



Government of South Australia
Department of Environment,
Water and Natural Resources

PROSPERING IN A CHANGING CLIMATE

A Climate Change Adaptation
Framework for South Australia
August 2012





Foreword

This Climate Change Adaptation Framework sets the foundation for South Australians to develop well-informed and timely actions to be better prepared for the impacts of climate change. It is intended to guide action by government agencies, local government, non-government organisations, business and the community.

Many communities around South Australia have already begun to prepare for changes in our weather patterns and rising sea levels. Communities on Eyre Peninsula have undertaken several projects to better understand and deal with climate change. The Barossa, Yorke and Mid North regions of the state have extensively assessed climate change vulnerability for climate change impacts and sensitivity, and the adaptive capacity of their communities.

Adaptation is not an isolated stand-alone agenda. It will need to be incorporated into all our policy and planning processes and embedded into public and private risk management frameworks. Adaptation will play a complementary and equally important role to mitigation in our efforts to respond effectively to climate change.

The majority of effort will need to occur at an individual, regional and local level. Those affected by climate change are likely to be in the best position to decide how to deal with its impacts.

Adaptation will also create many opportunities for innovation across all sectors. We have an unprecedented opportunity to incorporate sustainable development principles into everything we do.

Building adaptive capacity will help South Australians deal effectively with gradual changes to our climate. Adaptive capacity will also assist us to respond to the potentially abrupt climate change that has been observed in the past but is more difficult to accurately predict.

So far, South Australia's approach to adaptation has been to take full advantage of our scientific knowledge base and unique

natural environment. Skills in forestry, dryland farming and spatial mapping have been applied to factor climate change into evaluating future options for cropping and forestry industries. Land in strategic locations has been used for extensive tree plantings to provide salinity and biodiversity benefits in addition to carbon sequestration.

There are many ways in which we are already responding to the challenges of climate change. For example the *State Natural Resources Management Plan 2012* recognises climate change as an important priority for managing the State's natural resources. The State Government has developed *Water for Good - A plan to ensure our water future to 2050*, a plan for sustainable water supply and use in South Australia for at least the next 40 years.

The *30-Year Plan for Greater Adelaide*, and wider Planning Strategy, provides important policy measures to build an effective long-term approach to dealing with the impacts of climate change particularly in urban form, including energy efficient building design, less vulnerability of critical infrastructure and continued protection of coastal development from seawater inundation.

The Living Coast Strategy is a plan to protect the South Australian coast for the future. The Coast Protection Board will continue to play a key role in implementing many of its actions, including identifying development, infrastructure and ecosystems at risk, and developing and implementing strategies to inform adaptation planning.

No Species Loss: a biodiversity strategy for South Australia 2006–2016 identifies and recommends a suite of actions designed to



underpin South Australia's natural assets in the face of climate change.

The 2008 State of the Environment Report made a number of recommendations about adapting to climate change and in its response the Government announced a "planned and strategic approach to climate change adaptation, which involves all levels of government, the private sector and the community, and that cuts across all sectors". The Government also committed to conducting research on the health impacts of climate change, including through its effects on air quality, and to programs for generating community awareness and behaviour change.

This Framework will build on the good work that has already started in South Australia to improve resilience to climate change. Its guiding nature will ensure efforts by all sectors and levels of government are strategic and coordinated.

In the short term, the Framework provides the leadership necessary to coordinate actions by the parties affected by climate change including governments, businesses and communities. It also allows for the preparation and development of the adaptation research agenda that will inform adaptation priorities into the future.

Climate change will bring many challenges but it will also create opportunities for innovation, diversification and leadership in both mitigation and adaptation activities. Applied well, adaptation activities can improve the market position of existing goods and services produced in South Australia, and help develop new markets and businesses.

While governments can take on a leadership role and ensure that public services and assets can withstand and be responsive to the impacts of climate change, climate change risks to private interests will ultimately need to be addressed by business and the community. The Government will support information and planning frameworks to facilitate such actions by private parties. We will also work to establish regional agreements with key organisations to drive the development of community-based adaptation action plans that will enable South Australians to capture opportunities and continue to thrive and prosper into the future. This approach is supported by *South Australia's Strategic Plan* which has the target "to develop regional climate change adaptation plans in all State Government regions by 2016" (Target 62).

The community of South Australia has already contributed extensively to developing this Framework, which has been substantially revised following the many constructive comments on previous drafts. The effort and commitment shown in contributing to the Framework is illustrative of the strength of our communities in South Australia and highlights why we are well placed to prosper in the changing climate.



PAUL CAICA
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Summary

Impacts from climate change are inevitable. Projections for South Australia indicate warmer and drier conditions across much of the state with an increased risk of severe weather events, including storms, flooding, heatwaves, drought and bushfires. These changes will affect our health, wellbeing and key industries that underpin the state's economy.

Adaptation to climate change involves the planning and activity by individuals, communities and businesses to cope with the changing weather conditions. It is the work we do to address the impacts and prosper into the future.

The Climate Change Adaptation Framework for South Australia (the Framework), will guide action by business, the community, non-government organisations, the research sector, local governments and state government agencies to develop well-informed and timely adaptation responses. Appropriate investment in research, innovation, skills and workforce development can improve our adaptive capacity, enabling us to not only minimise the negative impacts of climate change but also to create new opportunities for our community and the economy.

The Framework informs and aligns with South Australia's policy on climate change. It will also inform the development of forthcoming strategies and plans, such as the *State Natural Resources Management Plan 2012*, and is intended to be consistent with national adaptation policies.

Progress on implementing the Framework will be reported once every two years as part of the formal requirements to report on activities under the *Climate Change and Greenhouse Emissions Reduction Act 2007*. The Framework will be reviewed after five years.

Implementation of the Framework will be guided by principles that describe how adaptation responses will be prioritised, developed and delivered (section 2).

The implementation is intended to deliver cohesive and coordinated responses to a changing climate. They will be integrated into established planning, decision-making and risk management systems, and help build recognition of the interconnections between social, environmental and economic systems.

Adaptation actions should be prioritised through assessment of risks, costs and equity while using the best available science, and taking into account the uncertainty of climate change projections.

Objectives

Four overarching objectives guide the adaptation responses we will need to make at the state level, along with the strategies to achieve them:

- leadership and strategic direction for building a more resilient state
- policy responses founded on the best scientific knowledge
- resilient, well-functioning natural systems and sustainable, productive landscapes
- resilient, healthy and prosperous communities.

In the short term, the Framework details the process to coordinate actions by government, businesses and communities affected by climate change. The Framework also facilitates preparation and development of the adaptation research agenda that will inform adaptation responses.

A regional approach

The Framework recognises that climate change and its economic, social and environmental impacts will vary across South Australia and therefore provides for the development of locally relevant adaptation responses across the 12 existing State Government regions (section 3). This approach ensures that future adaptation strategies take into account the knowledge of local communities and the differing circumstances and impacts in each region.

Preparing for climate change will require local organisations and State Government agencies to work with communities to assess climate change risks and opportunities, to determine priorities and to develop adaptation action plans. The first stage is development of regional integrated vulnerability assessments in each region to understand the sectors and systems that are most at risk. The Framework proposes that these assessments and the regional adaptation work that follows will be managed under regional agreements between the Minister for Sustainability,

Environment and Conservation, and local organisations, under the *Climate Change and Greenhouse Emissions Reduction Act 2007*.

Impacts on sectors

Climate change will create significant impacts across South Australia. Sector is a term used to characterise a part of the economy or society as a cohesive group or issue (e.g. manufacturing, agriculture or natural resources). Examples of impacts can be found in section 4, and section 5 of the Framework outlines the mechanisms for business and community groups to participate in the adaptation planning process.

Implementation

The regional approach is designed to deliver adaptation plans and responses that consider the social, economic and environmental drivers relevant to that region (section 5). It is anticipated that in developing adaptation plans, regional leaders balance these drivers at a local level. Regional leaders must also be able to access information and knowledge generated by peak bodies, government and large business, and to influence their planning processes. Thus regional leaders will engage organisations representing business and community sectors relevant to their region in developing adaptation plans and responses.

Implementation of the regional approach will therefore require:

- regions to learn from one another
- governments, business and peak bodies to both influence and learn from regional findings
- private and government organisations representing various parts of the economy and society undertake to deliver adaptation responses consistent with regional adaptation plans.

About this document

In 2009, the Premier's Climate Change Council (PCCC) reviewed climate change adaptation activities at local, state and national levels and concluded that adaptation activities are not well coordinated in the state and gaps may leave South Australia vulnerable to the impacts of climate change. Specific issues identified were:

- no guidance on roles and responsibilities for climate change adaptation
- the many worthwhile adaptation projects that were not coordinated and were duplicating effort
- poor engagement with the community and little general understanding of how climate change will affect all South Australians
- little recognition that climate impacts will vary from region to region in South Australia and that responses would be significantly improved with a more regional approach
- no coordination of adaptation research, much of which was fragmented and siloed.

The *Climate Change and Greenhouse Emissions Reduction Act 2007* requires the development and publication of policies to address issues that arise from changes to our climate, such as those identified by the PCCC and outlined above. Specifically, subsection 14(1) paragraph (a) requires the Minister to seek to develop policies that will assist in promoting or implementing measures to facilitate adaptation to circumstances that will inevitably be caused by climate change. Section 14 also places conditions on the development of such policies. Development of the Framework fulfils the key requirements of section 14.

The Climate Change Adaptation Framework was developed by the Sustainability and Climate Change Branch, Department of Environment, Water and Natural Resources, in partnership with the PCCC, the Natural Resources Management Council and key government agencies.

On 7 December 2010 the draft Framework was released for consultation until 14 April 2011, and feedback on the draft was then taken into consideration. The final Framework was endorsed by Cabinet as State Government policy under section 14 of the Act on 30 July 2012.

The Framework is arranged in five sections:

- Section 1 describes the reasons for needing to adapt to climate change, articulates the roles and responsibilities of all parties and outlines South Australia's early adaptation responses and opportunities
- Section 2 provides overall guidance for climate change adaptation activity in South Australia, by outlining objectives and guiding principles
- Section 3 outlines the regional approach to climate adaptation and defines the mechanisms for how it will be undertaken
- Section 4 outlines the impacts and challenges arising from the need to adapt to climate change, organised into 12 sectoral themes
- The implementation process for the Framework is described in section 5.

1 Adaptation in SA

Adaptation can be defined as planning and actions by individuals, communities and businesses to cope with changing weather conditions that result from climate change. It is the work we do to address the impacts and prosper into the future. A more detailed definition is contained in the glossary at the end of this document.

1.1. Why we need to adapt

South Australia has always had a highly variable climate. After one of the longest droughts on record we entered into one of the wettest years. The question of whether these trends were influenced by climate change unnecessarily diverts attention away from the urgent need to prepare for the significant negative impacts expected in the future.

Climate change projectionsⁱ for South Australia indicate warmer and drier conditions across most of the state, with an increased risk of extreme events such as flooding, drought and bushfires. These events will have variable impacts on the lives of all South Australians and on the natural environment across the state.

Likewise, climate change will have direct and indirect impacts on our health and wellbeing,

particularly for vulnerable members of the community such as the elderly, those who live in remote settlements, the sick and people on low incomes. Health and community services will be affected across the state.

Some of South Australia's key industries, such as wine, grain and seafood, are likely to be affected by changing weather patterns. The natural resources management sector will be challenged, risks to biosecurity will increase and our already fragile natural systems will be under increasing pressure. The state's water supplies will be severely threatened as rainfall decreases and temperatures rise. Indeed, maintaining sustainable water supplies will be one of South Australia's biggest challenges.

In vulnerable areas, homes, businesses and infrastructure will be threatened by the increase in extreme events, such as bushfires and floods, and coastal settlements and ecosystems will be exposed to the rise in sea levels, floods and storm surges.

Failure to adapt will expose us to possibly severe and long-term consequences including reduced productivity, reduced food and fibre production, property and financial losses, threats to biosecurity, higher costs for goods and services, serious health issues, reductions in social and human capital, and the loss of unique and essential natural systems and species.



Early action is likely to see us capture the most benefit from this change and avoid or minimise long-term negative impacts.

Strengthening the adaptive capacity of the South Australian community by expanding our options for dealing with climate change will be critical to delivering effective responses in the future. This preparedness is especially important given that the precise timing and magnitude of climate change impacts are uncertain. Better integration of risk management approaches and flexible decision-making processes will improve our adaptive capacity. Building the climate resilience of natural systems, which underpin our state's economic and social aspirations, will be equally important (Appendix 1).

The range of research, planning and policy activity across state and local government, and the private sector, needs to be better coordinated with a clearer strategic direction or we will be vulnerable to gaps in our adaptation response.

Climate change will create conditions we have not experienced before. We will need to do things differently, and work together in new ways and form partnerships across jurisdictional boundaries and between

different groups of stakeholders who, in the past, may not have worked together.

1.2. Who is responsible?

Adaptation actions minimise the negative impacts of climate change and maximise the opportunities that may arise from this change. All South Australians are responsible for adapting to climate change impacts where they have the capability to do so.

