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KANGAROO ISLAND COUNCIL

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Preparing KI: A Whole-of-Island Disaster Risk Reduction and Mitigation Action Plan

DRAFT REPORT



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Meridian Urban acknowledges the Traditional Owners and Custodians of the lands and waters of Karta Pintingga (Kangaroo Island).

We pay our respects to Elders past, present and emerging.

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Executive Summary

The Preparing KI Action Plan is Kangaroo Island Council's roadmap to delivering on and implementing its locally-identified priorities, and broader opportunities, to mitigate disaster risk, pursue enhanced climate adaptation and improve overall resilience.

This Action Plan is directly informed by and aligned with the priorities of the National Disaster Risk Reduction Framework (NDRRF) which highlights the ongoing need to understand risks, deliver accountable decisions, enhance investment and focus on governance, ownership and responsibility. This Action Plan articulates Kangaroo Island's Council's priority needs and activities across these national priorities for disaster risk reduction and mitigation. This Action Plan therefore provides a clear line of sight between local need and the resilience, disaster risk reduction and climate adaptation policy environment at regional, state and federal levels.

The Preparing KI Action Plan also serves a role in terms of recovery. The strategic and technical methodologies applied to inform this Action Plan may offer benefit in times of recovery and in informing recovery action options.

The Preparing KI Action Plan is intended to be championed across all areas of Council to better integrate and embed disaster risk reduction activities and opportunities as part of day-to-day decision making, through standard processes, and to inform decision-making of Council.

Natural hazards and risk exposure

Kangaroo Island is renowned for its natural beauty and wilderness areas, formed by isolation from the mainland and its exposure to the sometimes harsh weather influences of the Southern Ocean, owing to its location in the Great Australian Bight.

It can be an Island of extremes. This is not only understood by residents but is a key part of its attraction – as a place to live and to visit. This means that natural hazards are part of life on Kangaroo Island, underscoring the importance of this Action Plan and the need to collectively prepare for and manage our exposure to these hazards and their risks.

Whilst Kangaroo Island can experience many types of natural processes that present a hazard or risk, the focus of the Preparing KI Action Plan concentrates on:



Figure 1 - Focus Hazards adopted for the purposes of the Preparing KI Action Plan

The effects of climate change on the frequency and intensity of natural hazard events and conditions span a number of these hazards.

Priority actions

The Action Plan identifies 20 priority actions for active pursuit, along with a series of additional opportunistic actions should needs or circumstances arise.

The **top 20 priority disaster risk reduction and mitigation actions** identified by the Preparing KI Action Plan include:

Built environment and infrastructure

1. Update Council's Infrastructure and Asset Management Plan (IAMP)
2. Deliver and implement an updated IAMP
3. Invest in data and monitoring
4. Investigate managed retreat options for wastewater infrastructure assets
5. Evacuation centre and heat refuge hub planning
6. Key access route analysis
7. Evacuation study for townships
8. Road network vulnerability analysis

Human and social

9. Community-led local or district resilience planning
10. Preparation of a long-term community awareness and preparedness program

Natural environment

11. Continuation of annual fuel load reduction activities
12. Development of a high risk ecological values / assets register
13. Undertake a coastal adaptation study for foreshore assets, townships and communities

Economy

14. Prepare locally-specific messaging for visitors for different event types
15. Ensure a continued focus on Council organisational continuity
16. Support broader business continuity for service providers and industry sectors

Governance

17. Develop a corporate climate risk policy and strategy
18. Integrate disaster risk reduction and mitigation into Council's Strategic Management Plan
19. Invest in a resilience officer to support implementation of Preparing KI
20. Invest in human and physical resources to continue to deliver important fuel load risk reduction programs

Costs

The priority mitigation actions identified by the Action Plan are estimated at a cost of \$6.98 million, in addition to annual ongoing costs and other mitigation opportunities.

Council's annual income, based on its latest Annual Report, is \$22 million based on \$11 million drawn from rates and a further \$15 million drawn from various grants. Council receives \$3.5 million annual from the Government of South Australia for local road maintenance. Therefore, Council is heavily reliant on external funding and grant allocations to support its operations. In the last financial year, Council operated at a marginal loss.

Investment in natural hazard and disaster risk reduction mitigation measures for the priority actions identified by this Action Plan is beyond the current financial capacity of Kangaroo Island Council without support from State and Commonwealth funding and grant allocation.

Kangaroo Island Council

Preparing KI Action Plan

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1 Introduction

Preparing Kangaroo Island (referred to as 'Preparing KI') is a whole-of-island action plan which considers the disaster risk reduction and mitigation priorities which are relevant across a number of natural which affect Kangaroo Island.

The Preparing KI Action Plan comes at an important time for natural hazard and risk considerations across Kangaroo Island. Events including the devastating 2019/20 Black Summer bushfires have brought into stark view the importance of effort and action to avoid or mitigate future social, physical, economic and environmental impacts from different hazard events.

Over the years, a comprehensive number of natural hazard (and related) studies and plans have been prepared for varying purposes and across different geographic extents of the Island. Preparing KI brings together the recommendations, actions and projects identified by these separate documents to identify risk management and mitigation priorities required to bolster the resilience of the Island and its communities moving forward.

The Preparing KI Action Plan was funded through the Commonwealth Government's 'Preparing Australia's Communities' fund and commissioned by Kangaroo Island Council (KIC).

What is 'mitigation'?

Actions or activities that reduce long-term risks to people, property and the environment caused by natural and other hazards.

1.1 Purpose and objectives

The intent of Preparing KI is to guide Council, its stakeholders and the broader community of Kangaroo Island to pursue key projects and activities, including funding applications, to advance disaster risk reduction initiatives, and also to recognise broader opportunities for resilience and mitigation enhancement, as circumstances allow.

The overall objective of Preparing KI is to better plan, prepare and mitigate the risk of natural hazards and disaster events for the Kangaroo Island community.

Whilst this Action Plan is not a risk assessment, it has regard to risk and resilience opportunities, not just natural hazards.

The synthesis of actions and projects to enhance disaster risk reduction and resilience over time has been informed by a prioritisation process with a focus on multi-objective outcomes and cost benefit efficiencies. This gives rise to a clear plan for those activities that warrant active pursuit for funding and implementation, and those which can be considered as opportunity arises – as funding becomes available or circumstances allow.



Figure 2: Cycle of risk reduction actions

1.2 Methodology

The Action Plan preparation process was delivered across five (5) phases, commencing from April 2023 through to early 2024.

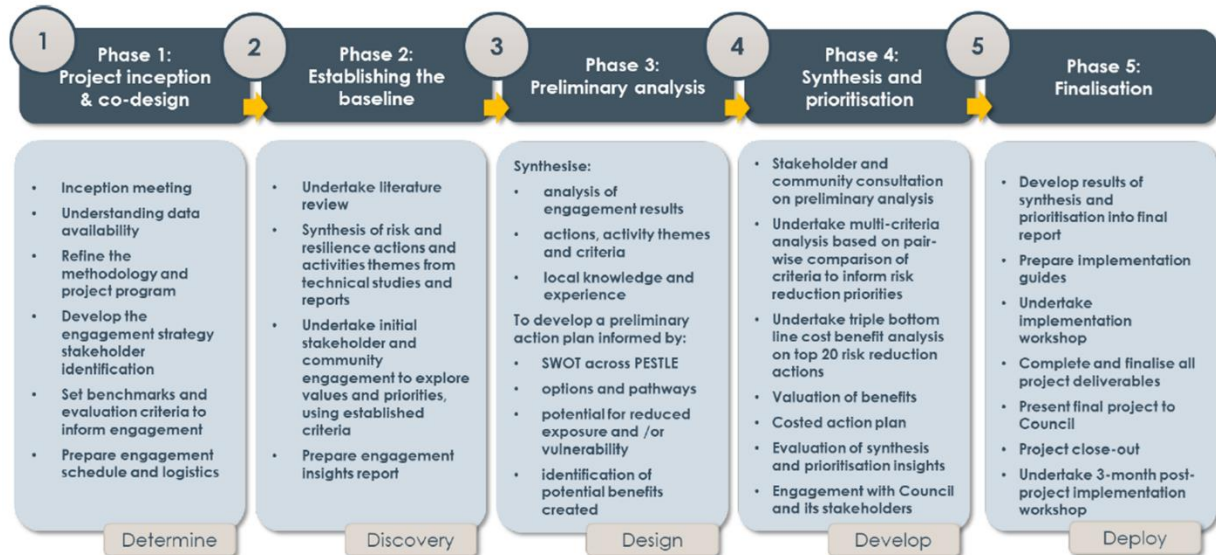


Figure 3 - Project delivery phases

Council and allied stakeholders, including State agencies, over time have undertaken a large number of studies, strategies and plans across different hazards and in line with not only legislative and regulatory obligations, but as part of best practice approaches. This has informed a comprehensive understanding of the natural hazard risks across Kangaroo Island.

A cross-cutting synthesis of the extensive range of technical studies, plans and strategies enabled the identification of priorities, aligned with the National Disaster Risk Reduction Framework¹ (NDRRF) to provide a holistic action plan or roadmap to guide Council and its stakeholders moving forward.

A key principle underpinning the preparation of the Preparing KI Action Plan involved testing the priorities to prepare an evaluated 'stocktake' of actions, project and activities to guide and support Council and stakeholder efforts and investment over time, in the most productive and efficient manner relative to risk needs. This ensures that funding and grant distribution can be targeted at those risk reduction and mitigation needs that are the highest priority and will deliver the most benefit. Importantly, this process involved three (3) central elements of consideration:

1. Community values, aspirations and needs
2. Contemporary technical risk insights and observations, drawn from existing studies
3. Government objectives and regulatory requirements, at all levels.

A number of different natural hazard types were considered to inform the Preparing KI Action Plan, refining its focus to those hazards considered to present the greatest existing or future risk to Kangaroo Island, but acknowledging that many identified actions or projects that address or mitigate these hazards are in fact hazard 'agnostic' and are capable of addressing a wide range of hazard types beyond those specifically contemplated.

¹ Australian Government, 2018, 'National Disaster Risk Reduction Framework', Available at <https://nema.gov.au/about-us/policies/strategies-and-frameworks#National%20Action>



Figure 4 - Focus hazards adopted for the purposes of the Preparing KI Action Plan

A number of existing and accepted technical methodologies were also used to support the overarching project methodology, guiding specific elements of the project to ensure overall alignment with the project objectives. This included:

- National Disaster Risk Reduction Framework
- The Commonwealth Government's Risk Reduction Prioritisation and Investment Guide²
- The Torrens Institute Resilience Scorecard Framework, achieving alignment with the methodologies informing 'Stronger Together: South Australia's Disaster Resilience Strategy'³.

1.2.1 A collaborative approach: consultation and engagement

The development of this plan involved a comprehensive stakeholder engagement program. Three (3) rounds of stakeholder consultation were conducted, each round focusing on a different aspect. The project engagement strategy was co-designed alongside Council with specific objectives to understand community views and insights, technical risk considerations and government objectives across different disaster risk reduction matters.

The engagement processes involved a range of approaches to canvas stakeholder views, insights and experiences. These approaches included:

- Community workshops
- Technical workshops
- Community drop-in sessions
- One-on-one targeted in-person meetings

² Australian Government, 2019, 'Climate and Disaster Risk: What They Are, Why They Matter and How to Consider Them in Decision Making. 5 Guidance on Prioritisation', Available at <https://www.aidr.org.au/media/6933/05-prioritisation.pdf>

³ Government of South Australia, 2019, 'Stronger Together – South Australia's Disaster Resilience Strategy', Available at <https://www.safecom.sa.gov.au/initiatives/stronger-together-south-australias-disaster-resilience-strategy/>

- Online targeted meetings with subject matter experts, government agencies and community representatives
- Councillor and Council officer workshops and briefing sessions
- Stall at the Kingscote Show.

Key insights drawn from these processes are presented over page.

1.3 Benefits of a mitigation action plan

There are a range of benefits from having a dedicated mitigation and disaster risk reduction action plan in place:

- A clear understanding of mitigation priorities to support investment and funding allocation, including decisions on new or upgraded assets
- Ability to derive the benefit of 'blue-sky' critical thinking as opposed to the immediacy of responding to recovery needs
- Identification of strategic priorities
- Reflection of local, State and Commonwealth risk reduction policy, thereby providing a clear 'line of sight' between mitigation priorities and the policy environment
- Identification of mitigation measures that respond to multiple hazards
- Ability to derive efficiencies from mitigation investment
- Provision of a strong evidence-base that supports strategic mitigation needs, informed by multiple technical approaches including multi-criteria and cost-benefit analysis.



