation, preparedness and building capability.
National Disaster Risk Reduction Framework 2018	Outlines a national approach to proactively reducing disaster risk, now and into the future	National Priority 2 calls for the introduction of robust frameworks to assess and reduce disaster risk in land-use and development planning.
Building Momentum: State Infrastructure Strategy 2018–2038	Sets out strategies to deliver infrastructure to meet the needs of NSW's growing population and economy over the next 20 years	Objective 5 seeks to ensure that existing and future infrastructure is resilient to natural hazards and human-related threats and, among other things, recommends a state-wide policy to embed resilience in strategic land-use planning.
State Level Emergency Risk Assessment 2017	Presents the findings of a state-wide emergency risk assessment consistent with the National Emergency Risk Assessment Guide	The risk assessment identifies land-use planning as a priority to be addressed in the 5 years to 2023 for the mitigation and prevention of natural disasters in NSW.

## Appendix B – Natural hazards significant to NSW

Hazard	Description
Bushfire	<p>A fire that breaks out in forest, scrub or grassland<sup>23</sup></p> <p>Bushfires and grassfires are common throughout NSW, but different fires exhibit different behaviours. Grassfires are fast moving, passing in 5 to 10 seconds and smouldering for minutes with a low to medium heat output, while bushfires are slower moving with a higher heat output.</p>
Coastal hazards	<p>Includes beach erosion, shoreline recession, coastal lake or watercourse entrance instability, coastal inundation, coastal cliff or slope instability, tidal inundation, and erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters (<i>Coastal Management Act 2016</i>)</p> <p>Coastal inundation occurs when a combination of marine and atmospheric processes raises the water level at the coast above normal elevations, causing land that is usually 'dry' to become inundated by sea water. Alternatively, the elevated water level may result in wave run-up and overtopping of natural or built shoreline structures (e.g. coastal dunes, seawalls).</p> <p>Erosion is the wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.</p>
Cyclone (tropical cyclones)	<p>Low-pressure systems that form over warm tropical waters and have gale force winds (sustained winds of 63 km/h or greater and gusts more than 90 km/h) near the centre<sup>24</sup> (AIDR Glossary)</p> <p>Cyclones can bring strong winds, heavy rain and coastal inundation to many regions on the western, northern and eastern coastlines<sup>25</sup>.</p>
Drought	<p>A prolonged, abnormally dry period when the amount of available water is insufficient to meet normal use<sup>26</sup></p> <p>There is no universal definition of drought and it is generally difficult to compare droughts as they differ in seasonality, location, size and duration. This is in part due to the different climate drivers from the Pacific, Indian, and Southern oceans that can influence variations in rainfall (such as the El Niño–Southern Oscillation and Indian Ocean Dipole).</p>

<sup>23</sup> GeoScience Australia, 2019, Bushfire, accessed 18 December 2019 at [www.ga.gov.au/scientific-topics/community-safety/bushfire](http://www.ga.gov.au/scientific-topics/community-safety/bushfire)

<sup>24</sup> Australian Institute for Disaster Resilience, 2020, Land Use Planning for Disaster Resilient Communities, accessed 7 July 2021 at [knowledge.aidr.org.au/media/7729/aidr\\_handbookcollection\\_land-use-planning-for-disaster-resilient-communities\\_2020.pdf](http://knowledge.aidr.org.au/media/7729/aidr_handbookcollection_land-use-planning-for-disaster-resilient-communities_2020.pdf)

<sup>25</sup> Planning Institute of Australia, 2015, National Land Use Planning Guidelines for Disaster Resilient Communities, accessed 7 July 2021 at [www.planning.org.au/documents/item/7804](http://www.planning.org.au/documents/item/7804)

<sup>26</sup> DPI, Drought in NSW, accessed 18 December 2019 at [www.dpi.nsw.gov.au/climate-and-emergencies/droughthub/drought-in-nsw](http://www.dpi.nsw.gov.au/climate-and-emergencies/droughthub/drought-in-nsw)