The many options available to address climate change impacts are not all efficient or desirable. Many parties who could deliver adaptation responses, are not necessarily best placed to do so. It is essential to be explicit about the roles and responsibilities of individuals, communities and institutions in delivering adaptation action. This issue has been at the forefront of the climate change policy agenda in Australia in recent years and includes work of the Council of Australian Governments, the Council of Australian Federation and the Heads of Treasuries. Wherever possible, the content of the Climate Change Adaptation Framework for South Australia (the Framework) reflects the deliberations and agreements in these discussions.



Adaptation to climate change is a shared responsibility requiring a joint effort by all levels of government, business, communities and individuals. Given that most assets and activities at risk of climate change are owned or managed by businesses or the community, it is reasonable to expect that they manage their own exposures. Given the scale and range of predicted impacts it is not feasible for governments to bear all the costs of adapting to the impacts of climate change.

Adaptation is not an isolated, stand-alone agenda; it needs to be integrated into national, state, regional, sectoral and local planning and operational processes. Public policy settings, underpinned by research, will enable action by the private sector. The settings include creating regulations, market mechanisms and non-fiscal incentives to encourage businesses to incorporate climate change risk assessment into their systems and practices.

The South Australian Government will take a leadership role in building the state's resilience and adaptive capacity. It is setting a regional approach to climate change adaptation in this Framework with all sectors collaborating to ensure our long-term sustainability and ongoing prosperity.

1.2.1. Government

Government's central role will be to create the right conditions for businesses, communities and individuals to make timely and well-informed decisions for protecting their personal situation. Governments must factor climate change into the legislative frameworks in which these decisions are made, and:

- facilitate climate change research with broad public benefit
- disseminate information on climate change impacts, risks and adaptation strategies for managing climate change risks
- lead and encourage forward-looking behaviour and private initiative
- ensure that market regulation, such as development rules, building codes and essential services, facilitates adaptation to changing climate risks

- ensure that climate change risks to public infrastructure are effectively managed, and delivery of public services such as health care and emergency management are responsive to demands from a changing climate
- protect environmental assets at risk from climate change.

Governments may also need to intervene in areas where individuals or the community are unable to respond and if there is a significant public benefit to do so. This may include identifying and implementing priorities to assist vulnerable communities or in areas that do not have sufficient resources to respond. It is also envisaged that the existing social welfare system will be used to support these communities.

All levels of government will require appropriate resourcing and funding to fulfil these responsibilities. Work undertaken as part of this Framework will ensure that adaptation actions are delivered efficiently, with less duplication and at the most appropriate level.

National, state and local governments will have complementary roles in leading climate change adaptation efforts.

Commonwealth Government

The Commonwealth Government sets national directions and priorities for adaptation, with the key roles of:

- maintaining a strong, flexible economy and a well-targeted social safety net
- providing leadership on national adaptation reform including working with other levels of government to establish national adaptation priorities for protecting the national economy, security and interests including natural systems of national significance, and setting implementation activities for these priorities
- working with governments to develop a consistent approach to adaptation responses and to establish/implement monitoring and evaluation for nationally coordinated policies, programs and research to ensure adaptation responses are effective and well-targeted

- providing national science and information including managing climate change science and national adaptation research to ensure a consistent approach to regional climate projections, climate change impact modelling and reporting
- modelling the climate and providing quality controlled climate data
- facilitating national adaptation forums to share adaptation experiences across jurisdictions
- working with governments to develop and verify nationally consistent assessment tools including risk assessment and modelling tools
- working with governments in managing climate change risks to public assets identified as being of national significance and for which the Commonwealth has some responsibility. This includes embedding climate change impacts into existing risk management frameworks.
- raising community awareness and promoting a risk management response to climate change adaptation by government and private parties
- ensuring that regulatory and market frameworks including the planning strategy, development plans, development assessment, and property and environmental legislation, promote effective adaptation by private parties
- partnering with the business sector and supporting business adaptation responses
- working with other governments to identify and implement priorities to improve adaptive capacity and strengthen climate resilience in vulnerable communities
- integrating adaptive capacity into planning decisions
- supporting local governments to facilitate building resilience and adaptive capacity in the local community and to ensure that policies and regulations are consistent with State Government adaptation approaches
- managing risks from climate change impacts to government infrastructure and services in such areas as emergency management, transport, land use planning, environment, health services and public housing
- undertaking actions not initiated by the private or community sectors because of market failure, for example by strengthening the resilience and adaptive capacity of natural systems
- establishing science and research priorities and conducting research in key areas of specific interest to South Australia not addressed in national research priorities and outcomes
- facilitating institutional arrangements that provide for an integrated approach to adaptation in sectors
- collaborating with other states and the Commonwealth to develop national standards, codes and approaches and implementing them through state regulatory instruments.

South Australian Government

Adaptation to climate change is an important priority for the South Australian Government. All agencies will play an important role in working with business, non-government organisations and local communities to develop state-wide and regional responses.

The four broad roles for the State Government are:

- developing legal and policy reforms that encourage climate resilience and adaptive capacity
- providing or disseminating relevant local and regional science and information
- managing public assets (including natural assets), infrastructure, service delivery and programs
- cooperating with other governments to implement the national adaptation reform.

Specific roles for the State Government may include:

- providing information and decision-making tools relevant to local communities, including educating communities about how to adapt to a highly variable climate

Local government

Local governments are closest to local communities where the effects of climate change will be felt the most and have the key roles of:

- administering relevant legislation to promote adaptation responses
- partnering with other regional organisations, such as Natural Resources Management and Regional Development Australia boards, to develop regional integrated vulnerability assessments (IVAs) and complete and review local government risk assessment and adaptation projects
- working with communities and sectors to develop regional adaptation plans
- building resilience and adaptive capacity in the local community by providing locally relevant information and decision-making tools to individuals and businesses
- advocating on behalf of the community for resources to assist in adaptation
- incorporating climate change adaptation into the management of infrastructure, assets, ecosystems and natural resources
- integrating adaptive capacity into planning decisions

- undertaking capital works and other projects to minimise the impacts of climate change
- managing risk and climate change impacts on local government service delivery.

1.2.2. Private parties - individuals, communities and businesses

Individuals, communities and businesses will primarily be responsible for managing risks to private assets and incomes, and the benefits they receive from doing so are a strong incentive to act. Private parties have a particular interest in maintaining the vibrancy and longevity of regional economies and therefore play an important role in developing local adaptation responses. Businesses such as the insurance, finance and banking industries will supply appropriate financial mechanisms to help manage risks. Not-for-profit and community organisations will have important roles in education to enhance the resilience of households and communities.



They will also play an important role in contributing to regional IVAs. Key roles for private parties include:

- factoring adaptation priorities into their activities
- undertaking risk assessments
- investing in strategies to reduce risk
- developing and supplying new products that assist with adaptation
- working with policy makers to ensure that adaptation policy is effective
- supporting regional adaptation to climate change
- researching the implications that climate change is projected to have for each regional industry
- participating in regional vulnerability assessments and the development of adaptation responses
- contributing financial support or in-kind support to the regional process.

1.2.3. Research institutions

Research institutions, including the CSIRO, South Australia's universities, Research and Development Institute, Premier's Science and Industry Council, Museum and State Herbarium have a clear role in the science and research that will underpin successful adaptation responses. Key roles for the research sector include:

- providing the relevant science to underpin policy development, including understanding of social and human capital aspects of adaptive capacity
- working with the Commonwealth to improve regional climate change projections, particularly the effects of rainfall and evaporation on water runoff and recharge, sea level rise and extreme events
- working with research institutions in other jurisdictions to collaborate on research
- lobbying for national research funding
- ensuring South Australia's science and research priorities align with national

priorities as outlined in national climate change adaptation research plans

- contributing to national and international research initiatives
- identifying gaps in knowledge and skills
- communicating science to the community.

1.3. South Australia's early adaptation responses

A range of adaptation activity has already happened across state and local government, research institutions and the private sector.

South Australia was the first jurisdiction to introduce a sea-level rise policy into its planning regulations. Allowances for sea-level rise over the 21st century were a key component of the Coast Protection Board's 1991 *Policy on Coast Protection and New Coastal Development*, which was incorporated into the land use planning system in 1994.

Under Section 16 of the *Climate Change and Greenhouse Emissions Reduction Act 2007*, the government has entered into a range of sector agreements with key sectors, businesses and State Government regions. These agreements will set basis for the sectors and government to work cooperatively to reduce greenhouse gas emissions and develop adaptation responses. Regional sector agreements with key regional leaders in the Eyre Peninsula, Barossa and Yorke and Mid North regions were signed in 2010 and 2011, to develop the state's first regional adaptation action plans.

The Premier's Science and Industry Council has actively supported adaptation-related activities, including identification of skill needs and support for research projects and infrastructure that contribute to South Australia's adaptive capacity. The Council has further supported adaptation projects through the Premier's Science and Industry Fund. An example is the Transect for Environmental Monitoring and Decision Making project in conjunction with the University of Adelaide, which will help establish a network for climate change

monitoring in South Australia for terrestrial and marine, natural and production systems, as a climate change early warning system and long-term monitoring record.

*Water for Good—A plan to ensure our water future to 2050*ⁱⁱ is the government's plan for sustainable water supply and use in South Australia for at least the next 40 years, and will largely underpin adaptation in the water sector.

The Goyder Institute for Water Research was established to provide independent scientific advice on the state's water supplies, improve the government's ability to forecast threats to water security, and develop an integrated approach to water management.

Sustainability and climate change resilience is one of the three interlocking objectives of the *30-Year Plan for Greater Adelaide*ⁱⁱⁱ, which has policies to improve the capacity of urban communities to adapt (Table 1).

In addition, local government's strategic directions reports address strategic planning issues in the council area with particular reference to the South Australian Planning Strategy.

The NatureLinks program, being delivered by Natural Resources Management boards, links tracts of land for conservation outcomes with the parks and reserves system to open wildlife corridors that help movement and migration in response to climate change.

No Species Loss: A nature conservation strategy for South Australia 2007–2017 includes as one of its five major goals 'Adjustment to the impacts of climate change'.

The *State Natural Resources Management Plan 2012*^{iv} recognises climate change as an important priority for managing the State's natural resources.

Initiatives such as Bushfire Awareness Week and the community-based FloodSafe program are current examples of initiatives to improve community resilience to climate related emergencies.

The *Climate Change Management Framework* for primary industries identifies strategies and proposes action in South Australia's primary industry sectors (agriculture, fisheries, aquaculture, forestry,

minerals and energy resources) to support ecologically and economically sustainable development under changing climatic conditions.

SA Health Extreme Heat Plan takes a planned, managed and effective response to an extreme heat event. The Emergency Management Unit in the Department of Health has produced a comprehensive suite of heat health information for the general public. The State Government in collaboration with the University of Adelaide is currently investigating community risk factors during extreme heat events including a survey of the elderly on their experiences during recent heatwaves.

Local governments across South Australia are already implementing adaptation actions, such as developing comprehensive climate change strategies, adaptation plans, and sustainable water initiatives (e.g. the Water Proofing the South project and the Water Proofing Northern Adelaide project).

A wide range of research projects at the University of Adelaide, Flinders University and University of South Australia are informing adaptation responses for both natural and human systems.

The South Australian Government has participated in an IVA project in partnership with the Central Local Government Region of South Australia, Regional Development Australia (Yorke and Mid North), Northern and Yorke Natural Resources Management Board, and Regional Development Australia (Barossa). The project will identify the areas across the Yorke, Mid North and Barossa Regions that are most susceptible to the impacts of climate change and highlight priorities for early action.

The Local Government Association has developed guidelines for undertaking an integrated climate change vulnerability assessment as part of an adaptation plan for use by local councils.

The South Australian Government and Adelaide and Mount Lofty Ranges Natural Resources Management Board have also worked in partnership to implement a broad framework to assist climate change adaptation decision making in and across natural resources management sectors.

1.4. Opportunities

South Australians have a history of resilience in the face of a variable climate, and have built a prosperous state. Our agricultural systems are a notable example of a flexible and innovative industry. While climate change will bring many challenges, it will also create significant opportunities for innovation, diversification and leadership. Some of the opportunities arising from timely and effective adaptation to climate change include:

- improving the market position of our existing goods and services
- developing new markets arising from adaptation to climatic changes and carbon constrained markets
- developing new markets for climate change adaptation related goods and services
- reducing climate change related costs to government and the community.

We will use our existing institutions that have developed world-class dryland agricultural practices, and our expertise in delivering and managing infrastructure and water resources in a harsh environment, to position our state's industries on a more competitive footing. We can also further build on the strength of the technological innovations and intellectual property that support South Australia's minerals and defence industries.

The challenges of climate change will open commercial opportunities for exporting our adaptation skills and technologies into developing and developed countries. There will also be opportunities for the mutual transfer of skills and technologies between countries likely to experience similar climatic changes. South Australia's knowledge and experience in building community resilience through planning, community development, governance and decision making may also be valuable internationally.