Figure 5 - Collection of community insights collated from community drop-in sessions





2 Disaster risk reduction and mitigation frameworks

The impacts of natural hazard (and other) events on people, property and the environment across Australia and globally over the past decade has given rise to a changing policy landscape. Australia is party to a range of goals and commitments across the realms of:

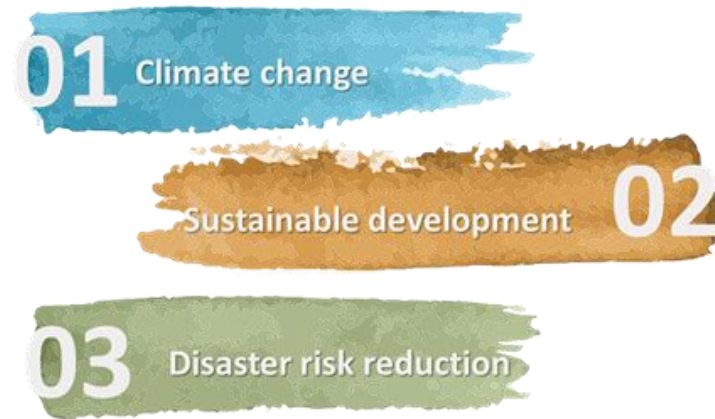


Figure 6 - Key areas of international policy focus relevant to mitigation action

The Commonwealth Government and Government of South Australia have taken steps to integrate and embed policy and procedural approaches that address these issues, providing a framework through which factors of disaster risk reduction and hazard mitigation can be contemplated in a changing climate at the local level.

Key instruments which form this framework include, but are not limited to, the following:

National Disaster Risk Reduction Framework

The National Strategy for Disaster Resilience (NSDR) and National Disaster Risk Reduction Framework (NDRRF) which together represent a coordinated approach to resilience. Their purpose is to guide national, whole-of-society efforts to proactively reduce disaster risk in order to minimise the loss and suffering caused by disasters, translating the first three Sendai Framework priorities into action for the Australian context. The NDRRF is intended to be applied across four priorities which are fundamental to natural hazard risk reduction, resilience and climate change, including the built, the social, the natural, and economic environments, these are:

1. Understand disaster risk
2. Accountable decisions
3. Enhanced investment
4. Governance, ownership and responsibility.

The NDRRF focuses on natural hazards and recognises that disaster risk is a product of:

- hazard – a sudden event or shock
- exposure – the people and things in the path of potential hazards, having regard to probability and consequence
- vulnerability – the potential for those people and things to be adversely impacted by hazard
- capacity – the ability for those people and assets and systems to survive and adapt.

National Risk Reduction Prioritisation and Investment Guide

The Commonwealth Government's Risk Reduction Prioritisation and Investment Guide supports implementation of the NDRRF. It is designed to help decision makers with the task of contextualising the systemic physical impacts of a changing climate. In particular, it seeks to harness local knowledge, capabilities and processes to apply climate and disaster risk to governance, strategic planning and investment decisions.

The Guide contains a prioritisation framework for climate and disaster risk reduction developed with capabilities critical for informing the prioritisation of investments to reduce climate and disaster risk. The framework:

- allows for the evaluation of interventions ('options and pathways') based on how much they reduce vulnerability ('values at risk') and the economic net benefits created ('value potential')
- is scenario-based to explore various possible combinations of future hazards, exposure, vulnerability and intervention options. Different assumptions can therefore be applied about changes in climate, population and socio-economic development
- provides a rapid assessment process of opportunities for value creation and capture.

Stronger Together: South Australia's Disaster Resilience Strategy

The Torrens Resilience Initiative is one of Australia's longest-standing research initiatives dedicated to disaster preparedness and management. Its research is advancing the concept of resilience and helping organisations, communities and nations balance disaster preparedness and prevention, response and recovery.

The Initiative's framework model is adopted by 'Stronger Together: South Australia's Disaster Resilience Strategy' and describes the identified four essential domains of community disaster resilience and is presented in the figure below. These four domains represent systems that overlap and interact, making relatively equal contributions to building disaster resilience in the community. Should a domain be weakened beyond its tipping point, overall resilience will be affected.

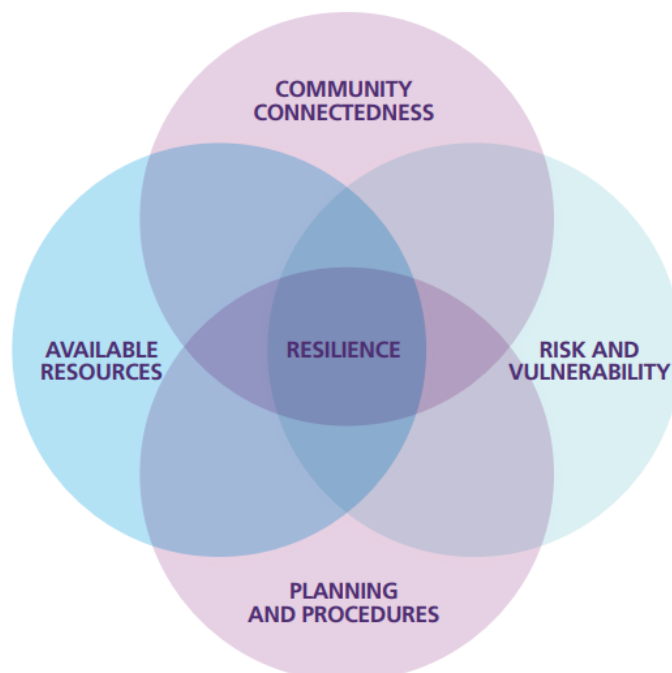


Figure 7 - Torrens Resilience model for community disaster resilience (Source: SA's Disaster Strategy)

The diagram below provides the policy lines of sight for disaster resilience and emergency management as relevant in South Australian and more specifically for Kangaroo Island, providing key framework elements which guide the need for mitigation and disaster risk reduction activities.

Disaster resilience policy line of sight

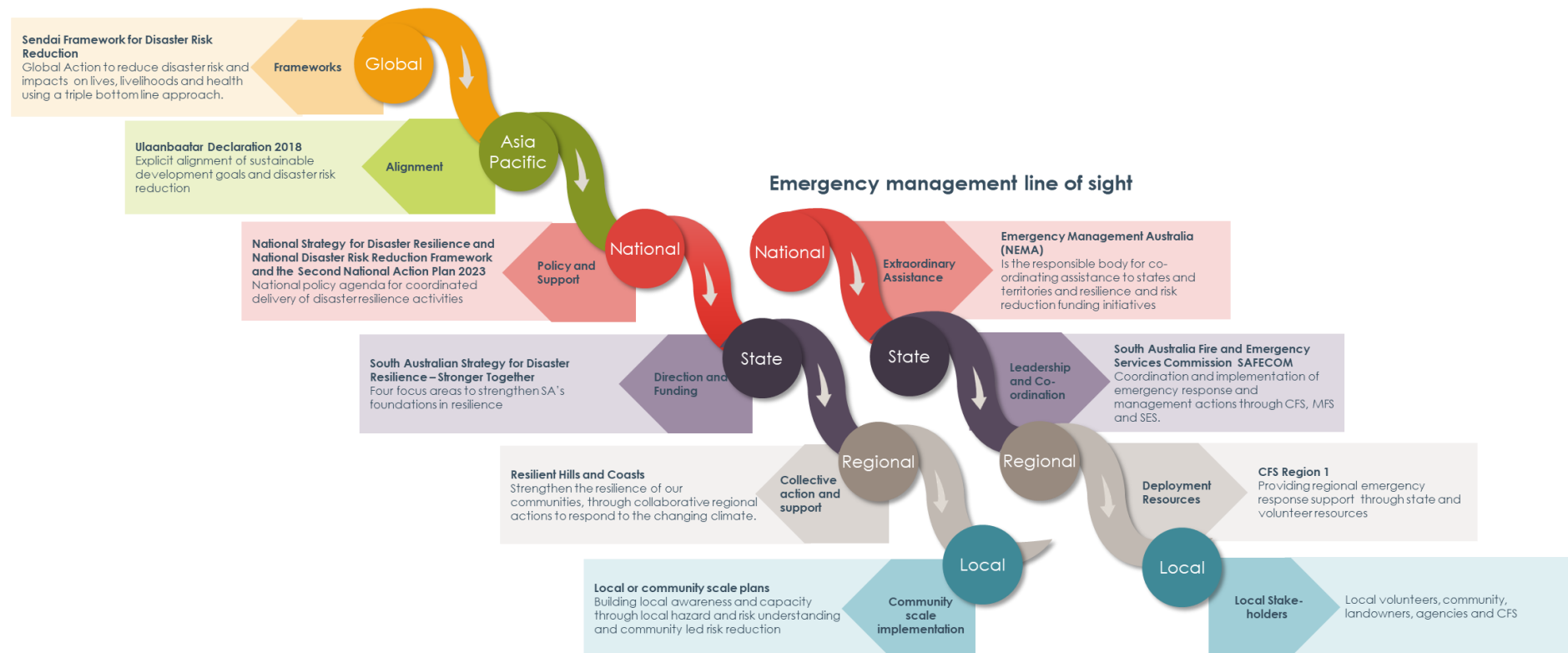


Figure 8 - Disaster resilience and emergency management policy lines of sight

3 Natural hazards on Kangaroo Island

Kangaroo Island is renowned for its natural beauty and wilderness areas, formed by isolation from the mainland and its exposure to the sometimes harsh weather influences of the Southern Ocean, owing to its location in the Great Australian Bight.

It can be an Island of extremes. This is not only understood by residents, but is a key part of its attraction – as a place to live and to visit. This means that natural hazards are part of life on Kangaroo Island, underscoring the importance of this Action Plan and the need to collectively prepare for and manage our exposure to these hazards and their risks.

Whilst Kangaroo Island can experience many types of natural processes that present a hazard or risk, the focus of Preparing KI concentrates on:

- Bushfire
- Flood
- Coastal hazards (storm tide and storm surge, sea level rise, coastal erosion)
- Earthquake
- Heatwave.

The effects of climate change on the frequency and intensity of natural hazard events and conditions span a number of these hazards.

3.1 Bushfire

South-eastern Australia is already one of the most bushfire prone areas in the world. It is projected that the south-east of Australia is likely to become hotter and drier in the future, with an increase in the length of fire danger seasons and extreme fire weather being observed since the 1970s. Longer fire danger seasons are likely, along with more frequent and intense fire danger days. Lightning strike accounts for approximately 70 per cent of bushfire ignitions on Kangaroo Island⁴.

The vegetation communities on Kangaroo Island comprises remnant vegetation covering 48 per cent of the Island, with the remainder comprised of cleared or altered landscapes, primarily for agricultural production⁵.

The fuel structure and availability within these vegetation communities has a significant influence on the bushfire hazard associated with this native vegetation. Mallee woodlands, as seen throughout the West and South Coast region, typically support Overall Fuel Hazards of High to Extreme⁶.

The KI Bushfire Management Area Plan (BMAP) identifies that the Island experiences approximately 26-30 bushfires per year, of which on average one can be considered to be a major campaign fire. The majority of the major fires are concentrated around the Gosse and Seddon plateaus, and the southern coastal bushlands on the eastern end of the Island. The 2007 fires were ignited by dry lightning ignitions resulting in excess of 90,000 hectares being burnt, the loss of one life and significant asset.

During the 2019-20 summer nearly half of the Island burnt within one day. Two (2) lives were tragically lost near Parndana. Firefighters and locals experienced burn-overs, stock and wildlife

⁴ Department for Environment and Water, 2009, 'Flinders Chase Fire Management Plan', Available online <https://cdn.environment.sa.gov.au/environment/docs/fire-management-plan-flinders-chase-plan.pdf>

⁵ Kangaroo Island Council, 2018, 'Native Vegetation Management on Kangaroo Island Council: Community information paper'

⁶ Ten Rivers and Meridian Urban, 2020, 'Kangaroo Island Council Bushfire Protection and Mitigation Strategy'

loss was extreme. At the time the Ravine fire was contained on 21 January 2020, 87 houses had been lost, 332 outbuildings, 322 vehicles and almost 60,000 head of stock were also lost⁷. Over 211,000 hectares were burnt, with many businesses and industries also impacted. Iconic tourism facilities were lost. The 2019/20 fires on Kangaroo Island were preceded by other major fire events including in 2007 when over 90,000 hectares was burnt. One (1) life was tragically lost in the event along with significant property and stock loss⁸.

In 2023, the National Parks and Wildlife Service released its draft Parks of Kangaroo Island Fire Management Plan⁹ for consultation, a holistic approach to replace four (4) existing park-based fire management plans. Based on the research conducted to inform the draft Fire Management Plan, major fires occur on the Island every ten (10) years. The draft Fire Management Plan illustrates the **fire history** across the island since the 1930s (darker shading indicates more frequent fire).

