Interim Report, May 2010

Local Government Association
of South Australia

Prepared by:

This report has been prepared for the Local Government Association of South Australia (LGA) and the LGA Mutual Liability Scheme (LGAMLS) to summarise the findings of Stage One of the LGAMLS Climate Adaptation Program, which aims to address identified climate and extreme weather event risks for the South Australian Local Government sector.

The LGAMLS is established pursuant to Schedule 1, Part 2 (1) (a) of the Local Government Act 1999 as a business unit of the Local Government Association, providing civil liability cover and risk management services to all Councils in South Australia.

In reference to technical information regarding Climate Change, the LGAMLS has relied on the advice of the Commonwealth Government Bureau of Meteorology and, in particular, thank

Darren Ray, Senior Meteorologist, Climate Services, South Australian Regional Office, Bureau of Meteorology.

Further, the LGAMLS acknowledges the support of Wallmans Lawyers (Adelaide) in providing legal advice as an essential component for the delivery of the Climate Adaptation Program.

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"In Australia over the last 12 months severe weather events have cost the Australian community an estimated $4.2 billion in insured losses. With weather events predicted to become more severe, improving the community's ability to withstand and recover from severe weather events is vital.

Community resilience to more severe weather is crucial for appropriate risk management of the built environment. Individuals and businesses need to change their perceptions of what can and should be done to prepare for and recover from severe weather events.

… It is the responsibility of the general insurance industry, governments, and the Australian community to take action on this issue. Policy decisions and key actions that can be taken to achieve greater resilience must be consistent across all tiers of government."

Insurance Council of Australia, September 2009

Contents

Preface

"… the message is that global warming is real, humans are very likely to be causing it, and that it is very likely that there will changes in the global climate system in the centuries to come larger than those seen in the recent past. Future changes have the potential to have a major impact on human and natural systems throughout the world including Australia."

Climate Change in Australia - Technical Report 2007, p14

All communities across the world are susceptible to significant catastrophic events caused by varying climates. Munich Re, one of the world's largest reinsurers, stated in December 2009 that there has been 'a marked increase in major weather-related natural catastrophes since 1950, with the number having more or less tripled'.

In Australia, we have already seen evidence that our local communities are experiencing vulnerability to climate events in the form of fires, floods, droughts, heat waves and tropical storms: the ongoing drought in the Murray-Darling Basin, devastating bushfires in rural Victoria in February 2009 and recent severe flooding throughout regional Queensland and New South Wales all come at the end of the warmest decade on record (Annual Australian Climate Statement 2009, Bureau of Meteorology (BOM), 5 January 2010).

In accepting that climate change is a reality, we also accept that, in future, the resilience of Australian communities will be further challenged by shifting rainfall patterns, extreme weather events and changing climatic zones. Against this backdrop, climate adaptation will continue to gather momentum as a priority for all levels of government in Australia - none more so than Local Government, which works most closely with the local communities it leads and serves.

In South Australia, where Local Government comprises 68 Councils covering a diverse range of climate-sensitive regions and cities, the Local Government Association (LGA) and the Local Government Association Mutual Liability Scheme (LGAMLS) are responding to the anticipated challenges of climate change through the LGAMLS Climate Adaptation Program (CAP). This Program aims to improve and maintain the resilience of local communities by assisting South Australian Councils to assess and manage climate-related risks at a local level, enabling them to make consistent policy, strategy and investment choices in an area where significant uncertainty exists.

Believing that an effective CAP for Local Government in South Australia should be built on multiple local assessments rather than national data augmented by a few local assessments, our goal has been to engage every South Australian Council in the Program. This approach enables adaptation measures to be evaluated and selected based on local applicability, then consolidated to build an industry-wide position that supports common community needs in South Australia.

By consistently using climate change variables identified in the Australian Government's *Climate Change in Australia: Technical Report 2007* and endorsed by the Bureau of Meteorology, South Australian Regional Office, Climate Section together with region-specific CSIRO scientific data, and by focussing on a period up to 2030 where less variation in climate-change projections exists, the LGAMLS has built plausible scenarios on which to base positive decision-making about future risks and potential adaptation measures.

Recognising that 'risk management is an iterative process' (Climate Change in Australia - Technical Report 2007, p108), the Program is designed to enable Councils to integrate adaptation strategies and measures with their strategic management plans - reviewing and modifying their priorities as required.

Since commencing the program in mid-2008, we have partnered with 29 of South Australia's 68 Councils to conduct individual risk adaptation assessments, tailoring our detailed methodology as we have learnt from our experience. The assessments were conducted using the consistent approach proposed by the Australian Government Office for Climate Change and the *Climate Change Australia: Technical Report 2007,* as endorsed by the BOM, South Australia.

This interim report explores the initial findings of the Program's first stage.

We believe that the LGAMLS CAP provides a sound basis for our Councils to apply effective and consistent risk management methodology. We look forward to working with the state's remaining Councils in Stage Two of the Program to ensure that South Australian local communities are well-equipped to withstand the future impacts of climate change.