Some adaptation opportunities for South Australia are summarised in Table 1.

Table 1 South Australia's climate change adaptation opportunities

Sector	Opportunity
Infrastructure and urban areas	Improving building standards and design guidelines to create more thermally and energy efficient new buildings
	Developing retrofit technologies for improving the thermal and energy efficiency of existing buildings
	Creating a more liveable urban environment by establishing a network of greenways, tree-lined streets, open spaces and community gardens, which have a cooling effect on nearby neighbourhoods and new buildings
Agriculture	Leading internationally in developing sustainable food and farming systems (e.g. biofuels, biochar-type soil conditioners and drought tolerant crops)
	Developing and promoting the adoption of new farming options better suited to climate variability (e.g. systems based on perennial plants) particularly in lower rainfall zones where few options exist
Biodiversity	Rehabilitating previously cleared or degraded natural systems
	Managing and restoring key ecological assets
	Creating greater connectivity between fragmented habitats to foster species adaptation to changing conditions
	Strategically using environmental water to build resilience
	Developing ecosystem services through market-based instruments such as combining biosequestration with other ecomarkets to make environmental plantings financially viable
Emergency management	Building expertise in hazard prevention, mitigation, response and recovery, and disaster preparedness
	Reducing exposure to emergency risks through improved education about reducing exposure and vulnerability
Biotechnology	Increasing South Australia's leadership in biotechnology, including products and services that will reduce the impacts of climate change and assist in building resilience (e.g. drought-tolerant crops, soil remediation technologies and biofuels)
Water management	Building on our expertise in sustainable water management technologies, including sustainable irrigation, water recycling, stormwater capture, storage and use, water trading and infrastructure
	Improving water allocation and water resource management to supply water to the environment
Food supply	Investing in sustainable, climate change-adapted local food industries, which could sustain employment and a vigorous and innovative food market
Financial and consulting services	Generating climate information and adaptation-related consulting services
	Providing appropriate insurance services
Forestry	Diversifying forest products by developing climate change tolerant species and processing technologies
	Generating greater industry involvement in connecting remnant vegetation

2 Guiding principles and objectives

This Framework is underpinned by guiding principles and four objectives for increasing South Australia's resilience to the impacts of climate change. State Government, local government, business, non-government organisations, the research sector and communities all need to work together to achieve these objectives.

Guiding principles

Implementation of the Framework is to be guided by principles that describe how adaptation responses at all levels will be prioritised, developed and delivered, to ensure a successful and consistent approach to adaptation in South Australia:

- recognise uncertainty and deliver adaptation actions where there is a plausible risk of harm
- prioritise actions based on careful assessment of risks, costs, efficacy and equity using the best available science to inform adaptation responses
- give priority to sectors likely to provide the greatest social, economic and environmental benefit for the state
- develop responses at the most appropriate scale to effectively address risks and maximise opportunities
- involve individuals, industry, business, academia and all tiers of government in developing responses using a coordinated approach
- build on, enhance and learn from the experience of communities, sectors and regions in developing adaptation responses
- plan for uncertainty and take action using an adaptive management approach to allow for readjustments as new information arises
- use the best available, most appropriate and locally relevant science based on good data and robust processes, to inform those best placed to deliver adaptation responses and manage risks
- take into account the need for flexibility to respond to emerging trends, including population projections and socioeconomic trends
- consider how best to optimise and recognise the interconnections between social, environmental and economic systems, and linkages between sectors in planning to adapt to climate change in a sustainable manner
- ensure responses avoid unintended consequences and do not undermine our ability to adapt over the long term
- take early action where there are demonstrated cost-benefits
- ensure that adaptation responses are appropriately integrated and mainstreamed into ongoing business.

Objectives and strategies

The Framework objectives focus largely on building the capacity of the business sector, industry, communities, individuals and natural systems to adapt to climate change. Capacity will be built by coordinating effort, providing strategic direction, making information and decision-making tools easily accessible, engaging with local communities, improving the responsiveness of government policy, and setting science and research priorities.

The four objectives are:

1. leadership and strategic direction for building a more resilient state
2. policy responses founded on the best scientific knowledge
3. resilient, well-functioning natural systems and sustainable, productive landscapes
4. resilient, healthy and prosperous communities.

Objectives one and two focus on enabling action through leadership, strategic direction and high quality, relevant science and information. Objectives three and four are closely linked and reflect our goals for building resilient communities, businesses and natural environments.

State government, local government, business, non-government organisations, the research sector and communities will all need to work together to achieve these objectives. A Government Action Plan, developed in consultation with government departments, outlines specific actions that government will undertake to support the achievement of the objectives.

Objective 1

Leadership and strategic direction for building a more resilient state

While action is needed at a range of levels, some responses must be coordinated at the state-wide level to reduce duplication, minimise costs, maximise opportunities for sharing information, ensure that adaptation responses are effective and build trust within the community.

Mechanisms that build resilience and adaptive capacity must be embedded into public and private sector decision making and risk assessment. This will require the right policy settings and creation of incentives to encourage action. Most adaptation responses are needed in the private sector, therefore it will be crucial for government to form strong partnerships with business and the scientific community.

South Australia must continue to show leadership on climate change by actively participating in and seeking to influence national adaptation policy and programs, keeping up to date with international developments and making the most of commercial opportunities to export skills and knowledge.

The Government Action Plan describes key actions under four strategies to help achieve this objective:

Strategy 1.1

Lead South Australia's adaptation efforts

Actions focus on establishing the regional processes outlined in the Framework and undertaking adaptation planning processes

Strategy 1.2

Build partnerships with the business community and non-government organisations

Actions focus on engaging with industry and non-government organisations

Strategy 1.3

Incorporate adaptation into all decision making

Actions focus on ensuring government agencies incorporate climate risk into agency planning

Strategy 1.4

Actively participate in national and international initiatives

Actions focus on working with national and international partners



Objective 2

Policy responses that are founded on the best scientific knowledge

Accurate, relevant and up-to-date science should underpin decision making to build resilience. South Australia has excellent adaptation research and climate science capacity but it is vital that our efforts are coordinated, prioritised and informed by the latest national and international developments. There will always be uncertainties about the extent and impacts of climate change and an adaptive management approach will allow sufficient flexibility to change our responses as new information arises. This will rely on continuously improving our knowledge and monitoring our responses. Community knowledge, including historical information, and community science programs, will also have an important role to play.

It is also vital that we have the right datasets to inform our responses. As yet, we do not have some of the underlying datasets that are needed. Finally, we will need to make sure that local communities and businesses have access to, and understand, the science that they need to make effective decisions.

The Government Action Plan describes key actions under three strategies to help achieve this objective:

Strategy 2.1

Establish a comprehensive adaptation research agenda for South Australia

Actions focus on developing and delivering adaptation research priorities

Strategy 2.2

Use up-to-date, high quality and relevant science to inform an adaptive management approach to building resilience and adaptive capacity

Actions focus on implementing the adaptive management approach to guide decisions by sectors

Strategy 2.3

Identify, create and share the datasets and knowledge to underpin successful responses

Actions focus on consolidating, integrating and publishing data



Objective 3

Resilient, well-functioning natural systems and sustainable, productive landscapes

Our health, wellbeing and economic prosperity depend upon healthy, natural systems and the services they provide, such as clean water, climate moderation, healthy soils, pollination and nutrient recycling.

Many natural systems in South Australia are already degraded and climate change adds complexity to determining management priorities. We will need to: increase ecosystem resilience and connectivity across the landscape through restoration and rehabilitation; manage major threats to biodiversity, many of which are likely to worsen under climate change; and ensure that protected areas conserve as many different ecosystems and habitats as possible.

Pests, weeds, soil erosion, water scarcity, loss of biodiversity, and extreme weather events threaten productive landscapes and primary industries that underpin the state's prosperity.

Primary producers need support to identify opportunities for diversification and the uptake of new technologies and management regimes. Farm management systems will need to incorporate measures that will increase resilience, and integrated approaches will be needed to address the impacts of fire, pests, weeds and diseases, all of which are expected to increase under climate change.

The flexible and integrated approaches to both mitigation and adaptation, will allow us to develop solutions that deliver positive outcomes and enhance the sustainable use of natural resources and biodiversity. We must make the most of these opportunities.

The Government Action Plan describes key actions under three strategies to help achieve this objective:

Strategy 3.1

Increase the resilience of South Australia's terrestrial, aquatic and marine biodiversity

Actions focus on using the outcomes from integrated vulnerability assessments, and other studies, to build resilience in natural systems

Strategy 3.2

Increase the resilience of primary production systems

Actions focus on using the outcomes from integrated vulnerability assessments, and other studies, to communicate impacts and develop actions for primary production systems

Strategy 3.3

Strengthen policy links to achieve mutual benefits for climate change, biodiversity conservation and the sustainable use of landscapes and water

Actions focus on ensuring relevant management and planning strategies consider outcomes from integrated vulnerability assessments



Objective 4

Resilient, healthy and prosperous communities

The impacts of climate change affect the economy and the way people lead their everyday lives. Resilient, healthy and prosperous communities are built by allocating risk appropriately, and maintaining economic and social diversity; by seizing opportunities, and promoting and recognising successes; by factoring climate change considerations into planning and policy (see Strategy 1.3), creating flexible decision-making frameworks, assessing the vulnerability of sectors and communities, and empowering people to take action with accessible information and decision-making tools; and by paying attention to the needs of the most vulnerable members of society, including the elderly, young children, and those who live in remote or highly vulnerable coastal communities.

Businesses and sectors that have the potential to prosper through effective adaptation also need attention. Planning for training and workforce development will equip communities with the skills needed to take advantage of climate change opportunities, allowing them to make use of innovative solutions and technologies.

Creating resilient and adaptive human systems will also mean paying attention to increasing the resilience of natural systems, because healthy, diverse ecosystems underpin successful and prosperous communities (Objective 3).

The Government Action Plan describes key actions under five strategies to help achieve this objective:

Strategy 4.1

Build the resilience and adaptive capacity of businesses and communities at the regional and local levels

Actions focus on supporting the regional approach in developing and delivering adaptation plans and actions

Strategy 4.2

Create climate resilient urban areas and address the needs of the most vulnerable members of the community

Actions focus on engaging with industry, government and non-government organisations

Strategy 4.3

Empower people to take action by making relevant information and decision-making tools easily accessible

Actions focus on providing climate information in a relevant and useable format

Strategy 4.4

Increase community awareness and understanding of the opportunities for adaptation

Actions focus on community engagement and on promoting the opportunities that adaptation action will bring

Strategy 4.5

Increase community resilience during times of crisis

Actions focus on improving resilience to weather related emergencies



3 A regional approach to objectives

3.1. Introduction

The economic, social and environmental impacts of climate change will vary across South Australia. Therefore, the different regions, including metropolitan regions, will need to develop their own approaches and actions based on the nature of their local economies, population structures, social cohesion and the surrounding natural environment.

The regional approach will be able to integrate the whole of economy and societal aspects of adaptation planning (Figure 1). Business and community organisations will largely deliver adaptation responses using established organisational structures.

The regional approach will build on existing processes and functions that already work well. It will be based largely on the 12 State Government regions (Table 2, Figure 2), the standard regions for State Government policy. The approach will be relatively flexible and encourage interregional collaboration.

Table 2 South Australian Government Regions

Far North	Eyre and Western
Yorke and Mid North	Barossa
Northern Adelaide	Eastern Adelaide
Western Adelaide	Southern Adelaide
Adelaide Hills	Fleurieu and Kangaroo Island
Murray and Mallee	Limestone Coast

¹ Section 16 provides that the Minister may enter into agreements (sector agreements) with a particular person or entity or industry or business group on a voluntary basis and may provide for such matters as developing strategies to adapt to climate change.

The benefits of a regional approach include:

- developing regionally specific adaptation strategies that take into account differing circumstances and impacts
- improving the capacity and knowledge of regional organisations already familiar with their lands, waters, communities and climatic conditions
- forging relationships between regional organisations and authorities, across regions and with State Government agencies
- more directly engaging local communities in the development of adaptive measures
- developing capacity so that those who bear the risks associated with climate change can adequately respond to those risks
- building a comprehensive, state-wide picture of climate change vulnerability.

The involvement of regional and local communities in developing adaptation responses will be fundamental to success. It will help to increase awareness and understanding about possible impacts, and thus help build the capacity of communities and sectors to take action that reduces risks, make knowledgeable decisions and maximise opportunities.

3.2. Regional agreements

Voluntary regional agreements will be established in each of the State Government regions (Figure 2). Formed under the *Climate Change and Greenhouse Emissions Reduction Act 2007*¹ these will define how the partners will work together to plan and implement adaptation action. The agreements, between the Minister for Sustainability, Environment and Conservation and key regional organisations such as natural resources management boards, local government, Regional Development Australia boards and key private sector organisations, will be put in place for an initial period of up

to five years. Amendments will be possible with the agreement of all parties.

A key purpose of each agreement will be to establish a program of activity for climate change adaptation in each region. A regional IVA will identify priority areas for adaptation action and guide the development of a regional adaptation plan (section 3.4). Target 62 of South Australia's Strategic Plan calls for development of regional climate change adaptation plans in all State Government regions by 2016.