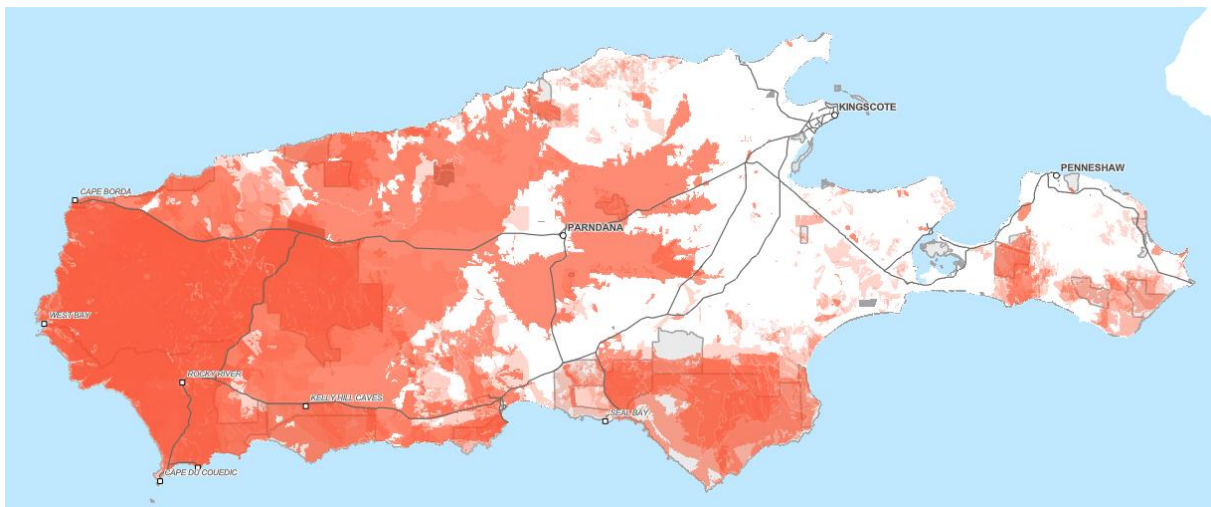


Figure 9 - All fire history for Kangaroo Island from 1930 to current day (Source: DEW, 2023)

Having regard to **frequency of fire**, the draft Fire Management Plan identifies the following:

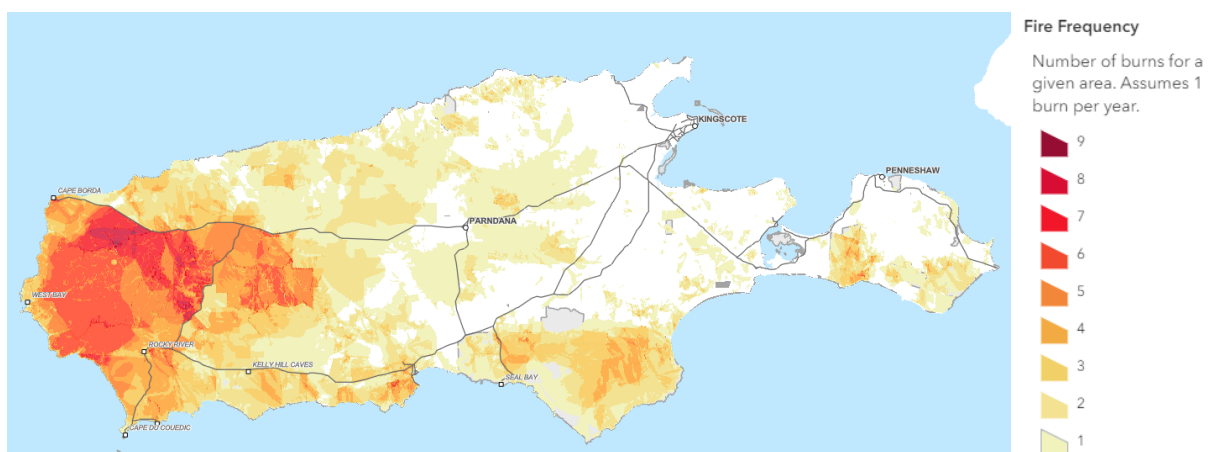


Figure 10 - Fire frequency mapping for Kangaroo Island from 1930 to current day (Source: DEW, 2023)

⁷ Government of South Australia, 2020, 'Independent Review of South Australia's 2019-20 Bushfire Season', Available at <https://www.safecom.sa.gov.au/publications/sa-governments-initial-response/>

⁸ Ten Rivers and Meridian Urban, 2020, 'Kangaroo Island Council Bushfire Protection and Mitigation Strategy'

⁹ Department for Environment and Water, 2023, 'Draft Parks of Kangaroo Island Fire Management Plan', Available at <https://www.environment.sa.gov.au/topics/fire-management/fire-science-and-planning/fire-management-plans/ki-fire-management-plan#:~:text=The%20new%20plan%20will%20provide,cultural%20heritage%20of%20the%20state.>

3.2 Flooding

While rainfall is the key component leading to a flood event, there are many contributing factors, including catchment size, land uses, ground moisture and vegetation in and around water courses. Kangaroo Island has 53 water resource catchments. Some major catchments and water courses discharge to the ocean, but a prominent feature of Kangaroo Island is that many catchments have large terminal¹⁰ waterbodies, for example Murray Lagoon, White Lagoon and Salt Lagoon. A number of smaller terminal waterbodies and farm dams are located within many catchments.¹¹

The distinguishing feature of these lagoons is that they have no overflow relief or connection to the sea and hence the land surrounding these lagoon areas is vulnerable to extended periods of inundation following wet years. The water bodies expand, covering roads and access routes, is slow to be absorbed or the drain. The figure below shows the number of short watercourses across Kangaroo Island.



Figure 11 - Kangaroo Island watercourses (Source: Geoscience Australia, 2023)

The primary watercourses are the Cygnet River which runs west to east and discharges into Nepean Bay (which can isolate access to Kingscote Airport). Timber Creek collects water from the Seddon and MacGillivray areas and discharges into Murray Lagoon and on the north side of the Island there is Middle River, collecting water from Gosse and Middle River and discharging to the ocean near King George Beach. Vivonne Bay has two water courses discharging into the Bay – the Harriet and the Eleanor Rivers. The highest part of the Island is around Gosse. A number of short water courses also flow west through the national parks. The Island is characterised by many short run water courses which have no discharge point, many low lying collection points and ponded water.¹²

The 2013 flooding event that impacted the MacGillivray and Haines area caused over \$9 million in damage with about half of that going to road reconstruction and almost \$3 million in agricultural loss. Due to the topography as described above, the water from the June 2013 rainfall, remained in place into 2014 and for months after that.¹³

Recent flash flood events occurred in 2022 and are covered in the storm section of this Action Plan.

¹⁰ Bodies of water that do not flow to an ocean

¹¹ Southfront, 2016, 'Kangaroo Island Council MacGillivray / Haines Flood Mitigation Options Study', Available at https://www.kangarooisland.sa.gov.au/_data/assets/pdf_file/0034/875482/Final-Report-Haines-MacGillivray-Flood-Mitigations-Option.pdf

¹² Ibid (as referenced above)

¹³ Ibid.

3.3 Coastal hazards

The impacts of coastal hazards such as erosion and inundation are already evident on the Island with anecdotal reports of past flooding and some settlements already having levees in place to provide protection against the impacts of large storm surge events. Extremely high tides caused some saltwater flooding in May 2022.

Kangaroo Island commissioned a recent Coastal Hazards Strategy dated 2018 which was underpinned by an understanding of the elevation of each settlement and oceanographic and coastal processes relevant to Kangaroo Island. The Coast Protection Board recommends that development allow for 30 centimetres of sea level rise by 2050 and one metre by 2100. Storm tide levels are based on the 100-year Average Recurrence Interval (ARI) water level for the Kangaroo Island coastline as provided by the Coast Protection Board.¹⁴

The Strategy describes potential impacts and response options of coastal hazards for each settlement on the Island. The impacts of future erosion and inundation differ widely across the Island depending on the location, with land height and the underlying shoreline geomorphology determining the amount of erosion and inundation risk under current and future conditions. At least four impact categories of towns and settlements can be identified:

- Both erosion and inundation – Antechamber Bay, Bay of Shoals, Brownlow, Island Beach, Nepean Bay and Sapphiretown
- Primarily inundation – American River is at risk primarily from inundation
- Primarily erosion – Brown Beach, Emu Bay and Penneshaw have sand beaches that are highly erodible
- Low erosion and inundation risk – Baudin Beach and D'Estrees Bay face some erosion risks to soft rock sections of shoreline, and Kingscote faces limited erosion risk at Reeves Point.¹⁵

Key coastal hazard statistics:

- American River – \$3.9 million private assets currently at risk to coastal inundation increasing to \$18 million by 2100
- Nepean Bay – \$2,000 private assets currently at risk to coastal erosion risk increasing to \$4 million in 2050 and \$25 million by 2100. \$9 million currently at risk to coastal inundation increasing to \$18 million by 2050 and \$25 million by 2100
- Brownlow – \$280,000 private assets currently exposed to coastal erosion risk increasing to \$32 million by 2100, and \$800,000 affected by inundation increasing to \$32 million by 2100
- Penneshaw – \$280,000 private assets affected coastal erosion risk increasing to \$6 million by 2100.¹⁶

The settlements at greatest risk now and in the future from coastal hazards are American River due to inundation risk, and Brownlow and Nepean Bay due to the combined impacts of erosion and inundation risk. Analysis was undertaken to identify the number and value of public and private assets at risk to provide Council with measurable impacts and assist in prioritisation.¹⁷

The coastal hazard mapping that informed the Strategy is available online at <https://watech.maps.arcgis.com/apps/webappviewer/index.html?id=d76412ac546242439b1d168ef708eea4>

¹⁴ Seed Consulting and Water Technology, 2018, 'Kangaroo Island Coastal Hazard Strategy', Available at https://www.kangarooisland.sa.gov.au/_data/assets/pdf_file/0014/311540/Coastal-Hazard-Strategy-FINAL.pdf

¹⁵ Ibid.

¹⁶ Ibid

¹⁷ Ibid.

3.4 Storm

Kangaroo Island has experienced some severe coastal storms over time and these events can include wind gusts, tornadoes, hail, and lighting as well as heavy rain which can lead to flash flooding.

As previously noted, lightning strikes from dry thunderstorms account for 70 per cent of bushfire ignitions on Kangaroo Island. The north-western end of the Island is anecdotally renowned for attracting lightning strikes, a combination of the influences of the weather patterns associated with the surrounding Southern Ocean and Kangaroo Island's land mass and topography. An ironstone ridge formation spans the northern and central areas of the Island.

Severe wind swept up off the Southern Ocean along with hail pose threats to buildings as well as the Island's agricultural production, particularly crops if hail occurs close to harvesting.

Flash flooding associated with extreme rainfall from storm events has occurred across different parts of the Island over time, but it's the cascading or flow-on impacts that have caused greatest damage. This is mostly associated with road infrastructure which in some cases can take many months to repair. More recently, severe storms and rain damaged Hog Bay Road between Kingscote and American River in October 2022, after flash flooding. Other roads used for detour purposes were not fit for the volume of vehicles or their loads which created further damage to the local road network.



Figure 12 - Flash flooding damage to Hog Bay Road (Source: ABC News, 2022)

3.5 Heatwave

Heatwave continues to be an underrated but dangerous risk to human health and for livestock on Kangaroo Island, with a risk profile that is accelerating as a result of a changing climate.

Heatwaves are an extreme heat event which cause substantial impacts for society and the environment in several ways including for human health, agriculture, economy, for ecosystems, and exacerbating the probability and intensity of other natural hazards (like bushfires and drought). They are also Australia's most costly disaster in terms of human impact, with severe and extreme heatwaves being attributed to more than half of all disaster related deaths¹⁸. Climate modelling shows extreme heat events are projected to occur more often and with greater intensity in the future, alongside projected ambient temperature increases¹⁹. In accordance with the SA Emergency Management Plan, SA Health is the primary agency with responsibility for heatwave hazard. The 'Healthy in the Heat' program identifies education and actions for community during heatwave events.

The South Australian Heatwave Service is operated by the State Emergency Service in line with the Bureau of Meteorology each year between October and March. The SES advises that low-intensity heatwaves are common in South Australia.

The Bureau of Meteorology defines a heatwave as three or more days of high maximum and minimum temperatures which are unusual for a given location. Accordingly, the forecast and measurement of heatwaves is relative and considers a combination of factors²⁰. The Bureau's services also extend to agriculture and commodities, as it does for other hazards of certain types. This can help primary producers to make informed immediate, medium and long-term decisions regarding stock and crops.

Most people have adequate capacity to cope with many of the heatwaves experienced, as they are low intensity heatwaves. However, less frequent higher intensity severe heatwaves can be challenging for vulnerable populations, such as those older than 65 years, pregnant women, babies and young children and those with a chronic illness. Rarer extreme heatwaves are exceptionally intense, impacting upon normally reliable infrastructure like power and transport. Heatwaves of extreme intensity are a risk to anyone who does not take precautions.

The South Australian summer of 2018-19 was the warmest summer on record (to date) with mean maximum temperature for summer at 3.09 °C warmer than average, making it the highest on record (previous highest was +2.87 °C in summer 2000-01). Above average mean maximum temperatures were observed throughout the State, while record high mean maximums were experienced in the far south-west, north, and north-east. January 2019 was South Australia's hottest month on record.²¹

Heatwave events in December and January saw daytime temperatures reach the high-40s and numerous sites had their highest summer temperature on record, including 46.6 °C at the Bureau of Meteorology's official Adelaide city site at West Terrace. Kingscote airport recorded 45.4 °C on 24 January 2019, surpassing the previous record of 43.8 °C on 2 February 2014.²²

¹⁸ SA Health, 2023, 'SA Health Extreme Heat and Heatwave Strategy', Available at <https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/public+health/disaster+management/extreme+heat>

¹⁹ Ibid

²⁰ Bureau of Meteorology, 2023, 'Heatwave Service for Australia', Available at <http://www.bom.gov.au/australia/heatwave/>

²¹ Ibid.