Cr John Ross
Chairman
Local Government Association Mutual Liability Scheme Board

About the program

"Risk management applies scientific and technical analyses to estimate the likelihood of different outcomes. The process is often conceptualised as a series of steps, which identify the context, characterise the hazards and/or potential consequences, assess the likelihood of different outcomes, evaluate risk, and, ultimately, implement appropriate method(s) for reducing risk."

Climate Change in Australia - Technical Report 2007, p109

The LGAMLS Climate Adaptation Program (CAP) stands as the first coordinated assessment of climate change risks of a government sector in Australia. The Program aims to give South Australian Councils a framework to translate climate impacts into identified risks to their business operations, whilst developing realistic adaptation measures over short and long-term planning horizons.

Program background

Adopting climate change as one of Local Government's highest priority activities, the LGA's State Executive Committee developed a comprehensive Climate Change Strategy (CCS) in 2008. The CCS was an important inclusion in the joint Climate Change Sector Agreement between the South Australian State Government and Local Government, which commenced on 4 June 2008 (see pg14). Among other measures, the Sector Agreement 2008 outlined the proposed Climate Change Risk Management Assessments and Adaptation Program, [now referred to as the Climate Adaptation Program (CAP)].

With a focus on the delivery of consistent industry outcomes and a 'whole of sector' approach, significant funding was provided by the LGA through its Mutual Liability Scheme (the LGAMLS) to implement the Program over a two-year period from mid-2008.

Stage One of the Program committed to completing 25 programs within 18 months from the commencement of the Sector Agreement. This target was exceeded, with the LGAMLS partnering with 29 South Australian Councils (approximately 50 percent of metropolitan and rural Councils).

Greater Adelaide 30 Year Plan

In addition to the Sector Agreement, the CAP draws on and contributes to, meeting the objectives of the Greater Adelaide 30 Year Plan (the Plan), which was prepared by the South Australian Government and launched on 17 February 2010.

The Plan guides South Australia's business, industry, local government and community leaders, setting out a vision for the growth and development of the Greater Adelaide region during the next 30 years. Forming the basis for South Australia's Strategic Plan, the Plan includes Local Government as an essential stakeholder. Accordingly, it will be used to guide the planning and delivery of services relevant to (inter alia) asset management, infrastructure, transport, health and community services.

Program methodology and design

The Program was designed in recognition of the need for a flexible approach that would meet individual Council operations and requirements, understanding that, for each Council:

- commitment from the Chief Executive Officer and Executive Management would ensure delivery of best outcomes
- officers responsible for environmental issues and risk management would be best placed to drive the program from within individual Councils
- consistent climate change scenarios selected in consultation with Bureau of Meteorology (BOM) would be critical to determine appropriate risks from predicted exposures
- adopting an organisation-wide risk management model and involving a variety of staff with knowledge of all Council operations would assist Councils to incorporate the Program outcomes into annual strategic plans
- the Program should successfully link various climate scenarios to identified impacts across all functional areas of Council
- Program outcomes would provide a sound base to assist Councils with the development of sustainability, emergency and other mitigation strategies.

The following nationally recognised guidance documents were used as a basis for the CAP's development:

- *Climate Change Impacts and Risk Management: A Guide for Business and Government,* Australian Greenhouse Office, 2006
- *Australian Standard AS/NZS 4360, ISO 31000 Risk Management*
- Climate Change Variables for South Australia identified in the *Climate Change in Australia: Technical Report 2007*

In addition, expert interpretation was provided by the:

- Bureau of Meteorology, South Australian Regional Office, Climate Section; and
- Wallmans Lawyer, Adelaide.

Risk management Framework

The Australian Standard: Risk Management, AS/NZS 4360:2004 (now AS/NZS ISO 31000) was selected as the preferred framework for providing guidance on applying the principles of risk assessment and management in decision-making.

As well as allowing Councils to integrate their CAP planning into their mainstream strategic plan, a framework based on the Standard allows for the uncertainties inherent in climate change, enabling new climate change information to be incorporated as it becomes available.
(See Appendix 2 for further information.)

Climate change variables

The Program adopted the best estimate of climate change based on the Climate Change in Australia, Technical Report 2007 modelling as outlined in the table below:

Climate change variable Adelaide		**Current**	**2030 A1B Change** (best estimate)
Extreme temperature	No. days over 35˚C	17 days	23 days
Rainfall	Annual average rainfall	553.4 mm	- 4 %
Extreme rainfall	Daily rainfall intensity (1 in 20 year event)	n/a	+ 3 %
Sea level	Sea level rise	n/a	+ 18 cm
Bushfire weather	No. days Very High - Extreme Fire Weather	19.5 days	24.1 days

Notes:

- Changes (relative to 1990) except for days over 35˚C are shown for Adelaide, South Australia, as per CSIRO 2007 *Climate Change in Australia: Technical Report 2007*. Sea level rise is calculated from A1B 2100 on the assumption that there is a 0.32 cm rise per year.
- Bushfire weather change is for 2030 relative to 1973-2007 as per *Bushfire weather in Southeast Australia: Recent trends in projected climate change impacts* (Lucas et al 2007).
- Information has been independently verified by the Bureau of Meteorology, South Australia, Regional Office, Climate Section. Climate change variables are applied to individual Councils based on geographical location and an assessment of relevant hazards.

(See Appendix 1 for more information on *'Predicted changes to the South Australian Climate'*).