The regional approach to climate change adaptation has already begun with the Eyre Peninsula Regional Sector Agreement, signed in 2010, between the Minister and Eyre Peninsula Natural Resources Management Board, Regional Development Australia (Whyalla and Eyre Peninsula), Whyalla Economic Development Board and Eyre Peninsula Local Government Association.

Other regions have adopted similar approaches depending on their local circumstances. For example, the Barossa Regional agreement is with Regional Development Australia (Barossa), and the steering committee consists of representatives from natural resources management, local government and other regional leaders. In the Western Adelaide Region, the agreement will be with the local councils.

3.3. Regional steering committees

Signatories to the agreements will form regional steering committees that will take responsibility for planning and managing the IVAs and prioritising, planning and managing adaptation responses in close consultation with business and the wider community (Figure 1). Each committee is likely to have a unique structure, including representatives from key regional sectors and industries along with executives from government agencies that have significant business in the particular region.

Specific roles of the regional committees will include:

- overall coordination of IVAs and adaptation planning
- facilitating and directing vulnerability assessments across the relevant sectors in each of the regions
- engaging local communities to ensure the results of vulnerability assessments are understood
- engaging local communities in the development of adaptation strategies and actions
- ongoing monitoring and evaluation of the process
- developing and enhancing adaptation methodologies promoting opportunities and best practice in other regions.

The regional steering committee structure established under this Framework does not create additional authority for decision making. Rather, it sets up a forum for community and regional leaders to consider priority areas for adaptation action in their region and recommend coordinated responses. The delivery of these actions will remain the responsibility of regional leaders in their existing organisations, which will maintain and continue to exercise their existing roles and responsibilities but in the context of collaborative discussions and agreements with other leaders in their region. In this way, the Framework further empowers and strengthens the role of existing regional decision makers, structures and plans.

Importantly, discussions and agreements made by the regional committees will need to balance the varying interests of parties in the region and, through evidence based assessments, achieve trade-offs between competing interests.

Figure 1 The regional model for developing adaptation responses

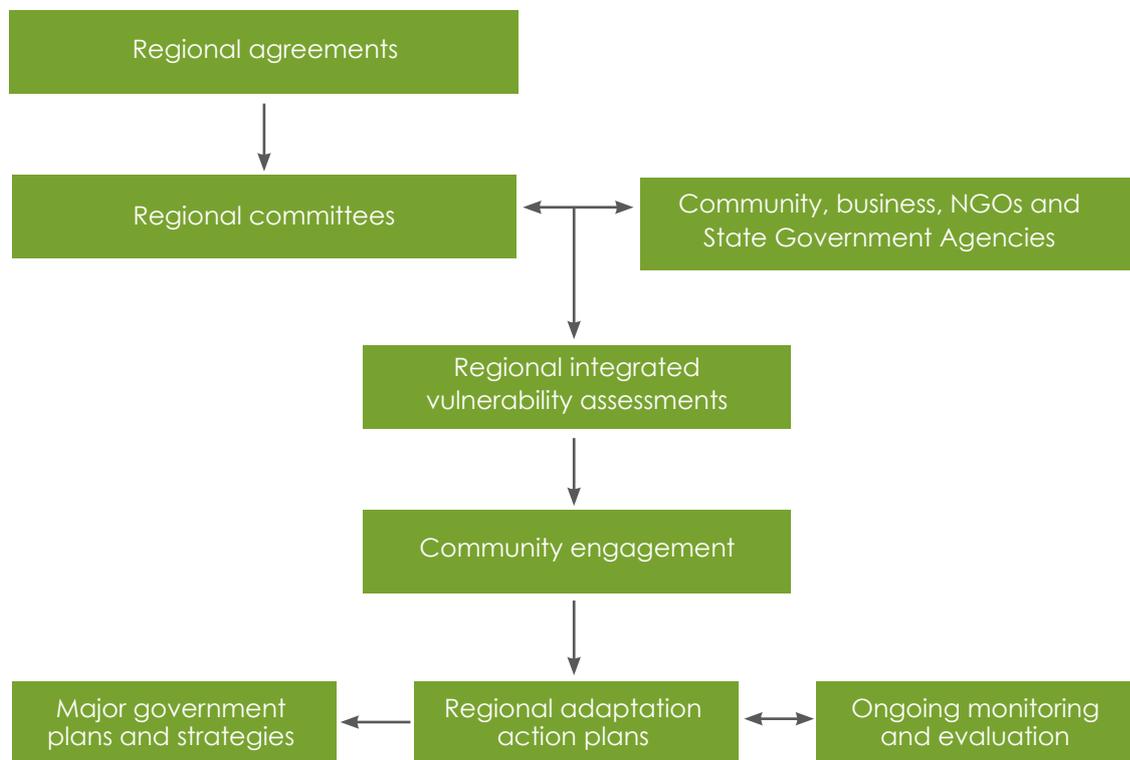
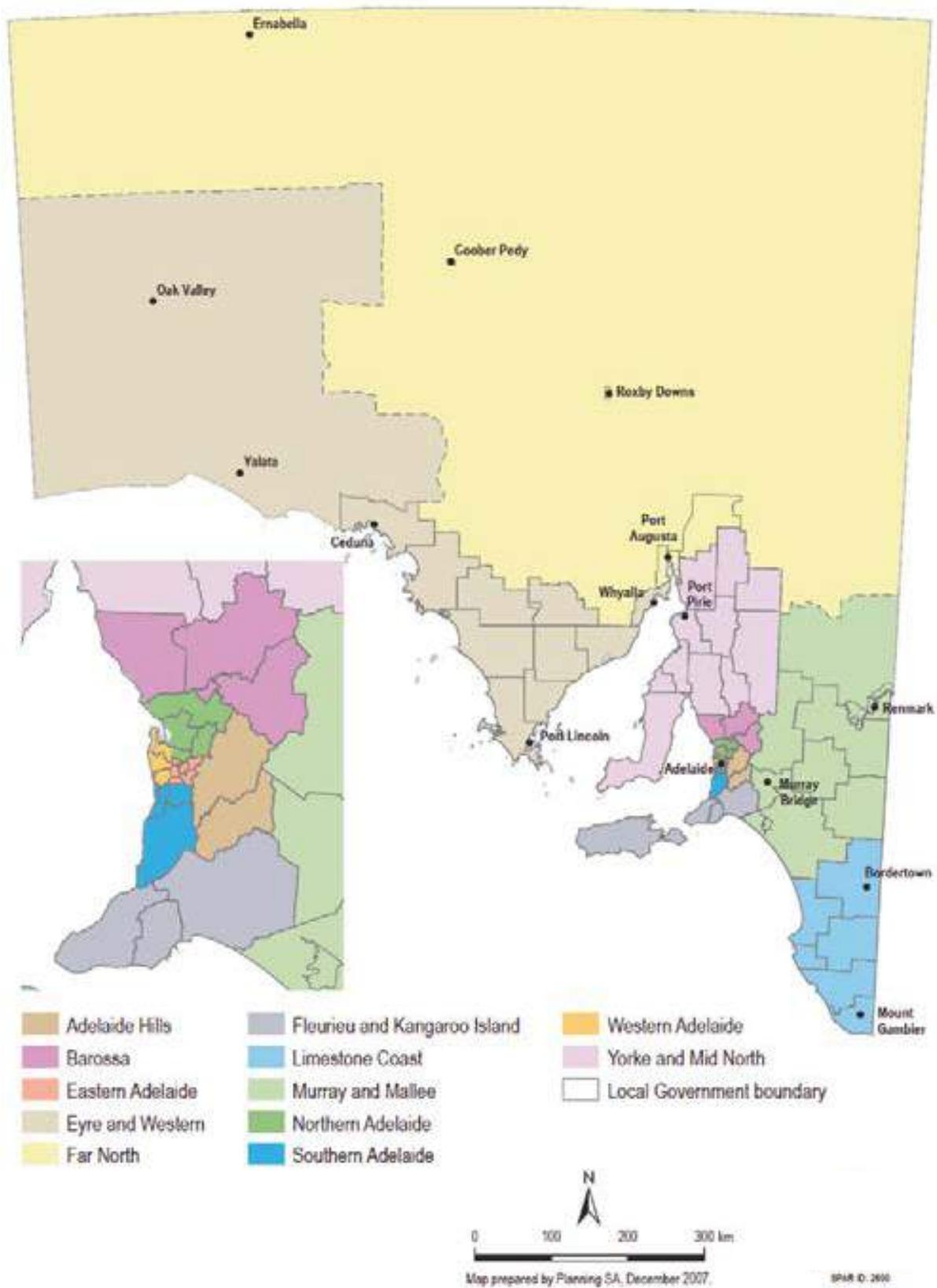


Figure 2 State Government Regions



3.4. Regional adaptation planning

Regional adaptation planning will occur in two phases. The first phase is to understand how climate change will impact the region using the IVA to identify those parts of the environment, society or economy that are most vulnerable. The second phase will use this information to create an adaptation plan that identifies and prioritises the adaptation options to address those vulnerabilities.

3.4.1. Regional integrated vulnerability assessments

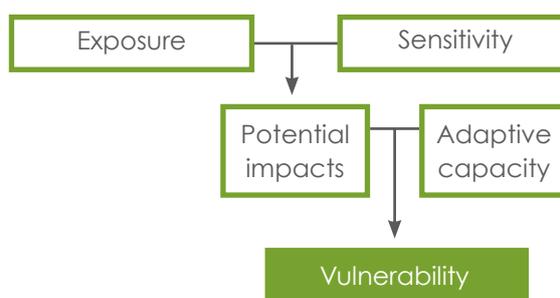
Understanding which sectors and systems are most at risk from climate change and the interconnections between them will assist in successfully planning for adaptation. An IVA considers not only the potential impacts of climate change on regional economies, communities and natural environments but also their capacity to adapt to the changes, and the interconnections between the sectors. By identifying the most vulnerable sectors and systems, appropriate adaptive responses can be planned, prioritised and programmed into investment strategies.

Understanding the interconnections of vulnerability is critical for understanding cross-sectoral impacts. Some examples include:

- increases in the frequency and intensity of extreme events in South Australia including bushfires, heat waves and floods and the implications for human health, infrastructure, disaster management, natural systems, and opportunities for tourism
- increased sea levels on affected coastal ecosystems, infrastructure including sea walls, marinas, roads, ports and other transport links, private and public property and the coastal communities affected
- a likely reduction in rainfall in areas reliant on primary production systems such as agriculture and forestry and how that will affect local economies and challenge food and water supplies. Secondary impacts on people's health, the social cohesion of local communities and the health of the surrounding natural environment also need to be understood.

Each region will undertake an IVA in accordance with guidelines developed in conjunction with the Local Government Association. An assessment of regional vulnerability includes an evaluation of a sector or system's likely exposure to the impacts of climate change, and the extent to which it will be sensitive to those changes and its level of adaptive capacity (Figure 3). By understanding the connections between these components, the reason why a system or sector is vulnerable to climate change becomes clearer and adaptive options can be better considered.

Figure 3 Relationship between climate change exposure, sensitivity, adaptive capacity and vulnerability^v



Exposure

Exposure considers the nature and degree to which a system is exposed to significant climatic variations. Common questions include: What type of climate changes and impacts can we expect, and which systems will be exposed? What is the plausible range of severity of exposure, including the duration, frequency and magnitude of changes in average climate and extreme events?

Sensitivity

Sensitivity describes the degree to which a system is affected, either adversely or beneficially by climate related changes. Common questions include: To what extent is the system (or systems) likely to be affected as a result of projected climate changes? Will the impact of exposure to the climate stress be minor or irreversible (e.g. death, species extinction or ecosystem loss)? What other substantial impacts can be expected (e.g. extensive property damage or food or water shortages)?

Adaptive capacity

Adaptive capacity is defined as the ability of a system to adjust to climate changes (including climate variability and extremes) to moderate potential damages, take advantage of opportunities or cope with the consequences. Common questions include: To what extent can the system adapt to plausible scenarios of climate change and/or cope with projected impacts? What is feasible in terms of repair, relocation or restoration of the system? Can the system be made less vulnerable or more resilient?^{vi}

Once the aspects of exposure, sensitivity and adaptive capacity have been evaluated, a list of criteria for assessing the importance of identified key vulnerabilities, identified by the Intergovernmental Panel on Climate Change (IPCC), can also be used to determine priorities for action:^{vii} The criteria include:

- **Magnitude** - impacts are of a large scale (e.g. high number of people or species affected) or a high intensity (e.g. catastrophic degree of damage such as loss of life or extinction)
- **Timing** - impacts are expected in the short-term and/or are unavoidable in the long-term if not addressed
- **Persistence/reversibility** - impacts result in persistent (e.g. water shortages) or irreversible (e.g. species extinction, melting of ice sheets) damage
- **Likelihood/certainty** - projected impacts or outcomes are highly likely
- **Importance** - sectors or systems at risk are of high value to society.