Hazard	Description
Earthquake	<p>An intense shaking of Earth's surface caused by a sudden slip on a fault or fracture in the tectonic plates that comprise the Earth's crust<sup>27</sup></p> <p>This shaking is caused by vibrations generated as rocks break under stress. Tectonic plates are slowly moving and can become stuck at their edges due to friction<sup>28</sup>. When the stress on the edge overcomes the friction, there is an earthquake that releases energy in waves that travel through the Earth's crust and cause a sudden slip.</p>
Flood	<p>Relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunamis<sup>29</sup></p> <p>Floods also relate to storms and east coast lows, inland troughs, and cyclone drop-outs.</p>
Heatwave	<p>A period of at least 3 days where the combined effect of excess heat and heat stress is unusual with respect to the local climate</p> <p>Both maximum and minimum temperatures are used in the assessment of heatwaves<sup>30</sup>. With development in our cities and towns, heatwaves can be made worse by the urban heat island effect.</p>
Landslide	<p>The movement of a mass of rock, debris, or earth down a slope under the direct influence of gravity<sup>31</sup></p> <p>The term 'landslide' encompasses 5 types of slope movement: falls, topples, slides, spreads, and flows. These are further subdivided by the type of geologic material (bedrock, debris, or earth). Debris flows (mudflows or mudslides) and rock falls are examples of common landslide types.</p>

<sup>27</sup> USGS, What is a fault and what are the different types?, accessed on 18 December 2019 at [www.usgs.gov/faqs/what-a-fault-and-what-are-different-types?qt-news\\_science\\_products=0#qt-news\\_science\\_products](http://www.usgs.gov/faqs/what-a-fault-and-what-are-different-types?qt-news_science_products=0#qt-news_science_products)

<sup>28</sup> GeoScience Australia, 2019, Earthquake, accessed 18 December 2019 at [www.ga.gov.au/scientific-topics/community-safety/earthquake](http://www.ga.gov.au/scientific-topics/community-safety/earthquake)

<sup>29</sup> Floodplain Development Manual at [www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/floodplain-development-manual.pdf](http://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/floodplain-development-manual.pdf)

<sup>30</sup> Bureau of Meteorology, 2013, Defining heatwaves: heatwave defined as a heat impact event servicing all community and business sectors in Australia, accessed at [www.cawcr.gov.au/technical-reports/CTR\\_060.pdf](http://www.cawcr.gov.au/technical-reports/CTR_060.pdf) on 12 December 2019

<sup>31</sup> USGS, What is a landslide and what causes one?, accessed on 18 December 2019 at [www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news\\_science\\_products=0#qt-news\\_science\\_products](http://www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news_science_products=0#qt-news_science_products)

Hazard	Description
Severe thunderstorms	<p>Severe thunderstorms can produce damaging wind gusts, large hail, tornadoes and heavy rain which may cause flash flooding and these phenomena can all cause significant damage. Thunderstorms are classified as severe in Australia if they produce large hail (2 cm in diameter or greater) or damaging wind gusts (90 km/h or greater) tornadoes or heavy rainfall conducive to flash flooding<sup>32</sup>. This can also include east coast lows.</p> <p>An east coast low is an intense low-pressure system that occurs off the east coast of Australia, bringing storms, high waves and heavy rain. East coast lows generally occur in autumn and winter off NSW, southern Queensland and eastern Victoria.</p>
Tornadoes	<p>A tornado and a twister are different names for the same type of weather event - a violently rotating column of air in contact with land or water. Tornadoes range in diameter from metres to hundreds of metres - some are even wider than a kilometre - and can last from a few seconds up to half an hour or longer. They have an intense updraught near their centre, which is why they can lift heavy objects such as cars and trees as well as cause enormous damage<sup>33</sup></p>
Tsunami	<p>Ocean waves triggered by large earthquakes near or under the ocean, volcanic eruptions, submarine landslides, and by onshore landslides in which large volumes of debris fall into the water<sup>34</sup></p> <p>Tsunami waves are unlike typical ocean waves generated by wind or storms and typically consist of multiple waves that rush ashore causing fast-rising inundation and powerful currents.</p>

<sup>32</sup> Bureau of Meteorology, Severe Thunderstorm, accessed July 28 2021 at <https://www.bom.gov.au/weather-services/severe-weather-knowledge-centre/severethunder>

<sup>33</sup> Bureau of Meteorology, Tornadoes, accessed 5 October 2021 at <https://www.bom.gov.au/weather-services/severe-weather-knowledge-centre/tornadoes>

<sup>34</sup> USGS, What are Tsunamis?, accessed on 18 December 2019 at [www.usgs.gov/faqs/what-are-tsunamis?qt-news\\_science\\_products=0#qt-news\\_science\\_products](http://www.usgs.gov/faqs/what-are-tsunamis?qt-news_science_products=0#qt-news_science_products)