Risk analysis

Risks were broadly assessed against the level of impact they would have on a community, in terms of the ability of that Council to continue its public administration and governance functions. This ability is expressed in terms of the CAP's success criteria. The criteria relate directly to the Local Government Act 1999 and can best be described as long-term objectives that underpin Council operations:

- Maintain public safety
- Protect and enhance the local economy
- Protect existing community structures and the lifestyle enjoyed by the people of the region
- Sustain and enhance the physical and natural environment
- Ensure sound public administration and governance.

The CAP makes the assumption that the climate change variables will occur. The analysis of each risk takes into account all existing or current controls and treatment methods that may impact on the risk. Risks were assessed by:

1. rating the level of impact a risk event would have on a community (in a range from 'insignificant' to 'catastrophic')
2. exploring the consequences those impacts would have on a community's resilience (as expressed by the success criteria)
3. rating the likelihood of a risk event occurring (in a range from 'rare' to 'almost certain')
4. assigning risk management priorities.

(See Appendix 2, 'Likelihood Table' for the likelihood rating of recurrent and single event risks; 'Risk prioritisation table'; and 'Consequence table', for a detailed summary of consequences.)

About the sector

The term 'Local Government' refers to the system in which 68 local Councils operate in South Australia. The *Local Government Act 1999 (SA)* creates the legal framework within which Local Government operates.

Councils have powers to raise revenue (primarily through Council rates), to provide and maintain infrastructure and services, and to regulate activities.

The Local Government system in South Australia is integral to the democratic system of government in Australia that provides vital economic, social and environmental support for communities. Councils' roles have steadily expanded, due to:

- changing community standards and expectations reflecting economic growth
- reductions in both Federal and State Government public services alongside growing legislative and statutory responsibility
- a greater demand for local services.

Local Government in South Australia is typified by:

- high standards of operational competence and accountability
- resource sharing (a high degree of collaboration, consultation and cooperation with other Councils and other spheres of Government)
- conservative management of finances
- expanding roles to respond to community demands and service provision.

Councils largely operate autonomously within the framework of the legislation and are primarily accountable to their local communities. Councils are generally not subject to Ministerial direction by either State or Federal Governments. Sometimes, however, such as in the area of planning and development, Councils work jointly with the State Government, and their decisions may be subject to advice and direction from the State and Federal governments.

The emerging focus on climate change (adaptation) is an example where a consistent industry approach enables Local Govenrment to effectively work jointly with South Australian Government and symbiotically with the Federal Government.

Challenges and opportunities

Councils are required to undertake varied roles and responsibilities defined in South Australian Legislation including (but not limited to):

- *Local Government Act 1999*
- *Food Act 2001*
- *Public and Environmental Health Act 1987*
- *Fire and Emergency Services Act 2005*
- *Emergency Management Act 2004*
- *Development Act 1993*
- *Environment Protection Act 1993*
- *Civil Liability Act 1934 (2004)*
- *Natural Resources Management Act 2004*
- *Occupational Health Safety and Welfare Act 1986*

The broad suite of local-level roles, responsibilities and functions performed by South Australia's Councils presents both challenges and opportunities in addressing and dealing with the risks posed by climate change.

Sector sensitivities

Factors that influence the sensitivity of the Local Government sector to climate change include:

- Councils' financial management is influenced by rate-based revenue
- Councils are involved in the promotion of economic development
- Councils are responsible for:
- land-use planning and are the relevant authority for development planning and building assessment
- delivering home and community care services for elderly and other vulnerable people
- managing natural resource and environmental programs
- undertaking food and public health inspections
- approving the management of events within their area
- Councils manage and maintain:
- a range of community infrastructure and assets of varying condition and age
- stormwater and drainage systems
- parks, reserves, sporting fields and other recreation facilities
- networks of sealed and un-sealed roads

- Councils' Elected Member bodies have primary responsibility for making decisions
- The expectations, perceptions, values and beliefs of its community are major elements of a Council's leadership function. Furthermore, Local Government and companies in general are susceptible to shifts in social trends and public opinion (influenced by the media) that drive policy agendas (TCIA 2006)
- Water availability within Council areas is influenced by the state of the Murray-Darling Basin and reservoir catchments
- Forty-five (45) of South Australia's Councils operate community wastewater management systems
- Thirty-nine (39) of South Australia's Councils have designated bushfire building protection areas
- Thirty-three (33) of South Australia's Councils have coastal geography.

Sector strengths

South Australian Local Government is in a strong position to effect climate change adaptation measures through its strategic and business planning processes. It has established standards, systems and information to manage climate change risks and legislative responsibilities that demand action. In addition, there is scope to modify existing systems to increase Councils' capacity to cope with changes in climate conditions. The sector's adaptive capacities include:

- The roles, responsibilities and objectives of Councils, established in the *Local Government Act 1999*, are compatible with and can enhance, climate change risk management and adaptation planning
- Councils understand the values, beliefs, expectations and socio-economic profile of their communities
- Councils have:
- the ability to guide development by making amendments to zones, maps and policy in Development Plans and Planning Amendment Reports, established under the *Development Act 1993*
- the ability to integrate climate change into strategic management plans, established under Section 122 of the *Local Government Act 1999*
- established consultation and communication plans for the collection and dissemination of information within their communities
- emergency management experience in undertaking prevention, preparedness, response and recovery measures for a range of extreme events, especially bushfire and flood.
- Councils are supported by:
- the LGA(State Executive) and a network of Regional Associations, to provide leadership and to advocate for and guide legislative change
- Local Government Corporate Services, as a purchasing and procurement specialist
- the LGA Asset Mutual Fund, for damage and loss to Council assets and infrastructure
- the LGAMLS, with a comprehensive risk and claims management program
- the LGA Workers Compensation Scheme, with a complete injury prevention management program.