3.4.2. The regional adaptation plan

Once key vulnerabilities for a region are identified through the IVA process, it is then necessary to determine what action needs to be taken. The process below outlines how actions will be determined. More detailed guidelines will be developed in the future as the Framework is implemented.

Determining key processes and values that need to be preserved

This stage involves identifying which factors, values or services in the region need to be sustained in the face of climate change. For example, what sort of region does the community want to live in and what features of the region need to be preserved or enhanced?

Effective engagement with the community in the region is critical to the success of this phase to determine a shared vision for the future. Vulnerabilities identified through the IVA process can be used to highlight the issues that could prevent achievement of this vision.

Prioritising of adaptation options that reduce vulnerability

The next stage explores and details the range of possible adaptation options identified through the IVA process. By considering each in the context of the values and vision for the region, the community can prioritise the range of actions to reduce vulnerability.

This process narrows the range of possible adaptation options that (i) are acceptable to the community; (ii) can be achieved within cost constraints; and (iii) are most likely to deal with the issues and achieve the desired vision for the region.

Decision and implementation

The final phase implements the chosen adaptation actions and a process of monitoring to ensure the action successfully reduces vulnerability.

The process of adaptation to climate change should not be viewed as a single process, event or response. Improvements in adaptation planning will occur as community understanding of the impacts increases, and the underpinning scientific knowledge evolves.

3.5. Community engagement

A critical component of successful adaptation will also be a community that is able to understand what climate change means for them and what they can do to adapt.

Climatic changes, and in particular the predicted increase in extreme weather events such as storms, heatwaves and bushfires, will have many impacts on communities. Thus residents must be made aware of the risks, educated on how to respond and empowered to act.

There will be a need for simple and broad awareness raising activities and it is likely that this will be the responsibility of state government. These activities may include targeted advertising or media campaigns, developing a centralised climate change adaptation website, and developing information about state-wide activities.

To engage the community in adapting to climate change at the local level requires individuals to have an understanding of the impacts on them personally—their livelihood, township, local environment and what they can do to help. Regional, community, industry, local government and environmental leaders will therefore need to play a major role in 'localising' climate change adaptation information so it is more relevant to local audiences and addresses their concerns.

It is anticipated that regional IVAs will highlight how each region will be most affected by climate change and what we can do to reduce the impacts and benefit from the opportunities. It will be essential to use local knowledge about the impacts, values and opportunities in each region in developing clear, relevant messages that highlight the 'local' challenges and motivate people to act.

Regional steering committees will be a key driver for localised community engagement. To support this process it is anticipated that some funding will be allocated to each region upon the creation of a communication and engagement plan.

4 Sectoral Impacts

All industries, communities and landscapes will need to adapt to climate change, with action required at the state-wide, regional and individual enterprise levels.

Our economy is organised around specific sectors that specialise in the most efficient production and delivery of goods and services (e.g. primary production including aquaculture, viticulture). Many business enterprises belong to industry associations that promote their interests and help them develop best practice performance. Supporting this structure, government operations are also organised around functional units (e.g. Health SA, Department of Planning, Transport and Infrastructure, Department for Education and Child Development) responsible for delivering government services in specific areas (e.g. health, transport and education). These functional arrangements encourage the development of specialised expertise, in both private and public organisations, that in turn improves performance and efficiency in each sector. Climate change adaptation will thus be based on action developed and delivered on a sectoral basis.

The risks posed by climate change will vary sector by sector with responses governed by the economic, social and environmental implications of climate change, and the complex interactions between sectors. The adaptation planning process (section 5) will help sectors better understand and plan for these risks.

Key adaptation sectors have been identified at a national level. The likely impacts and opportunities from climate change on the following example sectors show the range and type of impacts faced by different parts of South Australia but this discussion is by no means exhaustive.

Key sectors

- Community health and individual wellbeing
- Water resources
- Coastal management
- Biodiversity
- Agriculture
- Fisheries and aquaculture
- Forestry
- Infrastructure and urban areas
- Emergency management
- Tourism
- Manufacturing and services
- Minerals and energy.

4.1. Community health and individual wellbeing

Climate change will have varied direct and indirect impacts on regions, communities and the individuals in them. Some regions and communities are likely to be more vulnerable to the adverse effects of climate change. These include the elderly, people with a disability, young children, those living in remote or coastal communities and those on low incomes who are least economically equipped to move or adapt to their living conditions. However, all South Australians will experience some level of impact on their health and wellbeing.

The diversity of health risks presents a significant challenge to South Australia's health and community services. Understanding the risks, identifying vulnerable members of the community and developing appropriate adaptation strategies will need to take into account current and future demographic trends, including population growth and socioeconomic factors.

Possible impacts

Changes to our climate are likely to have significant impacts on community and individual wellbeing. While adaptation aims to capture new opportunities and reduce the adverse climate change impacts, climate change remains a threat to our current way of life and the viability of some communities. A focus on community and public health is important for managing many of the impacts of climate change.

Direct and indirect impacts could include:

- disruption of social networks, and forced migration
- lack of information, knowledge and skills
- heat stress, especially during heat waves
- increased risks to life and property as a consequence of greater and more frequent extreme events such as bushfires and flood
- an increase in the frequency of vector-borne infectious diseases such as Ross River Virus
- an increase in air pollution (e.g. from dust and bushfire smoke) that may increase respiratory diseases and allergies
- an increase in the frequency of water and food-borne infectious diseases
- a reduction in food production and nutritional quality
- the physical and mental health consequences that occur as a result of some direct or indirect impacts, such as drought.

In South Australia, heat-related deaths are likely to take the highest toll, particularly with an ageing population, which is generally less tolerant to heat.

In March 2008, Adelaide experienced 15 consecutive days of 35°C or higher and 13 consecutive days of 37.8°C or higher—almost doubling previous records and setting new records for any Australian capital city.

In January–February 2009 a maximum temperature of 45.7°C and minimum temperature of 33.9°C were recorded. Police reported increased sudden mortality during this event.

Possible opportunities

- Using the cross-sector focus on climate change adaptation to deliver community health and individual wellbeing through proactive measures (e.g. by delivering healthier lifestyles such as walker-friendly urban design)
- Fostering greater community cohesion, social inclusion and social justice
- Gaining more effective emergency responses from better decision making based on improved information
- Reducing exposure to poor air quality, especially of the more vulnerable members of the population.



4.2. Water resources

Low and highly variable rainfall has always been a challenge in South Australia. Higher temperatures, lower average rainfall and higher evaporation rates will pose additional and much more serious challenges for the state's future water supplies. Protecting them will be a top priority.

Adapting to drier conditions will mean thinking about completely new ways of managing our rural and urban water supplies, using a mix of traditional water sources in combination with water reuse and water sources that do not rely on rainfall, such as desalinated water.

Uncertainty about the exact impacts of climate change and the implications for future water supplies in South Australia mean that sustainable water management measures must be incorporated into all planning and infrastructure decisions at both state-wide and regional levels.

Possible impacts

Adelaide has been flagged as one of the most likely of Australian cities (with Perth) to suffer water shortages as a consequence of climate change^{viii}, with associated extreme effects on productivity, and operational, maintenance and capital expenditure.

In recent years, South Australia experienced unprecedented dry conditions, with flows into the River Murray the lowest since records began 118 years ago.

This reduced flow and quality of water into water storages prompted widespread water restrictions and placed constraints on rural water supplies. Rivers and wetlands, and the communities they support, suffered from reduced flows. Estuaries and inlets, which support highly productive ecosystems, were degraded and groundwater systems declined.

Threatened water security has serious economic, social and environmental implications for South Australia. It puts at risk our primary industries, ecology, and the quantity and quality of urban and rural water supplies. This will have serious implications for regional economies and the health and wellbeing of local communities.

The population and economic growth expected over the next few decades could pose additional challenges.

Possible opportunities

- Building on our expertise in sustainable water management technologies, including sustainable irrigation, water recycling, stormwater capture, storage and use, desalination, water trading and infrastructure
- Improving water allocation and water resource management to provide water to the environment, both in South Australia and in the context of national reform, for example in the Murray-Darling Basin
- Increasing use of environmental regulators to use limited water resources more efficiently and to effectively manage new sources such as desalination
- Fast-tracking water quality improvement plans for key catchments.



4.3. Coastal management

South Australia is vulnerable to sea level rise. The state has thus led nationally in developing strategic responses to sea level rise and coastal flooding and erosion. The Coast Protection Board's 1991 sea level rise policy^{ix} was incorporated into state coastal development plans in 1994².

This policy is currently being reviewed in light of 2007 projections in the Fourth IPCC Assessment Report, which indicates rises of 0.19–0.78m by 2100³. Research conducted since then indicates potentially higher sea level rises than quantified by the IPCC^x. Modelling based on 2002 IPCC projections indicated that a 0.5m sea level rise would flood the centre of Port Adelaide and a current 1 in 100-year flood would occur annually. This modelling is being updated to reflect 2007 scenarios.

Bureau of Meteorology monitoring shows that sea levels have been rising at Port Stanvac at an average rate of 5.1mm per year since 1992. The average sea level rise in South Australia over the previous century (calculated from tidal records) was 1.5mm per year.

Regional areas such as Yorke Peninsula are particularly vulnerable. Increasing development in the region, which is popular for retirees and people seeking a sea change, increases the risks. In a first for Australia, the Supreme Court rejected a developer's appeal for an 80-lot subdivision at Marion Bay in March 2008 on the grounds of the risk posed by future sea level rise.

Possible impacts

Sea level rise, increased coastal flooding, storm surges, coastline erosion, reduced sediment production through ocean acidification and aridification pose a significant and immediate threat to coastal communities and natural environments along South Australia's coastline. An estimated 60,000 or more buildings along South Australia's coast are likely to be at risk in the absence of adequate protection measures^{xi}. These factors also pose risks to natural environments.

An increased dependence on desalination will also intensify impacts from brine discharges, which would require appropriate regulation and management.

Potential impacts threaten a range of sectors, including tourism, emergency management, and insurance and finance. Disruption of local communities and increasing levels of stress and tension, would have implications for the health sector.

Across the state, damage to critical infrastructure, property, agricultural land and natural environments could cost billions of dollars in losses. Coastal landowners and lenders in the banking and finance sector face significant losses from inundation or erosion of land by rising sea levels.

Coastal ecosystems, including estuaries, coastal vegetation, wetlands and reefs, will also be vulnerable, as will land adjacent to the coast used for primary production, industry and residential purposes. Increases in coastal erosion will pose a risk for seagrass, which is an important source of carbon sequestration and a nursery for many fish stocks^{xii}.

The effects of sea level rise in the Northern Adelaide metropolitan region will be exacerbated by the subsiding coastline.

Possible opportunities

- Maintaining SA's leading role in coastal policy development and application, and further developing the state's expertise in climate change adaptation
- Integrating coastal adaptation policy and measures across sectors, particularly with emergency management and the state's planning system, to secure new settlements from foreseeable sea level rise and other coastal impacts of climate change, and guide the adaptation of existing communities to the impacts of climate change
- Strategically allocating land adjacent to the coast to allow sea level rise-induced retreat of tide-dependent ecosystems (e.g. mangroves and saltmarsh)
- Regulating coastal dredging and discharges.

² 30cm by 2050 and 1 metre by 2100

³ Note these do not take into account the melting of major ice sheets



4.4. Biodiversity

Healthy and diverse natural systems are essential to support vibrant economies and healthy, prosperous communities. Their benefits include nutrient recycling, water purification, pollination of crops, climate regulation and support for fisheries and aquaculture. A healthy environment also supports South Australia's multi-million dollar tourism industry and areas of natural beauty for recreation and relaxation.

It is highly probable that climate change will affect the ability of natural systems to deliver these vital services, and thus our way of life and state and regional economies.

Human activities, including habitat fragmentation, introduction of invasive species, altered fire regimes, pollution and urban development, over the last two centuries have placed South Australia's native plants, animals and ecosystems under significant pressure. Climate change is likely to exacerbate many of these pressures and stretch limits previously encountered by many ecosystems.

The impact of climate change on natural systems extends beyond rainfall and temperature to changes in ecological processes influenced by hydrological and fire regimes. More intense and frequent bushfires and changed water availability will threaten recruitment and regeneration for many species. More intensive management of fire risk through prescribed burning may further exacerbate the impacts.

Some species will be advantaged by climate change and are likely to become more abundant or have an increased distribution as their available habitat expands.

Possible impacts

Plants, animals and micro-organisms will be especially affected by climate change: they will have more difficulty than humans in adapting to large-scale, rapid changes in climate and climate change induced increases to other stressors such as pest species. Native species would have less ability to move to more suitable environments within the predicted timeframes for climate change.

Scientists generally agree that climate change is already starting to affect some species and ecosystems. They are still uncertain about specific impacts but they are likely to include:

- changes in the distribution and abundance of species (including invasive species)
- changes in reproduction timing and duration, and in growth rates
- species and ecosystem migrations
- changed interactions between species
- changes in coastal, estuarine and aquatic habitat
- warmer and more acidic marine environments
- fragmentation and changes of habitats
- loss of species.