## Appendix C – Key terms and definitions

Term	Definition
Disaster	<p>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</p> <p>Emergency is sometimes used interchangeably with the term disaster, such as in the context of biological and technological hazards or health emergencies. These, however, can also relate to hazardous events that do not result in the serious disruption of the functioning of a community or society.</p>
Disaster risk	<p>The potential loss of life, injury, or destroyed or damaged assets that could occur to a system, society or a community in a specific period, determined as a function of hazard, exposure, vulnerability and capacity</p> <p>The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses that are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least. It is important to consider the social and economic contexts in which disaster risks occur and that people do not necessarily share the same perceptions of risk and their underlying risk factors.</p>
Exposure	<p>The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas</p> <p>Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any hazard to estimate the quantitative risks associated with that hazard in interest.</p>
Hazard mitigation	<p>In this plan, means a potential or existing condition that may cause harm to people or damage to property or the environment</p>
Natural hazard	<p>A natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation</p>



Term	Definition
Residual risk	<p>The disaster risk that remains even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained</p> <p>The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach.</p>
Resilience	<p>The ability of a system, community or society exposed to hazards 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 through risk management</p>
Risk	<p>A concept used to describe the likelihood of harmful consequences arising from the interaction of hazards, communities and the environment</p>
Risk assessment	<p>The process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria</p>
Risk management	<p>The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk</p>

## Appendix D – Strategic planning framework relevant to natural hazard risks in NSW

Certain natural hazards, typically more frequent and well-known hazards such as bushfire and flood, are already addressed by the NSW land-use planning system. The table below highlights key plans and policies within the planning system and how they address natural hazards.

Policy/Plan	Comment
<p><i>Coastal Management Act 2016</i> NSW</p>	<ul style="list-style-type: none"> <li>• Instrument that establishes a statutory framework and overarching objects for coastal management in NSW</li> <li>• Manages the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of NSW</li> <li>• Defines the coastal zone, comprising 4 coastal management areas:               <ul style="list-style-type: none"> <li>○ coastal wetlands and littoral rainforests area</li> <li>○ coastal vulnerability area</li> <li>○ coastal environment area</li> <li>○ coastal use area.</li> </ul> </li> <li>• Defines coastal hazards</li> <li>• Establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities</li> <li>• Establishes requirements for local councils to prepare coastal management programs (CMPs) to set the long-term strategy for the coordinated management of land within the coastal zone</li> <li>• Enables provisions for CMPs to include mapped coastal vulnerability areas and establish relevant planning controls to inform land-use decisions and ensure legacy issues are not created for future generations</li> <li>• The coastal vulnerability area means land subject to coastal hazards. The objectives within this management area include ensuring public safety, preventing risks to human life, and mitigating current and future risk from coastal hazards.</li> <li>• Seven types of coastal hazards are identified as contributing to an area of coastal vulnerability.</li> </ul>
<p>NSW Coastal Management Manual</p>	<p>The Coastal Management Manual is a resource for local councils and public authorities to use when planning their future on the coast.</p> <p>The manual establishes mandatory requirements and provides guidance relating to the <i>Coastal Management Act 2016</i> in connection with the preparation, development, adoption, implementation, amendment, and review of, and the contents of, coastal management programs.</p>

Policy/Plan	Comment
<i>Rural Fires Act 1997</i> NSW	<ul style="list-style-type: none"> <li>• Primary legislative instrument that regulates the co-ordination of bush firefighting and bushfire prevention throughout NSW</li> <li>• Seeks to achieve the prevention, mitigation and suppression of bushfires and the protection of people, property and other assets from damage arising from fires</li> </ul>
Planning for Bushfire Protection 2019	<ul style="list-style-type: none"> <li>• Provides standards and guidance for:</li> <li>• strategic land-use planning to ensure that new development is not exposed to high bushfire risk</li> <li>• creating new residential and rural residential subdivision allotments</li> <li>• special fire protection purpose (SFPP) development taking account of occupant vulnerability</li> <li>• bushfire protection measures (BPMs) for new buildings</li> <li>• upgrading and maintaining existing development</li> </ul>
NSW Floodplain Development Manual	<ul style="list-style-type: none"> <li>• Supports the NSW Government’s Flood-prone Land Policy</li> <li>• Provides councils with a framework for implementing the policy</li> <li>• Presents general principles and a process for floodplain risk management</li> </ul>
Flood Prone Land Package	<p>Provides:</p> <ul style="list-style-type: none"> <li>• standard instrument Local Environmental Plan clause for flood planning</li> <li>• advice on notating flood prone land on section 10.7 planning certificates</li> <li>• guidance to council on considering flooding in land use planning</li> </ul>
<i>Environmental Planning &amp; Assessment Act 1979</i> NSW	<p>The Act is the primary legislative instrument that regulates land use within NSW and provides a context for risk reduction.</p> <p>The objectives of the Act include facilitation of ecologically sustainable development through integration of relevant economic, environmental and social considerations in decision-making.</p> <p>Part 3 requires the preparation strategic and statutory planning documents including regional, district and local plans as well as local strategic planning statements.</p> <p>Part 4 sets out, among other things, matters for consideration in the assessment of a development proposal including site suitability and the public interest. Relevantly, section 4.46 provides that development for which NSW Rural Fire Service approval is required under s. 100B of the <i>NSW Rural Fires Act 1997</i> is ‘integrated development’.</p> <p>Section 10.7 provides for the disclosure of some natural hazards on planning certificates such as flood, bushfire and other hazard risks. In conjunction with the Conveyancing Act, this enables property buyers to be made aware of relevant natural hazards at the time of purchase.</p>