Working jointly with the South Australian Government:

Sector Agreement

In developing the LGA's strategic climate change approach, the LGA identified the need to collaborate with the South Australian Government to ensure that it would complement the State Government's broader climate change initiatives and secure appropriate support and assistance.

A Sector Agreement was successfully developed between the LGA and the South Australian Government under the *Climate Change and Greenhouse Emissions Reduction Act 2007*. Part 3 of this agreement, *'Council business risk assessment and adaptation planning' formed the* foundation for the CAP.

Potential impacts for Local Government

Operational risks issues that arise from predicted climate change scenarios are rapidly evolving with potential impacts across the whole range of Council operations.

The following is a list of potential impacts on Local Government, relevant to each of the climate change variables considered during the risk management process:

Extreme temperature: potential impacts
Increase in:
■ heat-related health issues affecting the elderly, sick and economically disadvantaged
■ dog and cat management issues
■ visitation to swimming pools, beaches and Council–owned infrastructure that provides cooling
■ security and vandalism issues during summer
■ incidence of stop-work criteria being met for Local Government employees and contractors
■ work-related health issues
■ cancellation of community and sporting events
■ incidence of falling tree limbs from large Eucalypt species
■ peak demand for energy for cooling during summer
■ food and water-borne diseases
■ susceptibility of dams, lakes and other water bodies to algal blooms
Decrease in:
■ the integrity of exposed building materials, increasing maintenance and replacement costs
■ the integrity of road pavement, increasing maintenance and replacement costs
Change in community behaviour where less business is undertaken during normal business hours or there is an increasing preference to utilise information technology
Spontaneous combustion of waste management cells more likely
Overheating of equipment/plant (fixed and mobile), increasing maintenance and replacement costs
Potential for power black-outs and implementation of business continuity plans

Reduced average rainfall: potential impacts
Increase in:
■ maintenance and replacement costs for recreation reserves and playing fields (turf, water supply, irrigation equipment)
■ cracking damage to buildings when combined with temperature
■ cracking damage to water and sewerage infrastructure leading to contamination and pollution
Decrease in availability and quality of water supply
Closure of playing fields due to damage to turf
Emergency management for distribution of alternative water supply
Death of reserve and roadside vegetation

Extreme rainfall: potential impacts
Increased incidence of water/air borne virus
Flooding of:
▪ Council buildings and infrastructure
▪ Council facilities and recreation areas
Damage to Council buildings and infrastructure (stormwater, roads and bridges etc)
Emergency management for flooding events
Development planning in flood-prone areas

Sea level rise: potential impacts
Inundation of development planning zones
Inundation and flooding of existing development and transport network
Erosion of sand from coastal areas leading to stability issues with Local Government infrastructure (buildings, roads, water and sewerage systems)
Damage to buildings, water infrastructure and recreation facilities from storm surge
Increase in soil salinity and damage to buildings and infrastructure
Salt water intrusion of aquifers and contamination of water supply
Stormwater systems becoming redundant due to failure of systems
Management of events on coastal foreshore
Emergency management of inundated areas
Constrained retreat of salt marsh and mangroves due to levees and road infrastructure

Extreme bushfire weather: potential impacts
Increase in:
▪ number of permits for lighting and maintaining fire issued by Local Government Authorised Officers
▪ volume of Hazard Assessment under the *SA Fire and Emergency Services Act 2005*
Damage to Local Government infrastructure, parks and recreational facilities
Use of Local Government infrastructure, assets and facilities for response and recovery of bushfire
Business continuity planning during bushfire incidents due to interruptions to business, and employees undertaking response and recovery functions
Currency of Bushfire Risk Management Planning including currency of plans and obligations under the *SA Fire and Emergency Services Act 2005*
Use of high bushfire risk equipment by Local Government and contractors on days of a Total Fire Ban
Management of:
▪ assets and infrastructure (barbeques) located on Local Government reserves
▪ park and roadside vegetation
Replenishment of Local Government water supplies following bushfire
Development planning under the *SA Bushfire Management Planning Amendment Report 2008*

Key findings

With almost 50 percent of Councils involved in the Program so far, there are a number of key findings emerging. Whilst a significant number of the findings require further analysis, as they potentially challenge the future sustainability of Councils, there are a significant number of practical adaptation methodologies that have been identified to support the management of future climate-related risks.

The Program has identified seven areas of Council operations that were repeatedly identified as requiring high-priority local adaptation measures.