Research by the South Australian Government indicates that land-based species and ecosystems restricted to Kangaroo Island and the Mount Lofty Ranges are likely to be among the most vulnerable. Coastal ecosystems, including bird species that are internationally significant, will also be vulnerable to sea level rise, storm surges and reduced rainfall.

There is insufficient information about the impacts of climate change on ecosystems and species in many regions of the state, particularly for marine ecosystems. Further information is also required on the impacts of fire on biodiversity. Objective 1 of the Department of Environment, Water and Natural Resources *Science Directions 2010–15* is for DEWNR to lead in delivering a state-wide biodiversity climate change adaptation program that maximises the resilience of South Australia's terrestrial, marine, coastal and freshwater ecosystems and human settlements to the impacts of climate change. A range of research questions are listed under this objective.

Possible opportunities

- Rehabilitating previously cleared or degraded natural systems to provide ecosystem services
- Biosequestration
- Managing and restoring key ecological assets
- Building resilient ecosystems and linking fragmented habitats to enable species to adapt to changing conditions
- Strategic use of environmental water to build resilience.



4.5. Agriculture

Agriculture in Australia has evolved to cope with risk and uncertainty, not only in the extremely variable climate but also in response to issues such as market supply, demand cycles and legislative arrangements. Farmers have subsequently developed highly adaptive and successful land management practices; in 2010–11 state gross food revenue was \$13.7 billion.

This adaptive management approach may need to extend to changed farming systems that allow producers to increase their resilience. Some systems could be pushed beyond their viable limits, prompting diversification, economic restructuring and development of new systems. The significant challenges facing the industry will vary across regions.

Producers will also need to take into account potentially changing consumer demands for agricultural produce and implications for the entire value chain.

Possible impacts

The precise effects are uncertain but are likely to include:

- fundamental shifts in agricultural practices and capability, including changes in crop type
- changes to crop yields and produce quality
- changes to the quality of some crops
- impacts on livestock (e.g. drinking water, pasture quality and heat stress)
- changes to soil carbon levels
- impacts on flowering, pollination and fruit set
- increased susceptibility of some soils to erosion
- less potential for expansion of irrigated agriculture
- greater exposure to pests and diseases
- loss or damage from extreme events
- reduced volume and quality of water resources, including a potential reduction in the current irrigated area

- changes to dryland salinity in response to decreased rainfall and increased temperatures, bushfires and extreme rainfall events
- changes in abundance and distribution of invasive species
- reduced reliability and availability of water supplies for livestock
- loss of sustainable landscapes.

Possible opportunities

- Leading internationally on the development of sustainable food and farming systems, including biofuels, soil carbon capture technologies, biochar-type soil conditioners, drought tolerant crops and resilient grazing systems
- More efficient use of energy and water, including in-situ desalination.



4.6. Fisheries and aquaculture

Fisheries and aquaculture, including the interaction between the two sectors, will suffer a range of social, economic and environmental impacts, many of which require further research. For example, impacts on the recreational fishing industry will flow through to communities and other industries that rely on the fisheries sector, such as tourism.

A key challenge for fisheries, nationally, is greater precision in estimating the vulnerability of wild fish stocks to inform the development of sustainable management strategies. Non-climate change related threats on fish populations, such as over-fishing, must also be taken into account.

Possible impacts^{xiii}

Fisheries

South Australia's marine fisheries contribute around 22% of the nation's total fisheries production. Increasing ocean temperatures, acidification, changes to ocean currents and rainfall patterns, altered coastal processes and extreme weather events are all likely to affect commercial and recreational fisheries. Likely impacts include:

- changes to distribution patterns, breeding and growth rates, physiology and migration patterns
- risks to marine biosecurity through the spread of pests and diseases
- a decrease in the productivity and diversity of zooplankton, which underpin marine food chains
- degradation of samphire and mangrove communities, which shelter and feed a range of commercially and recreationally important fish in South Australia, including King George Whiting and prawns.

The combination of ocean warming around Australia and strengthening boundary currents like the East Australia Current is already changing the distribution, growth, recruitment and wild catch of some fisheries. Southern-ranged species, including those in South Australian waters, are most likely to be affected. Initial estimates suggest that prawn, western rock lobster, salmon and estuarine species could be particularly vulnerable.

Aquaculture

Aquaculture production represents almost 56% of the state's total seafood production, and in 2007–08 was valued at over \$657 million.

Increased flood events are likely to discharge larger than usual volumes of stormwater into the sea. The change in nutrient levels and water quality around aquaculture developments could cause death and increase the risk of disease. It may also cause the more frequent closure of shellfish sites through quarantine regulations.

Ocean warming and increased sea levels are beginning to influence the location of some aquaculture sectors and the species that can be farmed successfully in some areas. Sites may be difficult to reposition due to possible increased risk to infrastructure damage from more frequent storm events. A decline in rainfall and therefore water availability could affect land-based aquaculture industries that rely on a freshwater supply. The supply of feed ingredients for aquaculture operations, such as soybean meal and plant protein, may also be compromised by climate change.

Possible opportunities

- Investing in sustainable, climate change-adapted local food industries could provide employment and a vigorous and innovative food market.



4.7. Forestry

The impact of climate change on plantation forests is likely to have long-term economic, social and environmental consequences. A large percentage of the land used for forestry has multiple purposes, including recreation for people and habitat for native plants and animals, all of which would also be affected by damaged forest health.

Reduced forest productivity would have significant economic impacts on industries that rely on timber products, with flow-on effects to local communities.

Managing for climatic variability is particularly important for the long-term products of forestry: radiata pine takes around 35–40 years to produce a final crop and hardwood about 12 years.

The carbon sinks aspect of forests makes a strong incentive to ensure that the industry adapts and remains viable.

Possible impacts

Forestry and forest industries are a significant contributor to South Australia's economy, particularly in regional areas. The sector generated approximately 30% of gross regional product of the South East Region, and 25% of the employment^{xiv}. The wood processing industry produced around 10% of the state's manufacturing production.

Drier conditions and increased temperatures are expected to affect the state's forestry industry, although the degree of effect is uncertain. Reduced rainfall and higher average temperatures may affect growth rates, the frequency and intensity of bushfires and attack by pests, diseases and weeds. Forest ecosystems, already under pressure from salinity, fragmentation and competing demands for its inputs, will be less resilient to climatic change.

Most South Australian commercial tree plantings are located in the South East, with smaller operations in the Mount Lofty Ranges, Mid North and Kangaroo Island. These plantations may be vulnerable, particularly to reduced rainfall and the areas considered commercially viable for forestry may shift geographically, shrink or expand.

Increased atmospheric levels of carbon dioxide are expected to cause physiological changes that may benefit forest growth. The precise effects will depend upon the balance between that benefit and the extent of changes in rainfall and temperature^{xv}.

Possible opportunities

- Biosequestration and biofuels from forest products and residue
- Shade and shelter for native fauna and productive livestock.



4.8. Infrastructure and urban areas

The costs associated with the adaptation of infrastructure will be high but are likely to be higher in the long term if responses are delayed. The long lifespan of most infrastructure (e.g. roads, bridges, pipelines, airports, railways and ports are designed for a life of 50 to 100 years) can make early responses problematic. It will be a major challenge to adapt existing infrastructure to expected climatic changes.

The planning and development sector faces a major challenge in facilitating adaptation responses for settlements and infrastructure. The impacts of climate change must be factored into policy and regulations for land use and urban planning, infrastructure planning and design, and building design and performance standards (e.g. planning policy reviews of risk management criteria such as the one in 100-year flood level allowance).

Possible impacts

Almost all types of major infrastructure in South Australia are likely to be at risk from storms, coastal inundation, flooding and higher temperatures including heat stress. Water, sewer and stormwater infrastructure is also likely to be affected, as will homes, commercial and industrial buildings and community facilities such as schools and hospitals.

Impacts will vary from region to region depending upon local economies, population structures and geographic considerations, such as elevation and proximity to the coast. Settlements and infrastructure along the coast are particularly vulnerable (see section 4.4).

Roads and rail networks will be threatened by higher temperatures and changed rainfall, which may melt bitumen or buckle railway lines. Areas in the north of the state will be particularly vulnerable. Higher temperatures and prolonged heatwaves will also lead to greater energy demand for cooling, increasing stress on energy generation, transmission and distribution systems.

Possible opportunities

- Improving building standards and design guidelines to create more thermal and energy efficient buildings, and remove some climate change pressures on existing electricity and water infrastructure
- Creating a more liveable urban environment by establishing a network of greenways, tree-lined streets and open spaces, which have a cooling effect on neighbourhoods and nearby buildings.

Lochiel Park.

Living with nature.

Sustainability
Centre



4.9. Emergency management

Emergency management organisations will have a significant role to play in assisting South Australians to cope with the more severe and extreme impacts of climate change. Emergency management will require additional coordination across all services.

The expected increase in extreme events may also have resource implications. For example, South Australia's heatwaves brought a threefold increase in ambulance call-outs for cardiac arrests in 2009, each requiring a paramedic team of up to five crew members. On Kangaroo Island around 1200 people worked for over 10 days to bring the 2007 fires under control.

Possible impacts

The impacts on the community, economy and environment as a consequence of extreme events can be devastating. They include:

- loss of life
- social dislocation
- damage to, or destruction of, vital infrastructure
- disruption to industries and economic activity
- effects on physical and mental health
- widespread damage to the environment.

The unprecedented catastrophic fires in Victoria in February 2009 demonstrate the scale of the impacts and challenges faced by the emergency management sector.

Communities living near the coast will be exposed to flooding and storm damage, and communities in the Mount Lofty Ranges and rural areas are highly vulnerable to bushfire. Population growth in these areas increases the risk of these hazards. Remote communities are also particularly vulnerable to natural disasters, particularly fires, floods and extreme weather.

Possible opportunities

- Building on the state's expertise in hazard prevention, mitigation, response and recovery, and disaster preparedness.



Table 3 South Australian Emergency Management Hazards affected by climate change

Hazard	Hazard leader	Likely effects of climate change
Animal and Plant Disease	Primary Industries and Regions SA (PIRSA)	Warmer temperatures will change terrestrial and marine conditions, making them more favourable for some invasive species and diseases that adversely affect primary industries and ecosystems.
Bushfire	SA Country Fire Service (SA CFS)	Longer periods of drier conditions are likely to increase the frequency and intensity of bushfires.
Extreme Weather	SA State Emergency Service (SA SES)	Stronger wind and storm events are likely to increase the frequency and intensity of storm damage and coastal storm surge flooding. More frequent and longer heatwaves are likely to increase risks to human health and infrastructure.
Flood	Department of Environment, Water and Natural Resources (DEWNR)	Less frequent but more intense rainfall events are likely to change the intensity, frequency and duration of inland flood events. Sea level rise is likely to increase the frequency and severity of coastal inundation from tidal and storm surge events.
Human Health	Department of Health (DOH)	Changing climatic conditions will increase some vectors of disease, and increase the occurrence of some diseases. Changing climatic conditions will increase the severity of some medical conditions, posing a greater risk to human health.
River Murray River Bank Collapse	Department of Environment, Water and Natural Resources (DEWNR)	<p>Longer dry periods and prolonged droughts will affect flows and river levels in the River Murray, adversely increasing the risk of further instability and collapse.</p> <p>Increased dry periods will cause more drying of the riverbank, adversely affecting the likelihood of further collapses.</p>
Urban Fire	SA Metropolitan Fire Service (SA MFS)	Prolonged hot, dry conditions will increase electricity usage, in turn increasing the likelihood of urban electrical fires.

4.10. Tourism

Climate change is likely to lead to a loss of tourist attractions, a loss in the quality of attractions, increased costs for repair, maintenance and replacement of tourism infrastructure and increased costs for developing alternative attractions^{xvi}. Adaptation responses in other sectors, for example planning, coasts and emergency management, will have impacts on the tourism sector.

Possible impacts

Some of the state's premier tourist destinations may be affected, for example:

- a hotter and dryer climate affecting our iconic wine-growing regions such as the Barossa Valley and Coonawarra
- reduced river flows in the River Murray, and Coorong and Lower Lakes
- higher temperatures and extreme events, such as flood and fire, diminishing tourism in the north of the state, including the Flinders Ranges, and on Kangaroo Island
- sea level rise, coastal instability and storm events making coastal regions less attractive.

The potentially significant social and economic impacts on the tourism industry, which in 2007 contributed \$4.2 billion to the state's economy, extend indirectly to the regional communities that provide goods and services to tourists.

The Barossa Valley was one of five iconic tourism destinations in Australia included in a recent study by the Sustainable Tourism Cooperative Research Centre^{xvii} on the impacts of climate change. The final report concluded that achieving sustainable tourism in the Barossa Valley is inherently tied to the sustainability of local communities and industries, particularly the wine industry.

South Australia is a popular ecotourism destination. The significant opportunities for the ecotourism industry to demonstrate sustainable practices may be outweighed by the greater risk of flooding, storm surges, fires and heatwaves. This could have implications for major tourist destinations such as Kangaroo Island and the Flinders Ranges.