²² Ibid.

3.6 Earthquake

Damaging earthquakes remain rare, but such an impact can have very serious consequences. Earthquakes are a frequently occurring (in geological timeframes) phenomenon in South Australia in particular with some geographic areas registering clusters of events, especially around the Spencer Gulf. When an earthquake of a magnitude 5.0 or more occurs in or near a built environment it can cause significant damage to structures, particularly underground services and pipes, with potential risk to life due to the collapse of structures²³. While a combination of factors greatly reduce the risk of serious destruction, damaging earthquakes still remain a possibility for Kangaroo Island.

Earthquakes are vibrations within the earth caused by rocks breaking under stress, which occurs along fault lines. The magnitude of an earthquake is measured on the Richter scale. For every unit increase in magnitude, there is roughly a thirty-fold increase in the energy released. For example, a magnitude 6.0 earthquake releases approximately 30 times more energy than a magnitude 5.0 earthquake, while a 7.0 earthquake releases approximately 900 times more energy than a magnitude 5.0.²⁴

The intensity felt at a location depends on a wide range of factors, such as distance from focus, nature of the local strata overlying bedrock, local topography, physical damage and an observer's level of alertness and activity at the time of an earthquake.

Australia most commonly experiences very shallow earthquakes, with a focal depth of less than 10 kilometres. Adelaide is the most earthquake-prone capital city in Australia, with earthquakes of a magnitude five to six on the Richter scale occurring frequently enough to be a potential danger. Australia has experienced a number of destructive earthquakes in the past, most notably the 1954 Adelaide that caused widespread damage to housing and commercial structures, particularly unreinforced masonry buildings.²⁵

The 1954 Adelaide event experienced one of Australia's most damaging earthquakes for 20 to 30 seconds, a 5.5 Richter Scale earthquake caused damage to 3000 buildings.²⁶

²³ GeoScience Australia, 2023, 'Earthquake', Available at <https://www.ga.gov.au/education/natural-hazards/earthquake>

²⁴ Ibid.

²⁵ Ibid.

²⁶ Ibid.

3.7 Climate change projections

Nationally-recognised climate change projections for South Australia have been prepared by the Department for Environment and Water. This includes a guide to climate projections for risk assessment and planning in South Australia²⁷ and interactive mapping viewer²⁸.

Key climate projections relevant specifically to Kangaroo Island include:

Temperature

- Annual mean daily maximum and minimum temperatures will increase across all South Australian regions
- Mean daily maximum temperatures are projected to increase by 1.0 °C by 2030
- By 2030 mean annual minimum temperatures are projected to increase by up to 1.1 °C
- By 2050 mean annual maximum temperatures are projected to increase by 1.5 °C
- By 2050 annual mean minimum temperatures are projected to increase by 1.3 °C²⁹.

Seasonal temperature

- Across all South Australian regions, warming in spring is likely to be greater than in any other season
- By 2030 mean daily spring maximum temperatures are projected to increase by 1.0 °C compared to 0.9 °C for mean daily winter maximums
- By 2050 mean maximum spring temperatures are projected to increase by up to 2.7 °C, compared to mean maximum winter temperatures increases of up to 2.0 °C³⁰.

Extreme heat and heatwaves

- Across all South Australian regions, the frequency of very hot days will continue to increase, and heatwaves will get longer and hotter
- By 2030 the frequency of days per year above 35 °C in most regional centres is projected to increase by more than 30 per cent from the baseline period of 1986–2005
- By 2030 the frequency of days per year above 40 °C is projected to increase by more than 50 per cent from the baseline period of 1986–2005
- By 2050 the number of days per year above 35 °C is projected to increase by more than 40 per cent
- By 2050 the number of days per year over 40 °C is projected to more than double³¹.

²⁷ Department for Environment and Water, 2023, 'Latest Climate Change Projections for South Australia', Available at <https://www.environment.sa.gov.au/topics/climate-change/climate-science-knowledge-resources/latest-climate-projections-for-sa>

²⁸ Department for Environment and Water, 2023, 'South Australian Climate Projections Viewer', Available at <https://www.environment.sa.gov.au/climate-viewer/details/>

²⁹ Department for Environment and Water, 2023, 'Latest Climate Change Projections for South Australia', Available at <https://www.environment.sa.gov.au/topics/climate-change/climate-science-knowledge-resources/latest-climate-projections-for-sa>

³⁰ Ibid.

³¹ Ibid.

Frost

- Warming conditions will reduce the frequency of frost events after 2030. Locations where frost occurs only a few times a year under current conditions are projected to become nearly frost-free by 2030. Frost event frequencies are likely to remain comparable to current levels until then.

Rainfall

- Annual rainfall will decline across all South Australian regions
- By 2030 annual rainfall across the state is projected to decline by 1.7–6.8 per cent, from the baseline period of 1986–2005
- By 2050 annual rainfall is projected to decline by 4.0–23.0 per cent
- Across all South Australian regions, rainfall declines in spring are likely to be greater than any other season
- By 2030, rainfall declines are projected for all regions for spring and autumn. Declines are greater in spring than any other season, which for Kangaroo Island involves a projected 13.2 per cent decline
- By 2030, a small decline in summer rainfall is projected for Kangaroo Island
- By 2050 rainfall declines are projected for all regions in all seasons
- The amount of rain falling in extreme rainfall events will increase in all South Australian regions and the frequency of extreme rainfall events will increase³².

Drought

- The amount of time spent in drought will increase for all South Australian regions
- By 2030, time spent in drought (over a 20-year period) is projected to nearly double for Kangaroo Island. This means that up to 65 per cent of time could be in drought by 2030. By 2030 the frequency of extreme drought will more than double³³.

Fire weather

- All of South Australia is projected to experience harsher fire weather. Projected warming and drying across the state will lead to fuels that are drier and more ready-to-burn³⁴.

Potential evapotranspiration

- Potential evapotranspiration is projected to increase across all seasons and regions in South Australia
- By 2030 increases in annual potential evapotranspiration of 2.4 per cent is projected for Kangaroo Island
- By 2050 increases in annual potential evapotranspiration of 4.1 per cent is projected for Kangaroo Island³⁵.

³² Ibid.

³³ Ibid.

³⁴ Ibid.

³⁵ Ibid.

Sea level rise

- Sea levels along the South Australian coasts are projected to continue to rise. The height of extreme sea level events will also increase
- By 2030, a sea level rise of around 13 cm is projected compared with the average level during 1986–2005
- By 2050, a sea level rise of 22–25 cm is projected compared with the average level during 1986–2005
- By the end of the century, a sea level rise of between 39 and 85 cm is projected. However, if Antarctic ice sheet collapse occurs, these projections could be several tenths of a metre higher³⁶.

Sea surface temperature, salinity and acidification

- Sea surface temperatures are projected to continue to rise and acidity will continue to increase. Ocean salinity is likely to decrease in South Australian waters³⁷.

Acknowledging climate change projections allows us the ability to be forearmed about the frequency and intensity of trends and patterns into the future and gain insight into what it may mean in terms of the natural hazards we might experience. This allows us to better prepare and have regard to the spectrum of potential options available to mitigate future risks that are exacerbated by a changing climate.

³⁶ Ibid.

³⁷ Ibid.

4 Managing our risks

Kangaroo Island is exposed to a variety of risks, stemming from different natural processes. A key opportunity to deal with these risks in a proactive manner relies on their identification, so that we can consider how best to reduce them. This process is called 'disaster risk management' or 'disaster risk reduction'. It acknowledges that we may not be able to completely avoid or remove risks, but that together we take proactive steps to do what we can to reduce their probability, their consequences or our own vulnerability to them. This is called 'mitigation'.

Why do we need to think about this?

In Australia, disaster events cost the national economy an estimated \$38 billion per year on average and this is expected to reach at least \$73 billion per year by 2060³⁸. This is economically unsustainable, let alone the human and social, cultural, and environmental impacts that are associated.

In South Australia, climate predictions for hot weather have already reached the levels previously predicted for 2030. There has been an increase in extreme fire weather and the length of the fire season since the 1970s, and sea level rise has already increased the incidence of storm surge impacting the coasts of South Australia.³⁹

When we expand these characteristics into what it means about the risks we face, we know that South Australia is the driest state on the driest inhabited continent in the world, so our bushfire risk is elevated. We also have a large proportion of population living in coastal environments, exposed to inundation, erosion and severe weather risks. From an economic perspective, our economic activity spans agriculture, tourism, forestry, and fishing amongst others, all of which are exposed and vulnerable to natural hazards in different ways.⁴⁰

How can mitigation help?

For every \$1.00 invested through resilience initiatives, there is an estimated \$9.60 return on investment⁴¹. This return on investment means we are ultimately less exposed to serious risk consequences into the future, and our vulnerability is reduced. This makes us more resilient to withstanding the effects of serious weather and natural processes when they occur.

Part of this is also understanding exactly when mitigation measures are needed. We know that some natural hazards may result in serious impacts on the places we live and work in the future, so it is important for us to have a clear understanding of when certain decisions on specific matters is necessary. These are called 'trigger points'.

This enables us to focus on immediate risk priorities today, while keeping as many options open to deal with future risks as circumstances change. This also helps us to make the most of available funds for mitigation and management, ensuring they are directed to our highest needs. This is a key function of the Preparing KI Action Plan.

³⁸ National Emergency Management Agency, 2023, 'The Second National Action Plan: To Implement the National Disaster Risk Reduction Framework', Australian Government, Available at <https://nema.gov.au/about-us/policies/strategies-and-frameworks#National%20Action>

³⁹ Government of South Australia, 2019, 'Stronger Together – South Australia's Disaster Resilience Strategy', Available at <https://www.safecom.sa.gov.au/initiatives/stronger-together-south-australias-disaster-resilience-strategy/>

⁴⁰ Ibid.

⁴¹ National Emergency Management Agency, 2023, 'The Second National Action Plan: To Implement the National Disaster Risk Reduction Framework', Australian Government, Available at <https://nema.gov.au/about-us/policies/strategies-and-frameworks#National%20Action>

What does risk mitigation and management involve?

There are different ways of treating risks. For future risk, or risk that could be generated from decisions made today or tomorrow, we have the opportunity to avoid certain types, extents or levels of risk by making risk-informed decisions. An example of this is decisions made through land use planning processes which help to orient people and property away from highly exposed locations or circumstances.

Where treating extent risks, there are different strengths of mitigation approaches. One of the most potent options is that of transition, where decisions are made to transition people, property and/or assets away from highly exposed locations or circumstances.

We can also decide to arrest risk, which involves decisions to limit further risk exposure and maintain the current level of exposure. These situations may also involve proactive mitigation measures, which can be one-off actions or re-occurring activities which directly and indirectly seek to reduce risk by limiting probability of occurrence, through limiting potential consequences or decreasing levels of vulnerability. An example of a one-off actions might be the construction of a sea wall or levee to treat coastal hazard risks whilst an example of a re-occurring activity might include annual fuel load reduction actions such as planned burning or mechanical vegetation management.

Where risks might be sufficiently low enough to warrant, they can often be transferred or accepted. That is, the risk may be sufficiently low that a person, business, or entity (decision-maker) is willing to accept the risk in light of the potential consequences. Part of this may also include how risk is transferred. An example of this includes insurance, where the balance of accepted risk is transferred via insurance coverage. Other risks may be transferred to emergency services or other entities.

All of these mitigation measures help to limit residual risk, which is a key goal. This is the risk we are left with once mitigation measures have been undertaken. Again, not all risk can be avoided or removed, which is why limiting risk exposure is critical. When we understand the transfer of risk, particularly to emergency services, we better understand the need for collective mitigation of risk to ensure the impost or burden of this risk is as low as possible.

This concept is highlighted by the 'ALARP' principle of risk tolerance, illustrated below.