1. Development planning

Key points

- Development planning plays an important role in managing the vulnerability of individuals and the community, particularly from those climate change variables that are expected to exacerbate the impacts of coastal inundation and bushfire
- Development plan amendments are an important tool for managing development risks
- Planning decisions should be supported by coastal mapping, preferably for a range of sea level rise scenarios
- Bushfire protection area mapping should be monitored regularly to ensure compatibility with changing hazard scenarios.

Building in the coastal zone

Potential sea level rise and other impacts (erosion) are considered within development planning policy and amendments (DPA) together with coastal Councils' development plans. By adopting a risk management approach to the assessment of development applications and land-use planning, and diligently applying planning policy, Councils are less likely to be adversely affected, in the form of private/public nuisance resulting in negligence-based claims.

Two key risks may arise from the current planning policy for Councils:

1. In achieving the requirements of the development plan to maintain coastal protection buffers, relationships between Council and developers may become strained, increasing Council's involvement and management of the process. In this situation low lying areas zoned for development may enjoy minimal or no development due to inland retreat of the coastline and the continual management of a highly mobile dune system - the very buffer that policy seeks to protect. South Australian Councils also stand to have a reduced capacity in terms of land availability for development in prime coastal locations.
2. For areas within 500m of the coastline and low lying areas beyond this zone, mandatory referrals of development to the Coastal Protection Board creates the potential for inconsistencies. These areas are likely to suffer the same impacts as above.

Adaptation for these risks is predicated by access to high-resolution coastal mapping to assess the validity of coastal protection buffers and other policy such as residential zones contained within the development plan.

Adaptation measures for coastal Councils

- Engage with relevant State Government departments to ensure both tiers of government have a consistent understanding and systematic approach to dealing with the impacts of sea level rise in the Council area
- Develop a sea level rise impacts and risk-based information paper to enhance Elected Members' understanding of the issues
- Engage with the LGA to initiate a sector-wide strategy and project to support and assist coastal Councils in the development and financing of consistent approaches to spatial mapping that provides long-term information on the impacts of sea level rise and storm surge on development planning zones and infrastructure
- Engage with the LGA to initiate discussions with relevant State Government agencies to clarify roles, responsibilities and expectations regarding development in the coastal zone, in particular freehold lease and land management agreements
- Advocate for the establishment of a responsible authority on coastal sea level rise planning decisions

- Investigate alternative funding sources to undertake coastal sea level rise mapping including Commonwealth/State grants, LGA Research and Development Fund and partnerships with tertiary institutions and other relevant stakeholders
- Engage with the Department of Transport, Energy and Infrastructure to clarify roles, responsibilities and ownership of Crown Land and roads that become permanently inundated as a result of sea level rise (LGA/LGAMLS Roads and Infrastructure Project).

Building in bushfire-prone areas

Policy associated with building in bushfire-prone areas was established by the State Government Bushfire Management DPA, which referred planning policy and mapping to Council development plans. Risks associated with this include:

- the currency of the maps which inform bushfire protection areas
- the relevant application of levels of planning
- triggers for referral to the SA State Emergency Services/Country Fire Service.

Trends towards updating the bushfire hazard mapping over long planning horizons in the development plans, are potentially incompatible with the pace of change of climate events that influence the severity of bushfire weather. It has been evident that all Councils with bushfire protection areas expect State Government planning authority mapping to be updated regularly to adequately inform decision making regarding bushfire risk.

Adaptation measures for Councils in bushfire prone areas

- Engage with the Department of Planning and Local Goverment to ensure the accuracy bushfire hazard modelling. Ensure the frequency of development plan bushfire protection area hazard mapping updates reflect predicted changes to bushfire frequency and intensity
- Engage with the SA State Emergency Service/ Country Fire Service and other authorities to:
  - ensure bushfire management planning policies meet changing bushfire conditions
  - develop a compliance priority schedule and key performance indicators for bushfire planning and building rules.

2. Asset and infrastructure management

Key points

- Asset and infrastructure management will present the greatest challenge to Local Government in terms of financial sustainability and community expectation
- The impacts of extreme heat, reduced average rainfall and sea level rise all stand to hasten the rate of deterioration of assets, change maintenance regimes, prompt relocation and demand the construction of new, more resilient infrastructure
- Asset management planning and careful consideration of climate impacts on the useful life of assets is the key to resilience and sustainability.

Changes to asset life

Buildings, roads, footpaths and other Council assets are at risk of a reduced asset life together with increased costs for maintenance. There is a need to increase resilience to the effects of extreme heat, reduced average rainfall and coastal inundation. Council buildings are susceptible to damage from cracking as a result of soil movement and regular and/or permanent inundation from sea level rise and storm surge. The value of assets along the South Australian coastal zone is significant and a high percentage of these assets will need to be relocated and/or decommissioned. Adaptation measures include placing a greater emphasis on the life cycle of an asset, triggers for maintenance and relocation strategies.

A trend is developing for rural road networks: the risk of damage to sealed roads from extreme weather events will necessitate changes to the average resealing period and see a need to consider more resilient materials in construction.

With reduced capacity to undertake regular grading operations, unsealed roads have been identified as being more likely to present public safety issues as deterioration becomes more rapid. In some cases, Councils may need to increase budgets to engage additional services like grading contractors and water tankers or alternatively, close these roads until conditions improve. Materials with greater resilience are being investigated. These are likely to add significant costs to maintenance and construction programs.