4.11. Manufacturing and services

The relatively high vulnerability of South Australia to climate change impacts, is likely to expose local businesses sooner than in other economies. Local manufacturers and service providers face both challenges and opportunities.

Risks associated with natural resource security are key for some manufacturing sectors. Climate change may adversely impact on the costs, reliability and quality of water and energy supplies, and would introduce competitiveness pressures on some manufacturers. This could have a negative effect on investment attraction.

Climate change is likely to influence consumer preferences as the impacts of climate change and carbon pricing flow into product cost and availability. Some markets may shrink and others grow. Demand for products and services that help the community respond to climate change will increase (e.g. air conditioners and insulation) and demand for new and innovative products will stimulate business growth.

New opportunities will also eventuate through the knowledge intensive services sector, which specialises in climate change adaptation services, such as engineering, design, planning, and environmental science. Building the services sector and the associated intellectual property in climate change adaptation is likely to result in new export opportunities (e.g. tradeable services).

Possible impacts

The precise effect on the state's manufacturing and services sectors is not well known and further work is required to identify vulnerabilities.

It will be essential for some individual businesses to conduct risk assessments to determine their level of vulnerability and adaptive capacity. Forward planning for climate change, and embedding adaptation into risk management frameworks, will help to mitigate business risk and identify opportunities.

Possible effects on manufacturing and services businesses in South Australia include:

- increased business costs associated with energy and water supplies as the costs of adaptation measures are passed down through the supply chain
- increased costs associated with rising insurance premiums due to exposure to extreme weather events
- extreme weather events reducing manufacturing production through disruptions in energy, water supplies and supply chain reliability (e.g. transport)
- loss of production for firms that primarily rely on agricultural produce (e.g. food and wine)
- inhibited access to investment and capital if manufacturers do not implement measures to identify and reduce risks.

Possible opportunities

- Growing the knowledge intensive service sector
- Changing consumer preferences that increase market share and help local industry make the transition to a carbon-constrained economy.



4.12. Minerals and energy

Increasing international demand for mineral resources has seen the sector significantly grow over the last decade. The significant increase in the prices of minerals has made exploration, development of mines and extraction of minerals more profitable and therefore a lower-risk proposition.

However, mining operations around Australia are not immune to the impacts of climate change. The location of mines often requires operators to provide infrastructure for the workforce and secure transport networks to bring in consumables and ship out product to overseas markets.

In the often harsh environments of mining operations, weather extremes may become more pronounced, threatening the welfare of the workforce and mine infrastructure.

Extreme weather combined with high water demand for mining and processing operations has already forced miners to secure additional water sources including consideration of desalinated water.

Mining operations are already high users of energy and they may use more in response to hotter and drier climatic conditions.

Minerals exploration and extraction provides significant opportunities for using renewable energy, particularly in South Australia where a significant wind energy resource and infrastructure is already available. There is potential for use of solar thermal and geothermal energy in South Australia's north especially in light of existing and planned mining operations in that area. Deployment of other energy-saving technologies may also use geothermal energy, for example, to boil minerals processing wastewater and to yield recycled water for processing and incremental product as precipitate.

Possible impacts

Specific impacts on mining operations in South Australia will depend on the location of the operation, the transport corridors used in the business and the proximity of communities supplying mine staff and supporting services.

Possible climate change impacts on the minerals sector include:

- decreasing use of available water and the necessity to find alternative water sources including desalination and recycling
- adverse impacts on the health of mine staff and supporting communities related to more extreme weather conditions
- deterioration of mine infrastructure due to extreme weather events such as flooding
- increased use of energy to address more extreme weather conditions, limited water resources and infrastructure improvements
- increased cost in mine operation from weather-related operational delays and higher energy and infrastructure use
- damage to external transport infrastructure used to bring in consumables and export product including sea level rise threat to port operations
- threats to vulnerable ecosystems in areas in mining operations.

Possible opportunities

- Partnering with energy companies to source renewable energy for operations with high and predictable energy demand
- Establishing industries around new technologies such as carbon capture and storage and geothermal plants.



5 Implementation

Implementation of the approach set out in this Framework will be successful only with the involvement of all South Australians and sectors of the community, and the collaboration of State Government agencies, relevant advisory boards, local government, business, the research sector and non-government organisations (Figure 4).

Building resilience and adaptive capacity will be an iterative process that incorporates all the stages of adaptive management including monitoring and evaluating our responses and adjusting them as we learn more about climate change (Appendix 1).

Given the number of stakeholders, the process of integrating adaptation efforts will be complex and require effective coordination. This will be a major role for state government (section 5.3).

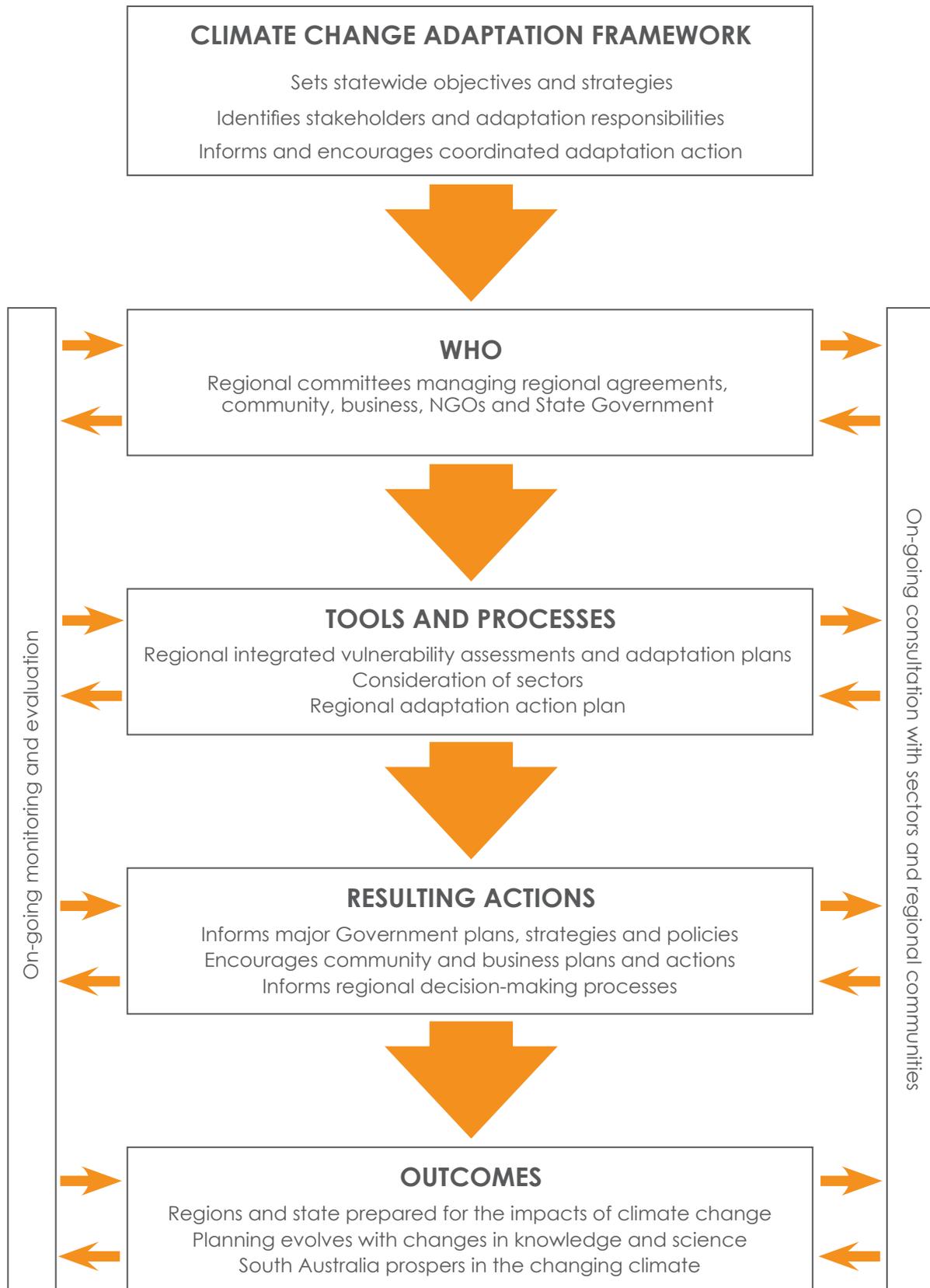
Successful implementation will not be without its challenges. The regional approach to building adaptive capacity described in section 3 introduces a new way of consulting with communities and asks regions to review and balance competing priorities. Regional committees must engage with peak bodies, government agencies and business to ensure that regional adaptation plans consider the needs of, and impacts on, sectors relevant to the regional economy.

Equally important will be the need for key industry and community sectors to commit to delivering adaptation actions that are consistent with the regional adaptation plans. Close interaction between regional committees and relevant sectors of their regional economies and societies is essential. In summary, the major components of the implementation process over the next five years are:

- 1. establishing regional agreements** with each of the 12 government regions between government and regional leaders representing local government, natural resources management and regional planning
- 2. establishing regional committees** under regional agreements to lead regional adaptation activities including engaging the community and key sectors, undertaking IVAs and planning climate change adaptation
- 3. encouraging interaction across the regions** including exchange of information and development of best practice processes for IVAs and adaptation planning
- 4. establishing and maintaining sector agreements** between the government and sectors including key industries, community groups and non-government organisations
- 5. encouraging industry and community sector interaction with the regional approach** including participation in the regional IVA and adaptation planning processes
- 6. implementing improved coordination of whole-of-government approach to climate change adaptation planning** including consideration of regional issues and findings of IVAs informed by the government's internal data and analysis
- 7. engaging with key state and national scientific institutions** to progress climate change adaptation science and research agenda with particular reference to the needs of South Australia
- 8. developing and implementing a communications strategy to promote the Framework** and engage industry, community and business in preparing for the impacts of climate change
- 9. implementing climate change adaptation plans by the regions and sectors**
- 10. reviewing the effectiveness of the regional approach, climate change adaptation planning and adaptation responses.**

Progress on implementation will be reviewed in five years. Progress will be reported through the reporting requirements under the *Climate Change and Greenhouse Emissions Reduction Act 2007*. Each report will include a brief summary of progress achieved under each objective and regional agreement.

Figure 4 Implementation model



5.1. Regional implementation

Successful implementation of the regional approach to climate change adaptation, which underpins this Framework, will depend upon:

- effective membership on steering committees
- regions engaging with peak bodies, government agencies and business to ensure that regional adaptation plans consider the needs of, and impacts on, sectors relevant to the regional economy
- the various business and community sectors developing adaptation responses consistent with regional adaptation plans
- regions working together to develop adaptation responses, particularly to minimise duplication of effort and address issues that cut across more than one region
- regions learning from one another and building on these lessons
- governments, business and peak bodies influencing and learning from regional findings and decisions.

Well-planned membership of the regional committees will facilitate interaction between the regions, the State Government and key regional business and community sectors and organisations. It will help to improve understanding of state-wide implications for relevant regional sectors, from both government and private perspectives.

Government representatives on the regional committees will assist in the exchange of information between the regions and State Government. DEWNR will coordinate a whole-of-government cross-sector view of the government's climate change priorities, informed by the government's internal data and analysis, and by adaptation planning across the regions.