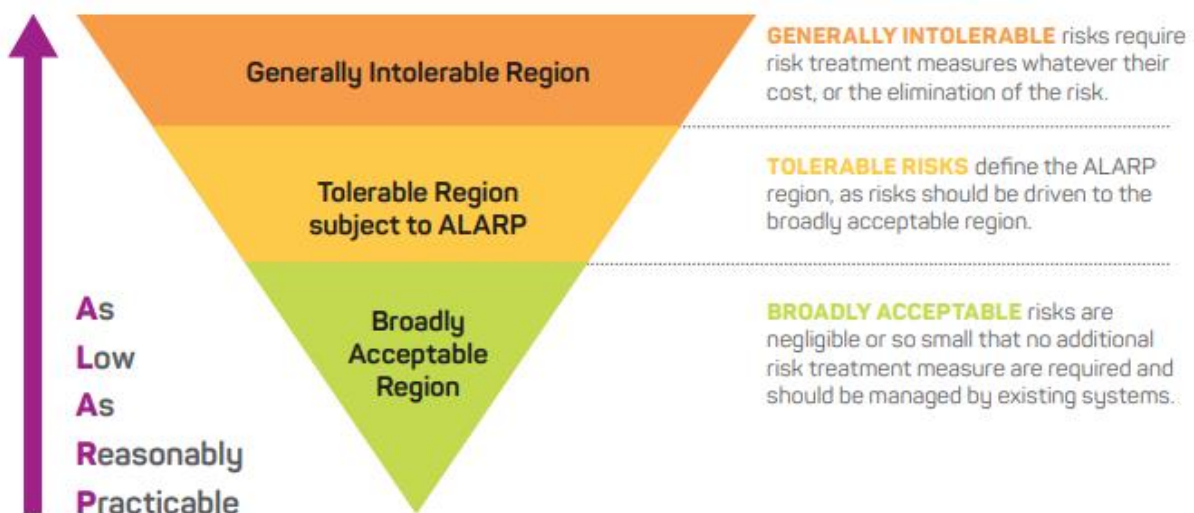


Figure 13 - ALARP principle of risk tolerance (Source: AIDR Handbook Collection, 2020)

4.1 Risk management on Kangaroo Island

There is an extensive history of proactive risk management approaches in place across Kangaroo Island. Learnings from past events have helped shape the necessary pathways for risk mitigation and future disaster risk reduction. A variety of risk management programs are in place that aim to minimise potential risks, and the Preparing KI Action Plan has involved a review of approximately 50 of these, ranging from local and district plans, local government-wide plans and strategies, as well as regional and State-level programs.

This review was necessary to identify where the priorities for mitigation exist against a large volume of actions provided across many different documents, plans, strategies and programs.

Key plans and programs that are currently in place to mitigate disaster risks on Kangaroo Island include (but are not limited to):

- KIC Strategic Plan
- KIC Infrastructure and Asset Management Plan
- KIC Township Bushfire Risk Management Strategy 2020
- KI Coastal Hazard Strategy
- KI Bushfire Management Area Plan (BMAP)
- Parks of Kangaroo Island Fire Management Plan
- MacGillivray/Haines Flooding Event 2013-14 Impact Assessment
- Resilient Hills and Coasts: Climate Change Adaptation Plan for the Adelaide Hills, Fleurieu Peninsula and Kangaroo Island Region
- South Australian Climate Change Action Plan
- Safer Together: SA Disaster Resilience Strategy
- Southern and Hills LGA Regional Public Health and Wellbeing Plan
- Independent Review into the South Australia's 2019-20 Bushfire Season.

Preparing KI has examined the actions identified by the above documents (and more) against the priorities of the NDRRF using a series of analysis techniques identified in the methodology section of this plan, to understand the forward priorities for investment either by active pursuit or through opportunity as circumstances (including funding) arises.

What is being done?

Risk reduction is a firm priority for KIC as well as other government agencies. In 2023, SA Parks and Wildlife Service consulted on its draft Parks of Kangaroo Island Fire Management Plan which will replace four (4) existing plans with a plan for the whole Island⁴². In addition, SA Country Fire Service (CFS) is understood to be putting arrangements in place to embark upon a revision of the KI Bushfire Management Area Plan (KI BMAP 2.0). Recent funding was also awarded for the revision of the Resilient Hills and Coast Climate Change Adaptation Plan, whilst KIC's Infrastructure and Assessment Management Plan is subject to ongoing, iterative updates.

Each of these processes introduce the opportunity for continued advancement and improvement in the way that natural hazard risk is managed and mitigated on Kangaroo Island.

⁴² Department of Environment and Water, 2023, 'Draft Parks of Kangaroo Island Fire Management Plan', Available at <https://www.environment.sa.gov.au/topics/fire-management/fire-science-and-planning/fire-management-plans/ki-fire-management-plan#:~:text=The%20new%20plan%20will%20provide,cultural%20heritage%20of%20the%20state.>

Other examples of proactive risk and resilience activities are highlighted by the following case studies:

Case study – Resilient Ready Business

The Kangaroo Island Business Hub is a free government service that connects businesses to information, support services and experts in one convenient place. Together with Resilient Ready, and the business communities of Kangaroo Island, it has delivered an online 'roadmap' to build local resilience. 'Business Climate' is the theme the local community has chosen.

Disasters are impacting the Kangaroo Island business community like never before. A constantly changing climate requires a new culture of business risk reduction and resilience. To build capabilities in business across the region, Resilient Ready was funded to create a free solution for the local business community. The 'Kangaroo Island Business Climate' Roadmap enables every person who owns, operates or works in a local business (including not-for-profits) to do business better – in the good times and bad.

This is a collaborative project between Resilient Ready, the South Australian Department for Industry, Innovation and Science (DIIS) and the Kangaroo Island Business Hub, funded by SAFECOM. Members of the Kangaroo Island business community can access the Roadmap online for free until 30 June 2026.

The Business Hub is located on Commercial Street in Kingscote, offering a range of in-house services including business information, expert advice, government support services, coaching and mentoring to help your business start, grow or become more competitive. It is jointly funded by the South Australian and Australian Governments to support the economic recovery of Kangaroo Island.

Case study – Red Cross Pillowcase Project

Pillowcase workshops help children prepare for, cope with and respond to an emergency. Children may be vulnerable in an emergency, but they also have unique strength and capacity to prepare, cope and help their families. Practical skills that contribute to disaster resilience can be learned and practised. Children who participate in disaster resilience building activities have been shown to be better equipped to deal with an emergency.

Research suggests that educating children in disaster preparedness helps create a culture of preparedness and resilience in the community as a whole. Children are positive change agents within their families and their communities. If given the opportunity to participate, they can make a very real and positive difference before, during and after an emergency.

The Pillowcase Project was originally inspired by events during Hurricane Katrina in the US. While evacuating from campus, university students used pillowcases to carry their cherished and basic possessions. After hearing this, American Red Cross staff developed the concept of using a pillowcase as an emergency kit. The program quickly grew into a global preparedness education program that has since become known as the Pillowcase Project.

Delivered by Red Cross volunteers and staff, the workshop encourages children to be active participants in their own emergency preparedness, reducing real and imagined fears and has successfully built children's stress management skills. The one-hour workshop involves engaging discussions and interactive activities to help students:

- Understand and discuss the importance of being prepared
- Prepare their mind for the thoughts and feelings that may arise before, during and after an emergency
- Know what to pack in an emergency kit.

Each student is given a pillowcase to decorate and take home, to start a personal emergency kit. This project was delivered with school children across Kangaroo Island in 2023.

What are our key vulnerabilities to natural hazard risks on Kangaroo Island?

Having regard to plans in place via emergency management protocols, the documentation of risk across multiple hazard management plans and strategies, and as articulated via community and stakeholder consultation, some of the key attributes of vulnerability which the Preparing KI Action Plan has identified include:

Our key vulnerabilities:

- Our Island location, reliant on ferry services and air transport for the mainland to support emergency management and recovery efforts
- Our reliance on a single sub-marine 33kV electricity cable from the mainland to Cuttlefish Bay near Penneshaw with limited electricity network redundancy
- A single road connection, Hog Bay Road at Pelican Lagoon, joins the Dudley Peninsula with the western half of the Island, is subject to a number of coastal hazards
- A number of critical infrastructure assets which support broader network connectivity are exposed to bushfire, flood and/or coastal hazards, where the potential for cascading risks for communities is present (i.e. telecommunications, wastewater treatment plants and pumping stations, water supply assets and local electricity networks). This includes exposure and vulnerability to saltwater intrusion of the groundwater table for underground assets
- Isolation of the Kingscote airport in certain flood events
- There is high collective knowledge across community in relation to bushfire hazard and risk, but comparatively less knowledge and experience with other hazards
- Ecological communities and wilderness values which are unique to Kangaroo Island, requiring protection
- An ageing resident population
- High tourism visitor numbers which are elevated in the summer season, involving persons who are unfamiliar with the landscape and often located in isolated areas
- Reliance upon a small number of dominant economic industries and employment. In addition, these industries rely heavily on the health of the Island's landscapes which are impacted by natural hazard events
- Construction of majority proportion of building stock prior to current building standards for bushfire, wind, minimum floor levels, etc.
- Access to services, including medical, with most services requiring travel to the mainland.

Some of our greatest vulnerabilities also underpin our greatest opportunities. Those attributes that increase resilience, as highlighted through the community consultation conducted as part of preparing this Action Plan, include:

- The demonstrated ability to stand shoulder-to-shoulder in the face of adversity
- The desire to work collaboratively towards the greater good and better outcomes
- A collective desire to preserve the sense of 'Island-ness'
- Broad dedication to protecting and enhancing the Island's natural values
- Community experience in responding to and recovering from past events, enabling lessons learnt to be carried forward and shared for the benefit of others
- A strong sense of community and community identity.

It is these tools that can be used to address our vulnerabilities and mitigate risks that stem from exposure to natural hazards on Kangaroo Island.

5 Mitigation priorities

This section outlines 20 priority areas for action and investment to mitigate and reduce disaster risk on Kangaroo Island and enhance resilience over time. These priorities focus on those activities that are principally within Council's jurisdiction to deliver, but which may require or be entirely dependent upon State, Commonwealth or other funding.

What considerations underpinned the identification of mitigation priorities?

The foundation of the Preparing KI Action Plan adopts a 'shared responsibility' model. This is a model that acknowledges that everyone has a role to play in risk mitigation and minimisation. Whilst this plan focuses on Council-led activities, any action led by any level of government is only as meaningful as the effort and actions taken by individuals, households and communities.

It is important that everyone understands their risks and takes steps to minimise them. There are roles and responsibilities for all.

Part of the 'shared responsibility' model acknowledges the collaborative partnerships required across government, with community, the not-for-profit sector and industry to successfully manage and mitigate risks.

A cornerstone risk management framework methodology in Australia is the 'Prevention, Preparedness, Response, Recovery' or 'PPRR' model. It reflects the cyclical nature of events and the processes required to effectively deal with them. Most priority actions identified by the Preparing KI Action Plan are 'prevention' and 'preparedness' measures, deliberately addressing risks to limit their probability, the consequences that might arise or our vulnerability to them.

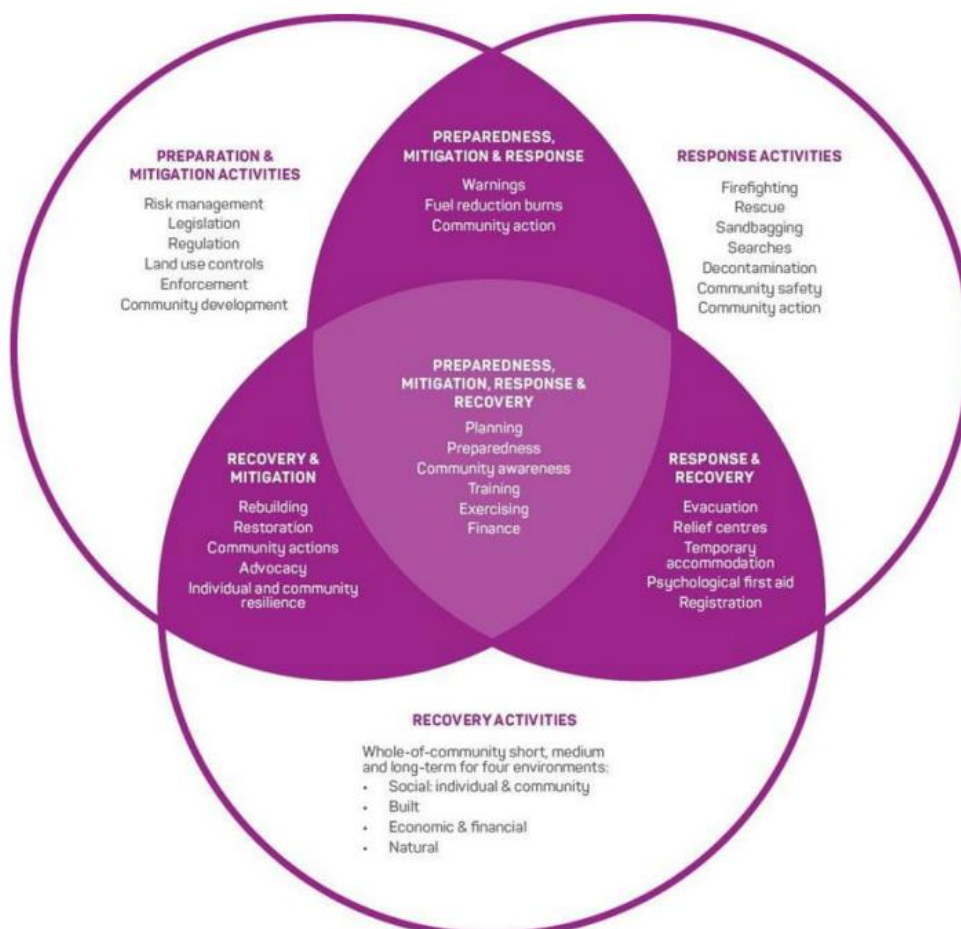


Figure 14 - Activities that can support PPRR (Source: AIDR Community Recovery Handbook, 2018)

How was the process of prioritisation undertaken?