Adaptation measures for Councils

- Review and adjust asset management planning methodology to integrate the collection of appropriate data, enabling the establishment of trends in the degradation of assets as a result of climate change
- Review engineering and design standards for Council assets to reflect the impacts of extreme heat and reduced rainfall, in order to achieve anticipated asset life
- Engage with bitumen providers to clarify needs and expectations of bitumen products in addressing long-term climatic conditions
- Undertake a cost benefit analysis of new road building technology and additives, taking into consideration changes to the asset life of roads
- Enhance road crack sealing programs to maintain surface quality
- Engage with the LGA/LGCS to trial new technologies.

Water-sensitive urban design

A high percentage of Councils have identified risks associated with meeting community expectations to introduce water sensitive urban design into all aspects of the public realm and the costs associated with implementation and ongoing maintenance of such systems. Councils are leaders in adapting to the effects of ongoing drought; there are exceptional case studies of infrastructure such as aquifer storage recharge and water reuse schemes. However, there is no question that widespread implementation of similar systems in rural and regional areas could be cost prohibitive. Community wastewater management systems offer an opportunity for further analysis to expand this State's capabilities for water reuse.

Tree management

Reduction in annual average rainfall, extreme heat events and more extreme winds are taking their toll on the health and behaviour of trees, which is already impacting on Councils' current tree management programs. Claim trends relevant to random limb and bough failure and unpredictable and invasive root system behaviour indicate that this is developing into a major resource issue and financial concern for the Local Government sector, with claim numbers escalating at a significant rate.

Adaptation measures for Councils

- Undertake an industry-based review of current best practice guidelines for the inspection, treatment and monitoring of trees (as a Council asset)
- Integrate trees in asset management planning
- Develop individual management plans for the preservation and protection of large native species, including adjusting open space design to include a greater area of mulching underneath tree canopies
- Develop a community education campaign to inform the community of the benefits of street trees in adding value to properties, reducing the urban heat island effect and enhancing urban biodiversity, together with measures that Council has implemented to mitigate effects of invasive trees
- Consider the effect of current legislation relevant to Local Government's powers in the overall management and ownership of trees.

Actions of the sea

The value of the coast to Local Government is reflected by a significant number and type of asset located within 200m of the coast, including open space, roads and public access, stormwater/wastewater infrastructure, amenities, buildings and facilities that are Council-operated or leased. The management of these assets is particularly important to Councils' financial sustainability, given that the impacts of climate change (such as storm surge, flooding and erosion) are likely to accelerate in the coming decades. Leadership, policy development and decision making will need to reflect a principle that assures that new land use and development does not expose the community and Council assets to impacts of sea level rise over immediate and long-term planning horizons. Further to this, Local Government will need to develop engagement and education strategies to assist the community with prevention, preparedness, response and recovery strategies to address sea level rise hazards, together with information on Councils' roles, responsibilities and protection works.

Leased assets

Omissions in specific lease agreements that demand immediate action to undertake mitigation in efforts to maintain functionality of assets, particularly those along the coast, present a risk to Councils. Coastal Councils assessed during the program are now undertaking an analysis of lease documentation to ensure that they have not unwittingly accepted some responsibility for impacts arising from extreme weather or climatic events. Adaptation measures include developing a long-term Council position and plan that establishes and clarifies Councils' roles and responsibilities for sea level rise and storm surge, including policies for the protection, retreat or decommissioning of coastal community reserves and assets.

Coastal stormwater management

Coastal Councils have consistently identified risks associated with the performance of coastal stormwater management systems as result of the combined effects of sea level rise, storm surge and rainfall events. In some cases, assessments identified that there may be back-flow issues due to failures in gravity outflow, leading to the potential for liability claims as a result of flooding. Engineering alternatives are being investigated by relevant Councils to ensure optimum performance of their stormwater systems.

Adequacy of sea walls and levees

Some Councils have existing seawall or levee infrastructure to mitigate the effects of high tides and storm surge. The risk issues for these Councils include the possibility that this infrastructure is unable to cope with future requirements. Climate change impacts such as water tables changes and salinity damage may, therefore, be unable to prevent coastal flooding. Analysing infrastructure design and upgrading infrastructure to mitigate those risks will incur further costs. Relevant Councils are now commencing engineering analysis to ensure enough tolerance is built into designs in relation to coastal inundation.

Wastewater management

Increased environmental contamination and public health issues arising from on-site waste water systems and Coastal Community Wastewater Management Systems (CWMS) along the coast is of concern to a number of both country and metropolitan Councils.

Successful mitigation of related risks will require:

- a spatial analysis of coastal properties to determine impact of sea level rise and storm surge on on-site wastewater systems
- service level reviews to increase the frequency of inspections to ascertain compliance and the condition of on-site wastewater systems
- the development of environmental health strategies for the decommissioning of on-site wastewater systems on the coastal foreshore
- the review of the useful asset life of CWMS
- the development of engineering solutions and/or a retreat and relocation policy for CWMS infrastructure

3. Emergency management

Key points

- The capacity of Councils to maintain statutory environmental health functions is likely to be challenged by increases in extreme weather events, in particular heat
- Partnering with the State and Federal Governments is essential for maintaining service delivery of education and awareness campaigns regarding bushfire preparedness, vulnerable persons, extreme heat policies and community care programs
- Councils predict a reduction in capacity to undertake bushfire hazard management.