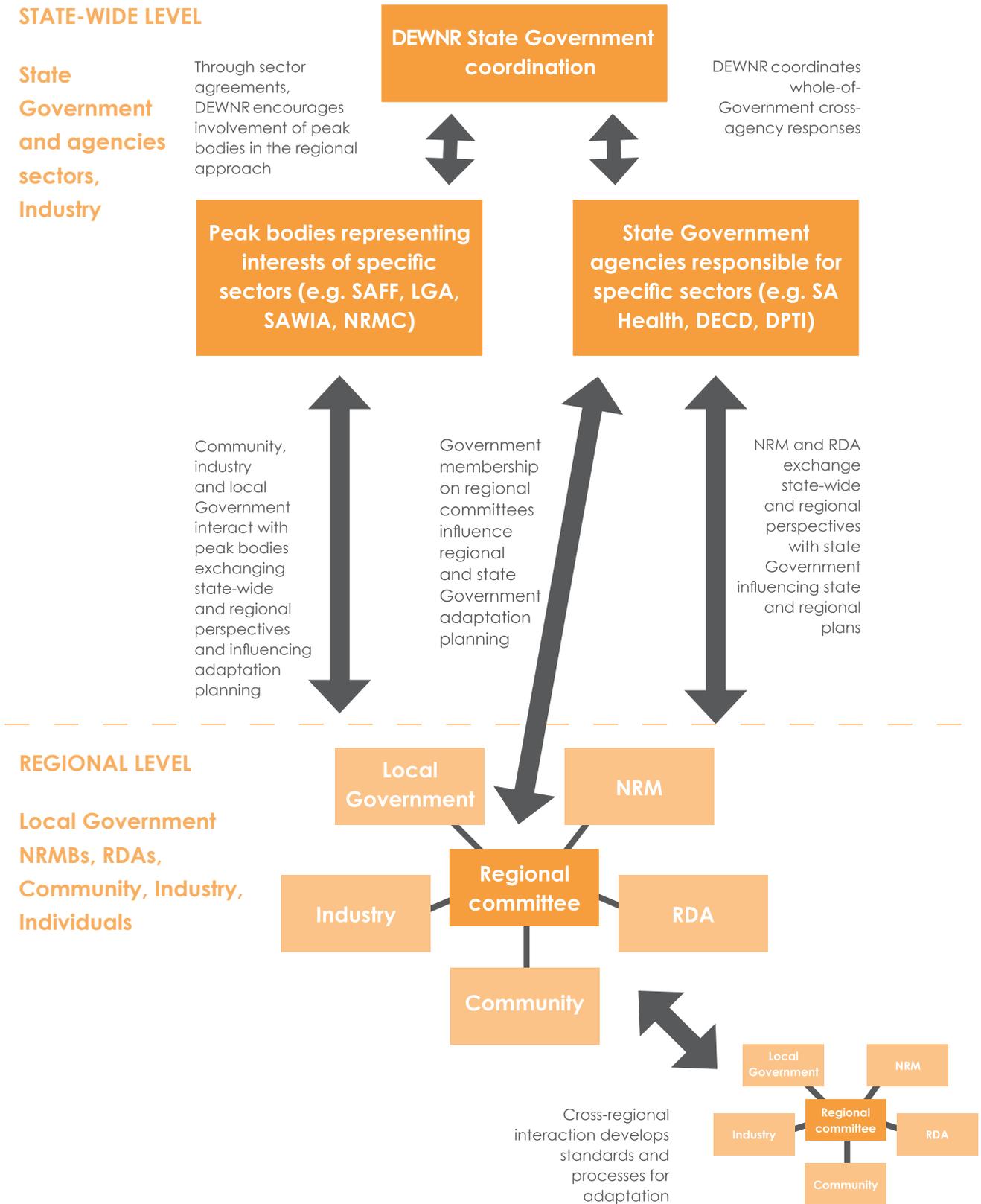
DEWNR will also support state-wide, cross-government and inter-regional collaboration. In the context of the regional committees, DEWNR will ensure information exchange and networking is open between the regions, including standardising processes for adaptation planning, to allow easier comparison of results from different regions.

Committee members representing key industry and community groups will give a regional perspective of climate change adaptation needs in their sector. By using contacts in their industry and through their representative peak bodies, they should also be in a position to provide a state-wide perspective on adaptation in their sector as a whole.

Individuals representing Natural Resources Management and Regional Development Australia boards will have responsibilities for providing input on adaptation planning for biodiversity and the regional economy respectively.

Figure 5 outlines the interactions between the regional committees and other stakeholders in climate change adaptation.

Figure 5 Interaction of the regional approach with organisations on regional and state-wide levels



5.2. Interaction with business and community sectors

The government will encourage relevant business and community sectors to actively participate in the regional approach and to support regional committees in their work. One mechanism will be the continued use of sector agreements under the *Climate Change and Greenhouse Emissions Reduction Act 2007* to engage with industries and community organisations on greenhouse gas management and adaptation planning. By participating in regional IVA and adaptation planning processes, business and community sectors can ensure that regional planning takes account of their needs and issues. The outcomes of regional processes will also inform private parties for their own adaptation planning, and promote consistency across the region.

The delivery of adaptation responses by the private parties is likely to fall into four broad categories^{xviii}:

- **Accepting the impacts and bearing the losses** - making a decision that no specific action is required to deal with the identified level of risk as existing systems and procedures are sufficient or the costs of adaptive strategies outweigh the benefits
- **Preventing effects or reducing risks** - introducing measures to provide some degree of protection such as relocating, changing use, improving preparedness and building resilience
- **Offsetting losses by spreading or sharing risks or losses** - reducing losses by using insurance or establishing partnerships or cooperatives to share risks or losses
- **Exploiting positive opportunities** - introducing new activities, behaviours, technologies, practices or species to take advantage of changed climatic conditions.

The development of regional IVAs is a critical first step in business and community based adaptation planning because they will help identify the key risks that a region faces.

5.3. The role of Government

To support the Framework and the regional approach the State Government has developed a *Government Action Plan for implementing the Climate Change Adaptation Framework (GAP)*. The GAP identifies actions of government agencies over the next five years to support the four objectives of the Framework. The GAP deals with issues of leadership supported by stakeholder partnerships and consultative arrangements. It also identifies an adaptation science and research agenda in cooperation with key state and national research institutions. The GAP will establish a cross-government coordinating function for developing whole-of-government views on state-wide climate change adaptation. It is also an avenue for government consideration of the IVAs and regional plans. These new arrangements will ensure that the plans and concerns of regional committees are capable of informing government policy.

At the five year review of the program, the government will evaluate the effectiveness of agency responses to adaptation issues identified at the regional level.

In support of the regional committees, the government will also take steps to encourage effective communication between regions to facilitate cross-regional information exchange. This will include the development of best practice processes and standards that could be used by all regions to undertake IVAs and develop adaptation responses.

The government will aggregate the outcomes from the regional IVAs and identify overlapping issues and concerns of state-wide significance, which will help inform the development of the State Government's own adaptation planning responses.

The government has also developed a communication plan to ensure a coordinated approach for communicating about climate change adaptation across government, with the regions and the broader community.

Table 4 Major roles for implementing the Framework

Organisation	Major Role
Department of Environment, Water and Natural Resources, Sustainability and Climate Change Branch	Coordinating adaptation responses across state government
	Coordinating development of regional agreements
	Coordinating implementation of the Framework, preparing budget submissions, overseeing regional governance arrangements and developing regional strategies and plans
Other State Government agencies	Either leading or partnering in the implementation of state-wide actions
	Working with regional partners and sectors to develop and implement regional IVAs
	Working with regional partners and sectors to develop regional adaptation plans
	Working with sectoral partners to address key themes
Coast Protection Board	Developing chief executive-level agreements on implementation actions
	Maintaining and updating policies to guide sustainable development and biodiversity conservation on the coast
	Providing guidance to planning authorities and other organisations on coastal development and land use
	Working with regional partners and sectors to develop regional IVAs
Premier's Science and Industry Council	Working with regional partners and sectors to develop and implement regional adaptation plans
	Working with the Premier's Climate Change Council on adaptation science and research issues
	Working with regional partners and sectors to develop regional IVAs (Section 3)
Regional Natural Resources Management boards	Working with local communities and sectors to develop regional adaptation plans
	Working with other key partners on implementation of Objective 4: Resilient, healthy and prosperous communities
	Working with local communities and sectors to develop regional adaptation plans
Regional Development Australia boards	Partnering with other regional organisations to develop regional IVAs (Section 3)
	Working with local communities and sectors to develop regional adaptation plans
Local government (including local councils and local government associations)	Partnering with other regional organisations to develop regional IVAs (Section 3)
	Working with local communities and sectors to develop regional adaptation plans
Universities	Working with the Premier's Science and Industry Council and other key partners on implementation of Objective 2: Policy responses that are founded on the best scientific knowledge
Non-government organisations and business	Working with other key partners to deliver relevant state-wide actions
	Working with regional partners to develop regional IVAs (Section 3)
	Working with regional partners, and local communities and sectors to develop regional adaptation plans
	Working with sectoral partners to address key themes



APPENDIX 1 Building resilience and adaptive capacity

Building the resilience of social, economic and natural systems so that they can withstand climate change without collapsing will be essential to successful adaptation. In a vulnerable or fragile system, even small changes can have disastrous outcomes.

We are part of the natural world and depend on the services provided by nature for survival. The intricate connections between people and the environment mean that we need to build resilience into both human and natural systems at the same time.

Resilience has three defining features^{xix}:

- the amount of change a system can undergo and still retain the same controls on function and structure
- the degree to which the system is capable of self-organisation
- the ability to build and increase the capacity for learning and adaptation.

In the context of climate change, a more resilient system has the ability to withstand higher threshold limits for such events as droughts, heat waves and floods.

Factors that can decrease the resilience of our natural, social and economic systems include:

- loss of biodiversity
- toxic pollution
- inflexible, closed institutions
- perverse subsidies that encourage the unsustainable use of resources
- a focus on production and increased efficiencies that lead to a loss of redundancy.

The key to building resilience in both human and natural systems is maintaining diversity and spreading risk. Adaptive management processes can also increase resilience.

Some of the actions that will increase the resilience of human and natural systems include:

- stopping practices that put people at high risk
- improving understanding and awareness of climate change and the need to adapt

The six stages of adaptive management

Assess the problem: determine management objectives, indicators of success, options for action, assumptions, key uncertainties and alternative hypotheses.

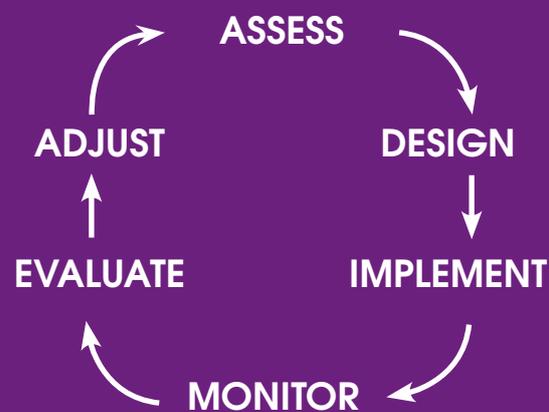
Design actions to test hypotheses; predict outcomes based on current knowledge.

Implement the actions as designed.

Monitor implementation and effectiveness: are there any deviations from the design, and were the objectives achieved.

Evaluate the results: which actions were most effective, and which hypotheses should be accepted or rejected.

Adjust and revise uncertainties and hypotheses and repeat; share what has been learned.



- incorporating climate change information into planning, practice and decision-making
- implementing measures that proactively reduce climate impacts
- developing informed risk-spreading practices.

Improving adaptive capacity creates and expands our options for dealing with climate change, and allows us to respond quickly and effectively to impacts that go beyond what existing systems can reasonably withstand.

Adaptive capacity is about building our understanding of the interrelationships and feedbacks between social, economic and ecological systems across time and space scales appropriate to climate change impacts. Understanding these interrelationships will allow us to prepare for behaviour changes necessary in the face of significant changes to our climate.

Glossary

Adaptation

Actions by individuals or systems to avoid, withstand or take advantage of current and projected climate changes and impacts. Adaptation decreases a system's vulnerability or increases its resilience to impacts. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory (or proactive) adaptation takes place before the impacts of climate change are observed.

Autonomous (or spontaneous) adaptation does not constitute a conscious response to the impacts of climate change but is triggered by ecological changes in natural systems and by market or welfare changes in human systems.

Planned adaptation is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state.

Adaptive capacity

In relation to climate change impacts, it is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate change

Any change in climate over time, whether due to natural variability or because of human activity.

Financial capital

Plays an important role in our economy, enabling the other types of capital to be owned and traded. Unlike the other types, it has no real value itself but is representative of natural, human, social or manufactured capital (e.g. shares, bonds or banknotes).

Human capital

Consists of people's health, knowledge, skills and motivation, all needed for productive work.

Integrated vulnerability assessment

The process of understanding the sectors and systems most at risk of climate change and the interconnections between them.

Impact

An effect of climate change on the structure or function of a system.

Maladaptation

Occurs when adaptive responses have unintended, adverse consequences that outweigh the benefits of undertaking them. An adaptive response that is made without consideration for interdependent systems may, inadvertently, increase risks to other systems that are sensitive to climate change. To avoid maladaptation, the social, environmental and economic consequences of a response must be taken into account.

For example:

Primary producers may pipe water to increase efficiencies and reduce water losses, which could have significant negative effects on biodiversity and native vegetation, and potentially increase the water demand of other crops.

Increased nitrogen fertiliser on crops to offset reductions in protein as a consequence of higher CO₂ levels could lead to significant greenhouse gas emissions.

Manufactured capital

Comprises material goods or fixed assets which contribute to the production process rather than being the output itself (e.g. tools, machines and buildings).

Mitigation

Actions to reduce greenhouse gas emissions.

Natural capital

Consist of natural resources (energy, environment and matter) and associated processes.

Resilience

The ability of a system to withstand negative impacts without losing its basic functions.

Risk

The result of the interaction of physically defined hazards with the properties of the exposed systems (i.e. their sensitivity or social vulnerability). Risk can also be considered as the combination of an event, its likelihood, and its consequences: the probability of climate hazard multiplied by a given system's vulnerability.

Sector

A part or division, as of the economy (e.g. manufacturing sector, services sector) or the environment (e.g. water resources, biodiversity).

Social capital

The institutions and networks that help us maintain and develop human capital in partnership with others (e.g. families, communities, businesses, trade unions, schools and voluntary organisations).

System

A population or ecosystem, or a grouping of natural resources, species, infrastructure or other assets.

Vulnerability

The potential for a system to be harmed by climate change, considering the impacts of climate change on the system as well as its capacity to adapt.

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