Through an examination of almost 50 documents including studies, plans and strategies, over 250 risk mitigation actions were identified via discrete bodies of work. The Preparing KI Action Plan has synthesised these across a range of criteria to perform a stocktake of actions.

The first round of investigation which was conducted for every action included a PESTLE⁴³ and SWOT⁴⁴ analysis. This gave insight as to the magnitude of the action relative to effort and time (i.e. how easy or difficult the action would be to implement to generate a risk reduction outcome). That assessment enabled a synthesised 'shortlisted' suite of actions to be identified, which was over 50 in number.

The next phase sought to assess the effectiveness of the action across a spectrum of criteria, using multi-criteria analysis (MCA). Benefit criteria informing this approach included an assessment of effectiveness, geoscale, multiple hazard response, co-benefits and longevity. Viability criteria included timing, permits, funding and technical feasibility. The highest scoring actions against each domain (see below) were identified as clear priority actions through the rigorous assessment process conducted.

A qualitative cost benefit analysis (CBA) was then conducted. Due to vastly different nature of the priority actions which are identified by Preparing KI, an 'efficiency quotient' (EQ) score was applied for each action rather than a cost benefit ratio. This measures the effectiveness or value of an action in relation to its costs. Following the EQ scoring, the options are ranked based on the Efficiency Quotient score and presented alongside the MCA results by line of resilience.

Overall, the approaches applied removed the potential for bias, informing action prioritisation through the application of methodologies to measure different variables. This provides a strength of evidence that supports the weighting of each action.



Figure 15 - Preparing KI action prioritisation process

⁴³ Political, economic, social, technological, legal and environmental

⁴⁴ Strengths, weaknesses, opportunities and threats

5.1 Costed priority actions by domain

The Preparing KI Action Plan uses domains or themes to communicate the breadth of mitigation and disaster risk reduction priorities. This adopts the same integrated and multi-disciplinary 'recovery domains' approach identified by the State Disaster Recovery Coordination Framework⁴⁵, with addition of a 'governance' domain. It is important that the same concepts to inform risk reduction and resilience are contemplated in the same manner as applied for recovery processes to provide a clear line of sight across the PPRR spectrum, thus the value in utilising a consistent framework.

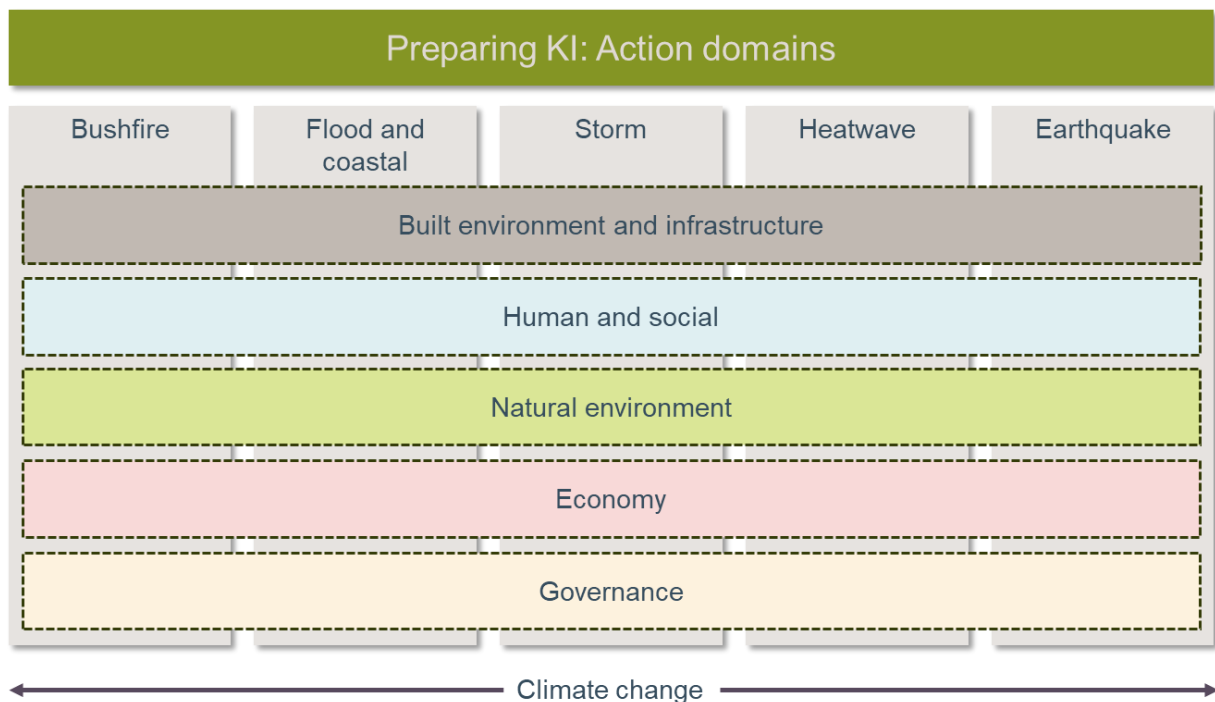


Figure 16 - Preparing KI action domains

Each of the action domains is expanded over the following pages, highlighting:

- The nature of the domain and what it covers
- Priority actions (within Council's sphere of control)
- Quick wins and wicked challenges
- Trigger points for decision-making or implementation.

This enables an 'adaptation pathways approach', offering the flexibility necessary to take action now, on that things that require immediate attention, whilst providing pathways for those that can be taken in the future. This enables the ability to plan for, prioritise and orient investment in mitigation to support informed decision-making. It also provides the ability to pivot and deploy multiple combinations of actions as circumstances and needs change over time.

The 20 priority actions identified by Preparing KI are direct pursuit actions, which represent 'no or low regret' actions which should be actively pursued by Council. Additional opportunistic actions are highlighted in the next section. The full action plan is included at **Appendix A**, including costs.

⁴⁵ Government of South Australia, 2022, 'State Disaster Recovery Coordination Framework', Available at <https://www.recovery.sa.gov.au/about-recovery/resources-for-recovery-coordinators/resource-documents/SDRCF-2022-SA-Disaster-Recovery-Coordination-Framework-V2.1-Final-Approved.pdf>

5.1.1 Built environment and infrastructure

The risk mitigation focus for the built environment and infrastructure relies on:

- Setting in place governance and policy measures for risk-informed decision-making and investment
- Investment in intelligence and monitoring
- Consideration of climate impacts on critical infrastructure assets, networks and services
- Evacuation and refuge management planning
- Road and transport network resilience enhancements.

Immediate (quick win) priorities can be delivered via Council's Infrastructure and Asset Management Plan program.

Ongoing funding and investment for intelligence gathering and data monitoring is necessary to underpin informed decision-making as circumstances change over time.

Investment in road and transport resilience, particularly for an Island community, remains a priority. Road investment is typically high cost both for State and local government, which underscores the need to ensure road and transport risk and resilience is captured as part of policy and governance processes.

Planning for evacuation centres and places of refuge focuses on ensuring venues and facilities are of sufficient standard to meet the needs of community.

In the longer term, the wastewater pumping stations sea level risk analysis provides an opportunity to understand the timeframes for action to protect and/or mitigate impacts on existing critical infrastructure. Work to date on this action identifies that all assets are at risk by 2050, some which are sooner due to erosion risk. This provides a clear framework for the triggering of decisions to ensure sustainable service continuity at 2050.

Costs and delivery

Built environment and infrastructure priority mitigation actions are estimated to cost more than \$5.2 million.

Council's annual income, based on its latest Annual Report, is \$22 million based on \$11 million drawn from rates and a further \$15 million drawn from various grants. Council's receives \$3.5 million annual from the Government of South Australia for local road maintenance. Therefore, Council is heavily reliant on external funding and grant allocations to support its operations. In the last financial year, Council operated at a marginal loss.⁴⁶

Investment in natural hazard and disaster risk reduction mitigation measures is therefore beyond the current financial capacity of Kangaroo Island Council without support from State and Commonwealth funding and grant allocation.

⁴⁶ Kangaroo Island Council, 2023, 'Annual Report 2022-23', Available at https://www.kangarooisland.sa.gov.au/data/assets/pdf_file/0029/1508627/2022-23-Annual-Report.pdf

ID	Built environment and infrastructure priority actions	Estimated costing
01	<p>Update the Infrastructure and Asset Management Plan to:</p> <ul style="list-style-type: none"> include whole-of-life costs that incorporate natural hazard impacts and potential costs of reconstruction design uplift to incorporate climate change consideration to 2100 a decision-making framework that considers climate change, risk reduction and adaptation identification of exists assets at risk and mitigation strategies a policy on adaptation, asset abandonment and renewal for assts at risk. 	\$20,000-\$100,000
02	Continue to deliver on and implement an updated Infrastructure and Asset Management Plan as business as usual	>\$5 million
03	Continue to invest in and collate hazard and risk data, including investment in monitoring, to inform decision making. This includes concurrent event modelling for flood and coastal hazards, groundwater monitoring, etc.	\$100,000-\$500,000 (annually)
04	Scope the effective mitigation or managed retreat of wastewater pumping stations at Brownlow, American River and Penneshaw, exposed to both coastal hazards and flooding. Roll out a second phase for other community wastewater management systems that are exposed	\$20,000-\$100,000
05	Enhance refuge and evacuation centre planning for facilities at Penneshaw and Kingscote (for bushfire, potentially for other locations for other events) as primary evacuation locations on the Island. Include heatwave strategies and heat refuge hub opportunities for Council assets (such as air-conditioned buildings and sustainable energy supplies). Consider multi-use facilities as part of renewal and new asset development for community uses	\$20,000-\$100,000
06	A register and spatial catalogue of key routes for all-weather access can be developed and included in Council's road hierarchy, levels of service, budget process and maintenance programs. This is not exclusive to emergencies but for economic purposes also, and can be shared with combat agencies	<\$20,000
07	Undertake an evacuation study for townships across the Island to determine if additional road access or other evacuation requirements are needed for different hazards but with a focus on bushfire	\$20,000-\$100,000
08	Undertake a program to identify key vulnerabilities (places where roads are cut, where water impacts pavement quality) of the existing State and local road network to inform funding priorities and identify on-going management and mitigation measures for different scenarios	\$20,000-\$100,000

5.1.2 Human and social

The risk mitigation focus for people and communities relies on:

- Involving the community in co-design processes to consider their own resilience (separate to emergency preparedness)
- Sharing technical hazard and risk intelligence procured by Council over time, in a format that is easily understandable by the public to support informed decision-making by the community
- Continued support for community events and opportunities for community to come together
- Active participation in delivering community education on natural hazards and risk.

There are many entities, organisations and community champions which support individuals and communities through preparedness and recovery, and indeed this remains one of the Island's highest resilience strengths – its sense of community.

Council's role in supporting people and communities centres around the dissemination of easily understandable information on different types of natural hazards and their risks that are specific to districts and places across the Island, to support informed decision making.

Over time, Council undertakes, commissions and participates in natural hazard and risk studies. It is important that insights from these bodies of work is proactively communicated with the Kangaroo Island community to provide continuous education and support community collaboration and participation in important mitigation decisions.

It is in Council's interest to work alongside, partner with and support human and socially-focused resilience programs and projects which work to build social capital, either directly or indirectly. Whilst the Kangaroo Island community maintains strong levels of community connection, this is constantly being challenged by emergent technologies, new of doing things, changes in demographics, impact from events and recovery processes, etc.

From the community's perspective, it is incumbent upon individuals and households to continuously grow awareness and work together to bolster existing levels of resilience. Kangaroo Island is exposed to a range of different natural hazards, as well as other hazards like biosecurity, disease and pandemic, etc. Bushfire is perhaps the most front of mind, but awareness of other hazards and risks, and the potential consequences of these, is lower which potentially increases vulnerabilities in some aspects.

Costs and delivery

Investment in human and social measures is low cost compared with other domains but can yield some of the highest benefits. Ongoing annual investment is estimated at around \$100,000.

ID	Human and social priority actions	Estimated costing
09	As per the Kangaroo Island Community Recovery Plan, support community-led local or district resilience and preparedness or community action plans, commencing with a pilot to design the program for whole-of-island roll out	\$20,000-\$100,000 (annually)
10	Prepare long-term community awareness and preparedness program in the context of hazard and how they occur on Kangaroo Island, including programs offered by stakeholder agencies, not-for-profits and groups	<\$20,000

5.1.3 Natural environment

The environmental risk mitigation focus for Kangaroo Island Council relies on:

- A continued focus on fuel load management on Council land and road reserves
- Implementation of existing bushfire management plans and strategies, in partnership with associated entities
- Appreciation for and understanding of the environmental values and risk consequences of the Island's ecosystems, and interaction of natural processes with the built environment and critical infrastructure.