Bushfire hazard management

Councils have specific responsibilities for prevention strategies under the *Fire and Emergency Services Act and Regulations 2005.* These include inspection and compliance activities together with contract management associated with:

- reducing hazardous vegetation
- managing permits to light and maintain fires during the fire danger season
- managing the District Bushfire Prevention Committee
- developing, monitoring and reviewing the District Bushfire Prevention Plan.

The capacity for Councils to continue their current bushfire management responsibilities may be compromised in a future where there is greater potential for more severe bushfires. An identified risk to Councils in this area is meeting the challenge of slashing vegetation as a result of non-compliance with a Section 83 Hazard reduction notice. This is compounded by competing objectives of public safety and native vegetation retention. Engagement with relevant authorities in the development of bushfire management is the key to successful adaptation.

Adaptation measures for Councils

- Undertake a review of the impact of the Bushfire Management Committee (established under Section 72A *Fire and Emergency Services Act 2005*) on Councils' former bushfire prevention roles
- Ensure that bushfire risk management is undertaken with a focus on open space and other community land that is vulnerable to bushfire
- Ensure that bushfire risk management is undertaken to determine high-risk open space areas that present public safety implications
- Review and update emergency management plans and relevant bushfire management action plans to ensure adequate consideration of the increased frequency and intensity of bushfires.

Response and recovery planning for bushfire and coastal flooding

Councils have a variety of infrastructure, personnel and equipment that have traditionally been identified by emergency management agencies as a resource pool under emergency management plans. Significant risks for Council are loss of service delivery and increased costs as a result of personnel, equipment and resources being used to:

- construct control lines and supply water, emergency management facilities and recovery services for bushfires
- respond to coastal inundation impacts including traffic management and mitigation or control measures for coastal flooding.

Response and recovery to both of these climate-induced events is a significant issue for Local Government, given forecasts for the increased frequency of these events. The most important measures for successful adaptation are to ensure that Local Government's roles and responsibilities under the *Emergency Management Act 2004* are clear, and that relevant agreements and plans exist for the provision of resources in response to bushfire and flooding incidents.

Integrating bushfire policy into Local Government systems

Australia has one of the most severe fire environments in the world, due to its climate, topography and vegetation. Bushfire is an annual hazard for Local Government and, in order to exercise its statutory responsibilities, is addressed through various risk management strategies in the context of prevention, preparedness, response and recovery under an emergency management framework. The forecasted increase in frequency, intensity and severity of bushfires, together with trends in more risk-averse state bushfire management policy, will undoubtedly flow into decisions and policy development at the Local Government level.

Adaptation to greater severity of bushfires in South Australia's bushfire-prone environments will pose risk challenges to Local Government as Councils deal with increased service delivery levels for hazard management, asset management, provision of personnel, equipment and facilities for response and recovery, together with changes to human resource management, brought about by national and state bushfire policy. Currently, Local Government is intensively managing issues of staff occupational health safety and welfare, and meeting service standards during the declaration of catastrophic bushfire weather days. The key to success will be a thorough analysis of each Council's capacity to delivery its services, together with appropriate consideration of all key business drivers to ensure that relevant frameworks are flexible enough to sustain the responsibilities of Local Government.

4. Sustainability and environmental management

Key points

- Regional partnerships with natural resources management boards supported by Council development plans are important for successful biodiversity management in a changing climate
- Water use and quality management policy should be upgraded to meet future climate impacts.

Biodiversity management

A number of Councils manage natural reserves, with some of these containing plants and animals of high conservation significance. These reserves often represent remnants of native vegetation that provide wildlife corridors between parks and reserves managed by the State Government and other entities. Regional natural resource management principles have identified the importance of landscape connectivity by linking habitats with buffer zones and corridors to reduce fragmentation. A reduction in the annual average rainfall and coastal inundation may impact on these areas by changing species composition and contributing to invasion of pest plant and animal species. Adaptation in these areas will require further partnership with relevant natural resources management boards.

Adaptation measures for Councils

- Ensure that amendments to development plans consider planning policy for retaining open space and other habitats to maintain biodiversity
- Engage with the Natural Resource Management Board to gather appropriate information on techniques to support biodiversity during ongoing changes to the climate
- Review and update Council's biodiversity management strategy to ensure adequate consideration of climate change impacts
- Understand local urban habitats and ensure strategies are in place to maintain connectivity, together with measures for restoring and enhancing their function to conserve species in a changing climate
- Develop and implement a community support strategy for maintaining biodiversity in extreme weather events, especially heat related.

Water quality

Reduced average rainfall and increased periods of high temperatures, present risks in terms of management, costs and reputation to maintain the quality of non flowing water in lakes and wetlands owned by Councils. Increases in bacteria, pathogens and blue-green algae have the potential to:

- increase management to undertake water testing
- reduce amenity
- lead to closures which may impact on local businesses that rely on water.

In addition to the issues with non-flowing water, bore water management has become an increasing issue for Councils that use this water source for maintaining public open space. In some cases, Councils have observed lowering of water table levels and increases in salinity.