Policy/Plan	Comment
<p><i>Greater Sydney Commission Act 2015</i> NSW</p>	<p>The Act is a legislative instrument that, among other things, constitutes and confers functions upon the Greater Sydney Commission (GSC).</p> <p>Importantly, the Act also amended the Environmental Planning &amp; Assessment Act in relation to strategic planning.</p> <p>The principal objectives of the commission set out at Section 9 explicitly include encouraging development that is resilient and considers natural hazards.</p>
<p>Regional plans</p>	<p>Regional plans strategic policy prepared by the Department that set out a 20-year plan for delivery of homes, jobs, community infrastructure and a healthy environment in regions across NSW.</p> <p>Regional plans acknowledge the challenge natural hazards and climate change pose and the need to balance future growth with achievement of sustainable and resilient communities.</p> <p>Most plans include actions to continually incorporate natural hazards and climate change data to reduce the exposure and vulnerability of communities to natural hazards.</p>
<p>Greater Sydney Region Plan</p>	<p>The plan is a strategic policy prepared by the Greater Sydney Commission that sets out 10 directions to achieve a liveable, proactive and sustainable Greater Sydney region over the 40 years to 2056.</p> <p>The plan includes ‘Direction 10: A Resilient City’, which includes objectives addressing climate change and natural hazards, with a particular focus on heatwaves.</p>
<p>District plan</p>	<p>A district plan is a strategic policy prepared by the Greater Sydney Commission that sets out a 20-year vision and plan to implement the Greater Sydney Region Plan across Greater Sydney’s 5 districts.</p> <p>Consistent with the Greater Sydney Region Plan, all district plans include a planning priority to adapt to the impacts of urban and natural hazards and climate change.</p> <p>Some district plans address specific hazards such as heatwave, flooding, and climate change and include mapping.</p>
<p>Local strategic planning statement</p>	<p>A local strategic planning statement is a strategic planning policy prepared by local councils to set out a 20-year vision that implements actions in the regional and district plans as well as the community strategic plan.</p> <p>The Department has prepared guidance to assist councils as they prepare their local strategic planning statements. This includes ‘Planning Priority 15: Adapt to natural hazards and climate change’.</p>

Policy/Plan	Comment
State environmental planning policy	<p>State environmental planning policies (SEPPs) are an environmental planning instrument prepared by the Department. SEPPs deal with matters of state or regional environmental planning significance.</p> <p>Some SEPPs address natural hazards. The Coastal Management SEPP, for example, provides for the mapping of land subject to identified coastal hazards and requires planning authorities to consider these when assessing development within the coastal zone.</p> <p>Within NSW, there is a program of reviewing and consolidating the number of SEPPs that are in force.</p>
Local environmental plan	<p>A local environmental plan (LEP) is environmental planning instrument prepared by local councils to guide planning decisions through zoning and development controls, which provide a framework for the way land can be used.</p> <p>The Department has developed a Standard Instrument LEP to provide a template for the development of these plans. The Standard Instrument LEP includes a dictionary of terms that may not be altered by councils.</p> <p>Several local governments have adopted model provisions relating to flood planning, foreshore building line and acid sulphate soils.</p> <p>Several local governments have also chosen to include local provisions that address hazards relevant to their local government areas such as landslip and bushfire.</p>
Development control plan	<p>A development control plan is a non-statutory plan prepared by local councils to provide detailed planning and design guide to support the planning controls in the local environmental plan.</p> <p>Several local councils have included provisions relating to natural hazards in their development control plan, establishing building requirements and/or exclusion areas to address hazard risk.</p>