Kangaroo Island comprises unique landscapes and natural values which are not located elsewhere in Australia, or the world. It is because of these assets that it was named the World's Number 2 must-visit region for 2024 by Lonely Planet.

A large proportion of the Island is dedicated as national park or wilderness area, under the stewardship of the National Parks and Wildlife Service as part of the Department for Environment and Water. Council's continued partnership with the Department is essential to ensuring collective environmental management on a whole-of-island basis.

The draft Parks of Kangaroo Island Fire Management Plan seeks to apply a whole-of-island approach to the management of national parks and reserves from a fire ecology perspective, but also having regard to the landscape-scale fuels which multiple parks (as well as private and Council lands) contribute to. Council's support of its implementation alongside the Department is essential. This likewise applies to the management of dune systems, coastal and estuary environments which are managed by other entities, and for which community groups are also heavily involved.

With specific regard to environmental mitigation measures, a focus for Council remains heavily associated with annual fuel load management across its lands and road reserves, working with others including the Kangaroo Island Landscape Board, CFS, and Native Vegetation Council to support private landholders to improve fuel load management across private landholdings.

Costs and delivery

Ongoing annual investment in environmental mitigation measures is estimated up to \$500,000.

ID	Natural environment priority actions	Estimated costing
11	Continue to implement fuel risk reduction activities in accordance with Council's fuel load management programs (prescribed burning, fuel breaks, asset protection zones, fuel reduced zones), the Kangaroo Island Bushfire Management Plan and Township Risk Mitigation Strategy, and continue to support efforts of other landholders and stakeholders to manage fuel loads across Kangaroo Island having regard to ecological values and fire regimes	\$100,000-\$500,000 (annually)
12	Develop a register of high risk ecological values / assets and integrate these into Council's fire management program and for the purposes of programs facilitated by other stakeholders	\$20,000-\$100,000
13	As per the Kangaroo Island Coastal Hazard Strategy, undertake an adaptation study to investigate the mitigation and adaptation options to protect coastal and foreshore assets, townships and communities from coastal hazards	\$20,000-\$100,000

5.1.4 Economy

The economic mitigation focus for Kangaroo Island Council relies on:

- Providing locally-relevant messaging to guide visitors who are unfamiliar with the area on what to do in case of different events / emergencies, given the large proportion of visitor numbers present on the Island at any time
- Maintaining continuity planning in perpetuity, through processes that leverage lessons learnt from previous events, situations and circumstances so that this knowledge is not lost over time.

Economic resilience, particularly for an Island population which relies on service continuity, access to supplies and ongoing employment, underpins social fabric. Connected communities and sustainable economic function go hand-in-hand.

Business and organisational continuity is therefore a key opportunity to ensure previous lessons learnt are transitioned into protocols and procedures to ensure service continuity before, during and after events, helping both businesses as well as the local economy to remain buoyant. This also applies to the function of Council as part of its service delivery, which is already supported by a comprehensive continuity plan. Maintaining this plan and scenario-testing it is a critical part of Council's risk management program.

More broadly, locally-specific messaging for the Island's large volume of visitors is a key activities that was previously identified by Council's Township Bushfire Protection and Mitigation Strategy, owing to the large number of short term accommodation formats where visitors may not be aware of locally-relevant information to help them prepare or guide what they may need to do, should the need arise.

Further, support for external programs like the Business Hub is a valuable way to help equip the broader business community to contemplate and develop risk management procedures, like business continuity plans.

Costs and delivery

Investment in economic mitigation measures is estimated at \$60,000.

ID	Economic priority actions	Estimated costing
14	Prepare consistent and locally-specific messaging for visitors in case of different natural hazard events and emergencies (i.e. for accommodation providers to make available)	<\$20,000
15	Ensure a continued focus of organisational continuity from multiple event types to ensure ongoing service provision for key essential activities, adopting a continuous improvement approach	<\$20,000
16	Work with stakeholders and the Kangaroo Island business community to support business continuity planning that contributes to broader community resilience	<\$20,000

5.1.5 Governance

The governance mitigation focus for Kangaroo Island Council relies on:

- A commitment that involves a permanent uplift to the business-as-usual arrangements, involving a dedicated and concerted effort, to enhance natural hazard mitigation and climate adaptation arrangements
- A commitment to the pursuit of grant funding as well as internal budget allocation and internal resourcing to implement the Preparing KI Action Plan in perpetuity
- Investment in people and community capacity to continuously improve upon how disaster risk reduction and climate adaption is embedded across the different service lines of Council.

The priorities of the NDRRF highlight the ongoing need to understand risks, deliver accountable decisions, enhance investment and focus on governance, ownership and responsibility. The Preparing KI Action Plan is Kangaroo Island Council's roadmap to delivering on and implementing its locally-identified priorities, and broader opportunities, to mitigate disaster risk, pursue enhanced climate adaptation and improve overall resilience.

The governance actions identified below represent pragmatic pathways forward which reflect the areas of focus highlighted above. Having regard to the population of Kangaroo Island relative to its expansive area and added need to cater for large volumes of non-resident tourists who also use local infrastructure, pressure on local government service delivery will persist. This underscores the need for investment in people (i.e. through training, education and capacity building) to continue to generate continue governance improvements.

The resilience to respond to an event is one thing, but resilience to recover is different. It is longer in duration, it is unrelenting, complex and exhausting. The Kangaroo Island community are no stranger to this contrast, but its ability to continue to endure lengthy, complex recovery processes will decrease over time as the frequency and intensity of events and its impacts potentially increases. Risk-informed governance processes which aim to incrementally reduce risk and grow collective climate adaptation will stand the Island and its communities and townships in good stead into the future.

Costs and delivery

Investment in governance mitigation measures is estimated between \$240,000 and \$1.1 million.

ID	Governance priority actions	Estimated costing
17	Develop a corporate climate change risk policy and strategy and embed it across Council's service areas / divisions	\$20,000-\$100,000
18	Enhance the integration of disaster and risk reduction, mitigation and resilience into Council's Strategic Management Plan and embed these elements across all relevant corporate plans and strategies	<\$20,000
19	Invest in a resilience officer to support implementation of the Preparing KI Action Plan	\$100,000-\$500,000
20	Invest in human and physical resources (i.e. machinery, equipment, digitising the Council's radio network) to continue to deliver Council's fuel risk reduction activities	\$100,000-\$500,000

6 Other action opportunities

The priority actions identified as part of this Action Plan are those that require direct pursuit over time to address. However, other actions have also been identified that, should funding opportunities allow, also offer various disaster risk mitigation benefits.

These actions should continue to be considered in all Council activities and opportunities for implementation, beyond the priority action for direct pursuit. These balance actions remain important and should be progressed as opportunities arise, which may include:

- Funding opportunities for specific actions
- Emerging complementary actions which could be merged as a program of work
- New staff or technical capacity or capability arises
- A willingness or priority emerges from stakeholders to pursue this action
- Opportunity arises in association with another event, recovery funding or actions.

These action opportunities include:

Investigate the validity of investing in emergency alert sirens	Prepare a capacity building, training and education plan for staff across programs and purpose which includes: - formal training - technical support - mental health first aid - embedding climate change into policy and other activities	Identify tasks for a Landowner Partnerships program for effective fire management and risk reduction	Invest in spatial data management programs and/or personnel to support the management and capture of spatial datasets
Establish and/or maintain regular contact with CFS to ensure risk mitigation strategies are aligned	Develop and implement community engagement strategies for different hazards and risks	Develop a Council endorsed prospectus that identifies the fundamental strategic investment priorities for the Island	Make a permanent position for a bushfire mitigation and resilience officer
Use technologies to identify flood peak extents and undertake a time series of summer and winter water levels	Enhance the character, amenity, safety and accessibility of the built environment through an active streetscape and public realm beatification program	Engage a suitably qualified technical expert to review options for increasing the height of existing levee banks or investigate new levee design and function options	Maintain the health and extent of seagrass coverage, and protect and enhance coastal dunes
Continue to work collaboratively to implement and update the KI BMAP Treatment Register System (TRS)	Develop a tourism operator bushfire emergency strategy	Increase knowledge and skills in relation to DRFA obligations and opportunities	Consider long-term buy back of land to assist with joint risk management

7 Roles and responsibilities

Roles and responsibilities in emergency management are clearly articulated by the State Emergency Management Plan. For resilience, disaster risk reduction and climate adaptation, roles and responsibilities are less defined.

The bottom line is that everyone has a role, though the scale of the role might vary. It also involves different things from different people or groups.

Local government

Local government is the closest level of government to community and therefore it wears many hats. It has a large number of statutory service delivery obligations and it also acts a voice for the community to higher levels of government. It can also provide many other community-servicing functions that 'fall through the cracks' of governance processes, even where there is no statutory requirement to do so. This is particularly the case with facets disaster risk reduction, climate adaptation and resilience. A significant reason this is the case is because of the systemic nature and inter-relationships of issues across domains.

Local government is also the level of government with the least resources to perform the functions it is required or requested to provide. Councils have statutory responsibilities for prudent financial management and are subject to stringent reporting processes. Councils there must be diligent in how and where it allocates its limited resources.

In addition to its statutory and non-statutory responsibilities, Council's also have a role in identifying and advocating for projects and activities that are needed locally to mitigate existing and emergent disaster risks, and build resilience. Council can also actively utilise existing governance arrangements, such as the emergency management arrangements, to identify risks and issues that it cannot manage on its own, and transfer these risks or issues to higher levels of government to address.

State government

The state government has a strong role to play in advancing risk reduction locally and regionally, both in supporting the strengthening of communities and places and providing resources and leadership during and following events. This is achieved in three (3) ways:

- Via its emergency management responsibilities
- Through the provision of funding, resourcing and technical assistance or support to achieve statutory obligations
- Ensuring government activities and services, such as the provision of transport, health, urban development, administration, etc. aid risk reduction and do not inadvertently increase risk or vulnerability.

Commonwealth government

The Commonwealth government is responsible for national leadership on adaptation, managing Australian Government assets and services including significant investments in public infrastructure, and providing national climate science and information. It maintains a strong, flexible economy and well-targeted safety net to ensure that disaster events and climate change does not disproportionately affect vulnerable groups.

Control versus influence

Across our various roles that contribute towards disaster risk mitigation and enhanced resilience, some things may be in our direct control, and others we may not control but we can influence.

For example, as an individual or as a household we can control whether we prepare our properties and have emergency or evacuation plans in place. We cannot control whether our neighbours have a plan, but we can help to influence them by discussing our plan with them and asking what their plan involves, to trigger conversation.

We can also actively advocate, which involves a public expression of support for an idea, need or position.

The control versus influence contrast exists across all risk domains and so it is important that we remember that whilst we may not have control over something, this does not mean we are not part of the solution.

7.1 The roles and responsibilities of communities and individuals

Whilst the Preparing KI Action Plan provides a roadmap for local government in its investment in disaster risk reduction, it is also important to note the role and responsibilities of the community, households and individuals in not only preparing for severe weather and events, but for investment of time (and resources, to the extent feasible) into continuing to build resilience.

This may involve:

- Maintaining community connections, involvement in community groups and volunteering
- Preparing emergency and evacuation plans for households and businesses, sharing it with others and implementing it
- Taking steps, the degree feasible, to improve the resilience of properties and buildings. This might involve implementing and maintaining asset protection zones, building maintenance, replacing structures with more resilient materials, generators, fuel powered water pumps, increasing static water supply, and so on
- Having an emergency kit and keeping it stocked. This includes battery operated radios, portable device chargers, water, food, medications and other supplies to last about 3-5 days
- Establishing community gardens and the like to grow local produce and help alleviate cost of living
- Understanding the plan of loved ones, friends and neighbours in an event
- Checking insurances to make sure sufficient coverage is included
- Actively participating in risk management and resilience consultation processes to ensure local voices and needs are heard and understood.

8 Implementation framework

The priority actions provide key activities for pursuit by Kangaroo Island Council, either as part of business-as-usual or pursuant to State or Commonwealth funding. For this reason, it is important to acknowledge that the delivery of the majority of priority actions is almost entirely dependent upon funding and grant application success.

This Action Plan also includes a series of opportunity actions should funding arise.

Importantly, the Preparing KI Action Plan also serves a role in terms of recovery. The strategic and technical methodologies applied to inform this Action Plan may offer benefit in times of recovery where projects to enhance resilience can be considered under Category D of National Disaster Recovery Funding Arrangements (DRFA) where exceptional circumstances apply.

The Preparing KI Action Plan should be championed across all areas of Council to better integrate and embed disaster risk reduction activities and opportunities as part of day-to-day decision making, through standard processes, and to inform decision-making of Council.

Responsibility for implementation of the Action Plan lies with the Works and Infrastructure Division of Council.

A number of actions identify rely on inter-agency partnerships, stakeholder collaboration and coordination.

Noting that disaster risk reduction is an ongoing journey of improvement, it is recommended this Action Plan is updated every five (5) years, taking into account emergent science and information, changing technologies, and lessons learnt.

It is intended that the content of this Action Plan, and the rigorous methodology applied to inform it, is utilised by Council and allied stakeholders to inform applications for funding and grant assistance for the delivery of priority and opportunity actions to mitigate and reduce disaster risk across Kangaroo Island. It provides a clear line of sight between local need, and the resilience, disaster risk reduction and climate adaptation policy environment at regional, state and federal levels.



APPENDICES



Appendix A - Full action plan

Table 1 - Kangaroo Island Council prioritised disaster risk reduction and mitigation action plan

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
BUILT ENVIRONMENT AND INFRASTRUCTURE							
01	<p>Update the Infrastructure and Asset Management Plan to:</p> <ul style="list-style-type: none"> include whole-of-life costs that incorporate natural hazard impacts and potential costs of reconstruction design uplift to incorporate climate change consideration to 2100 a decision-making framework that considers climate change, risk reduction and adaptation identification of exists assets at risk and mitigation strategies a policy on adaptation, asset abandonment and 	<p>A number of actions identified across a suite of existing studies, plans and strategies identify a range of updates and additions to be embedded within Council's Infrastructure and Asset Management Plan. In particular, the Climate Change Governance Strategy prepared for Council highlights a number of climate adaptation related tasks required to ensure it is embedded across Council's infrastructure and assessment planning and delivery, and forms part of Council's decision-making processes. The integration of disaster risk reduction and climate adaptation considerations into the plan is a key opportunity to embed resilience enhancement into Council service delivery over time.</p>	4.23	4.52	1	4.52	\$20,000-\$100,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	renewal for assts at risk.						
02	Continue to deliver on and implement an updated Infrastructure and Asset Management Plan as business as usual	Continued delivery of the plan, alongside other plans and strategies which focus on mitigation, risk reduction and climate adaptation, will provide deliver resilience enhancement over time throughout the lifetime of the plan. The plan sets in place the framework to ensure risk and adaptation are featured as part of the Council's decision-making processes with regard to investment in infrastructure and asset provision, management and maintenance.	4.0	4.26	2.0	2.13	>\$5 million
03	Continue to invest in and collate hazard and risk data, including investment in monitoring, to inform decision making. This includes concurrent event modelling for flood and coastal hazards	There is an identified need, featured across technical studies as well as evidenced via stakeholder consultation, that addition investment in and focus on monitoring is essential to inform evidenced decisions. This includes aspects such as groundwater, water quality, biodiversity and ecology, waste, ocean, land use and land cover monitoring, as examples.	2.91	2.42	3.0	0.81	\$100,000-\$500,000 (annually)

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
04	Scope the effective mitigation or managed retreat of wastewater pumping stations at Brownlow, American River and Penneshaw, exposed to both coastal hazards and flooding. Roll out a second phase for other community wastewater management systems that are exposed	This includes the Brownlow wastewater treatment plant, 5 pump stations and 13 child assets across Kingscote and American River to understand the nature of potential impact and options available to address identified impacts. This includes trigger points for decision making associated with projected permanent inundation or coastal erosion. These assets are highly exposed and service the populations of Kingscote and American River, accounting for a large proportion of the Kangaroo Island population.	3.17	2.81	2.0	1.41	\$20,000-\$100,000
05	Enhance refuge and evacuation centre planning for facilities at Penneshaw and Kingscote (for bushfire, potentially for other locations for other events) as primary evacuation locations on the Island. Include heatwave strategies and heat refuge hub opportunities for Council assets (such as air conditioned buildings and	The Kangaroo Island Township Bushfire Protection and Mitigation Strategy prepared in 2020 identifies the need to undertake a stocktake of evacuation and refuge facilities to ensure they provide adequate services and amenities to support the community, emergency services and recovery agencies during and after events. This includes ensuring adequate governance arrangements are in place (including staffing, equipment	3.79	3.77	2.0	1.89	\$20,000-\$100,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	sustainable energy supplies). Consider multi-use facilities as part of renewal and new asset development for community uses	and supplies, etc). There is the further ability to consider heat refuge hubs for community members to escape the heat during heatwave events, with a focus on renewable energy supplies to power air conditioning etc.					
06	A register and spatial catalogue of key routes for all-weather access can be developed and included in Council's road hierarchy, levels of service, budget process and maintenance programs. This is not exclusive to emergencies but for economic purposes also, and can be shared with combat agencies	<p>The 2013/14 flood impact report identifies the need to consider key vulnerability locations across the Island's road network. This action extends beyond flood hazard to consider other event vulnerabilities from hazards like coastal hazards.</p> <p>Hog Bay Road is a key access route between the Dudley Peninsula and the western half of the Island, and this road is exposed to both flood and costal hazard impacts. This road is therefore a priority for consideration.</p>	3.59	3.41	1.0	3.41	<\$20,000
07	Undertake an evacuation study for townships across the island to determine if additional road access or other evacuation requirements are needed	The Independent Review into South Australia's 2019-20 Bushfire Season identifies the need for improved evacuation planning. The Island includes a large number of dispersed small	3.43	3.21	2.0	1.61	\$20,000-\$100,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	for different hazards but with a focus on bushfire	settlements which are reliant on specific roads for evacuation, some being one-way in and out. Specific pre-event evacuation studies and plans should be undertaken to identify opportunities for evacuation enhancement.					
08	Undertake a program to identify key vulnerabilities (places where roads are cut, where water impacts pavement quality) of the existing State and local road network to inform funding priorities and identify on-going management and mitigation measures for different scenarios	The 2013/14 flood impact report identifies the need to consider key vulnerability locations across the Island's road network. This action extends beyond flood hazard to consider other event vulnerabilities from hazards like coastal hazards.	3.16	2.59	1.0	2.59	\$20,000-\$100,000
HUMAN AND SOCIAL							
09	As per the Kangaroo Island Community Recovery Plan, support community-led local or district resilience and preparedness or community action plans, commencing with a pilot	Community-led and co-designed resilience plans offer the opportunity for community members to come together to discuss and coordinate locally-led approaches to resilience building. This goes beyond emergency preparedness to cover issues like volunteering, how the community	4.22	4.02	2.0	2.01	\$20,000-\$100,000 (annually)

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	to design the program for whole-of-island roll out	can work together, evacuation planning, opportunities for community cohesiveness and property preparedness – including for farms and businesses. This should ideally be a facilitated process which places community resilience at the centre.					
10	Prepare long-term community awareness and preparedness program in the context of hazard and how they occur on Kangaroo Island, including programs offered by stakeholder agencies, not-for-profits, and groups	A number of existing plans, strategies and studies identify the need for ongoing community education, awareness and engagement. This includes the Community Recovery Plan, the KI BMAP, Township Bushfire Protection and Mitigation Strategy, SA Disaster Resilience Plan, the Regional Health and Wellbeing Plan, Coastal Hazard Strategy and Council's Strategic Plan. A coordinated program which addresses multiple hazards and focuses on community level resilience is a key opportunity.	4.17	3.95	2.0	1.98	<\$20,000
NATURAL ENVIRONMENT							
11	Continue to implement fuel risk reduction activities in accordance with Council's fuel load management programs	Bushfire is the largest scale and highest risk at present on Kangaroo Island, with over half of the Island comprising remnant vegetation. Management of fuel	3.26	3.02	3.0	1.01	\$100,000-\$500,000 (annually)

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	(prescribed burning, fuel breaks, asset protection zones, fuel reduced zones), the Kangaroo Island Bushfire Management Plan and Township Risk Mitigation Strategy, and continue to support efforts of other landholders and stakeholders to manage fuel loads across Kangaroo Island having regard to ecological values and fire regimes	<p>loads in perpetuity is fundamental to managing the potential risk to life and property, as well as ecological risk from more frequent fire regimes.</p> <p>The KI BMAP and Township Bushfire Protection and Mitigation Strategy set out a number of priority activities to manage fuel loads in perpetuity.</p> <p>In addition, Council should ideally dedicate resourcing to the revision of the KI BMAP 2.0 process alongside CFS and NPWS.</p>					
12	Develop a register of high-risk ecological values / assets and integrate these into Council's fire management program and for the purposes of programs facilitated by other stakeholders	The current KI BMAP identifies the need to better integrate ecological assets that require protection, from a biodiversity or cultural perspective, in the same manner that built environment assets are incorporated. This may include assets and values on Council land which are vulnerable to the threat of fire attack.	3.08	2.68	2.0	1.34	\$20,000-\$100,000
13	As per the Kangaroo Island Coastal Hazard Strategy, undertake an adaptation study to investigate the mitigation	A concurrent event where significant rainfall in nearby catchments coincides with a storm surge event would create more significant inundation than	3.15	2.74	2.0	1.37	\$20,000-\$100,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	and adaptation options to protect coastal and foreshore assets, townships and communities from coastal hazards	<p>was projected in this study. This is especially the case at American River, Nepean Bay and Brownlow, as well as more broadly across Western Cove. Further modelling is required to better inform the extent of flooding under such a scenario and therefore the timing of future actions.</p> <p>At present, American River and Nepean Bay do not have a major levee protecting houses, although the raised height of some of the roads does afford limited protection from rising waters during storm surge events, as observed during May 2016. As such, a priority in the next decade should be to determine whether a levee could be an appropriate response to reduce future inundation risk.</p>					
ECONOMY							
14	Prepare consistent and locally-specific messaging for visitors in case of different natural hazard events and emergencies (i.e. for accommodation	The Kangaroo Island Townships Bushfire Protection and Mitigation Strategy prepared in 2020 identified specific issues and challenges in relation to the number of short term accommodation provides on the Island, many of which are	3.44	2.95	1.0	2.95	<\$20,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
	providers to make available)	independently operated, and the lack of or inconsistent (or inadequate) advice or information provided to visitors in relation to their options or what action to take relative to different situations, events or emergencies. Locally-specific information (i.e. information for short term accommodation venues in Emu Bay which is bespoke to the circumstances of Emu Bay, for example) which is prepared alongside relevant agencies will help avoid potential confusion and ensure consistent advice and information sources is available for visitors.					
15	Ensure a continued focus of organisational continuity from multiple event types to ensure ongoing service provision for key essential activities, adopting a continuous improvement approach	The need for business continuity and continuity of services across the Island is identified as a key area of focus to work toward greater resilience, and this is reflected in the Safer Together – SA Disaster Resilience Strategy. This includes ensuring Council's business continuity plan is maintained and updated with the benefit of lessons learnt, as well as support for broader business continuity planning and workshops for Kangaroo Island-	n/a	3.53	4.0	0.88	<\$20,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
		based business and services upon which residents and visitors rely.					
16	Work with stakeholders and the Kangaroo Island business community to support business continuity planning that contributes to broader community resilience	The need for business continuity and continuity of services across the Island is identified as a key area of focus to work toward greater resilience, and this is reflected in the Safer Together – SA Disaster Resilience Strategy. This includes ensuring Council's business continuity plan is maintained and updated with the benefit of lessons learnt, as well as support for broader business continuity planning and workshops for Kangaroo Island-based business and services upon which residents and visitors rely.	n/a	4.09	3.0	1.36	<\$20,000
GOVERNANCE							
17	Develop a corporate climate change risk policy and strategy and embed it across Council's service areas / divisions	The Climate Change Governance Strategy identifies that Council currently does not have a climate change risk policy or strategy which highlights how Council will, in various ways, demonstrate leadership in terms of climate mitigation and adaptation. This includes aspects like fleet management, renewable energy supply for Council buildings and	4.23	4.39	2.0	2.20	\$20,000-\$100,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
		assets, and policy positions in relation to specific adaptation transition steps.					
18	Enhance the integration of disaster and risk reduction, mitigation and resilience into Council's Strategic Management Plan and embed these elements across all relevant corporate plans and strategies	A number of actions identified across a suite of existing studies, plans and strategies identify a range of updates and additions to be embedded within Council's Strategic Plan. In particular, the Climate Change Governance Strategy prepared for Council highlights a number of climate adaptation related tasks required to ensure it is embedded across Council's service delivery, and forms part of Council's decision-making processes. The integration of disaster risk reduction and climate adaptation considerations into the plan is a key opportunity to embed resilience enhancement into Council service delivery over time.	3.71	3.66	1.0	3.66	<\$20,000
19	Invest in a resilience officer to support implementation of the Preparing KI Action Plan	The implementation of the Preparing KI Action Plan requires a dedicated resource to support its actions to be embedded across Council services, to support funding and grant application processes and to support community education and	n/a	4.04	4.0	3.66	\$100,000-\$500,000

ID	Action	Description	MCA score	Benefit score	Cost score	Efficiency quotient score (CBR)	Estimated cost
		messaging regarding natural hazards and risk, as well as resilience building.					
20	Invest in human and physical resources (i.e. machinery, equipment, digitising the Council's radio network) to continue to deliver Council's fuel risk reduction activities	The fuel load management and other outdoor mitigation measures required to be delivered by Council requires continued investment in physical and human resources for delivery. This includes outdoor staff to undertake essential mitigation works, as well as equipment including for example, the digitisation of Council's radio network to ensure teams can be contacted during operations and during events.	3.26	3.02	3.0	1.01	\$100,000-\$500,000