Adaptation measures for Councils

- Undertake an assessment of alternative water quality techniques that can be installed in Council-owned water catchments to increase turbidity and limit algae growth
- Engage with independent water quality consultants to ascertain necessary changes to monitoring and evaluation processes to meet the needs of increased extreme heat events.

5. Community services and recreation facilities

Key points

- Community expectations for Councils to provide ongoing services during extended periods of extreme temperature have already increased, thereby presenting service delivery and resource pressures

  The provision of recreation facilities is severely impacted by increased temperatures and reduced rainfall. Sporting grounds and playgrounds are at extreme risk of deterioration and declined use in future years as they may not be "fit for purpose" for parts of the year.

Safer places and heat relief refuges

Community expectations regarding Council facilities present cost implications for Councils in terms of upgrading existing facilities, establishing new facilities and altering services.Extreme temperature (heat wave) events have already demonstrated a change in community behaviour: people are seeking out cool and comfortable facilities such as libraries and civic centres to escape the heat.

Successful adaptation measures will need to focus on providing these heat-relief facilities, whilst maintaining a reduced carbon footprint. Councils may need to re-evaluate the delivery of relevant support services, in order to maintain community health and wellbeing during extended visits.

Another trend that has cost implications is the provision of shade (natural or formed) for Council facilities where there is high visitation. In particular, a high-risk exposure for Councils is the public safety of playground equipment and meeting community expectations for shade in other areas of community land, such as sporting grounds and swimming pools.

Adaptation measures for Councils

- Consider Local Government's role within the State Government Extreme Heat Policy to identify where Council facilities may accommodate and adapt to community expectations
- Review Council asset management plans and update with relevant criteria and standards for enhancing health and wellbeing during extreme heat events
- Undertake a needs analysis of Council facilities that identifies existing equipment and plans for procurement, or retrofitting of, relevant equipment and infrastructure
- Review Council open space and playground strategies and initiate a consultation process to determine community expectations with regards to natural and artificial shade structures at public open space, playgrounds, sporting fields and other relevant Council facilities
- Amend Council procurement requirements to reflect urban design principles that acknowledge extended heat periods
- Review outcomes of the LGA initiated *Tree and Tree Activity* project in relation to public safety and natural shade benefits
- Review Local Government's participation in State Government initiatives (i.e. Red Cross 'Emergency RediPlan', Cancer Council SA 'SunSmart' program and similar programs), to explore opportunities for integration into Council operations.

Playground design for extreme heat

Liability claims arising from injuries sustained by users of playground equipment present an ongoing risk management issue for Local Government that is likely to be exacerbated by extreme heat events in the future. There has been widespread evolution in materials used in the construction of playground equipment, with manufacturers reducing the amount of metal surfaces and replacing these with plastic and rubber. Unfortunately, these changes have not necessarily achieved the desired results with the surfaces producing enough conductive heat to cause potential burns to users. In addition, rubberised soft fall beneath the equipment also conducts a considerable amount of heat.

A paradigm shift is needed to adapt to a future extreme heat environment and to reduce liability claims in this area. Councils must consider the management of playground equipment and areas by increasing the cover of shade, naturally and/or by erecting shade structures. Future adaptation may be better served by active engagement with manufacturers and engineers to incorporate suitably visible labelling into the structures so that users/guardians are warned of the safety aspects of the equipment. This strategy would benefit Councils by saving costs associated with erecting warning signs for individual pieces of equipment.

Community land management

Significant risk has been identified with recreational turf areas and community land as a result of the loss of condition of turf and vegetation arising from the combined effects of reduced average rainfall and extreme temperature. In particular, the main risk issues are associated with maintaining sporting grounds in a 'fit for use' state and ensuring that the aesthetics and amenity of open space meet community expectations. Each of these risks has significant implications in terms of safety and cost.

Adaptation measures for Councils

- Review Community Land Management Plan to consider public perception and expectations in relation to open space issues in an extreme weather climate
- Assess current and future open space utilisation in light of projected increases in extreme weather events
- Review and update asset management plans to include the impacts of climate change as a key strategic plan initiative
- Develop policy and assessment criteria for the aesthetics, amenity and environmental value of open space and link to asset management planning
- Undertake continuous improvement of native plant species selection by monitoring ongoing condition and growth and investigating further application of arid zone plants
- Undertake a review of existing planting policy to include an impact assessment of surrounding heat absorbing structures that have the potential to impact on the health and survival of new plantings
- Undertake research into Federal and State Government and other recognised trials on horticultural techniques for the Adelaide Plains
- Establish a 'Water Sustainability Alliance' to develop Local Government sector principles, systems and approaches to water sustainability with an emphasis on the integration of water capture, waterproofing and reuse across the region
- Develop and implement an integrated water resource management plan for sustainable development to allocate and monitor the district/regional water resources in the context of economic growth and environmental management.

6. Health and wellbeing

Key points

- The capacity of Councils to maintain statutory environmental and health-related functions is likely to be challenged by increases in extreme weather events
- Partnering with Federal and State Governments and other recognised support agencies is essential for maintaining service delivery of community care and other programs during extreme weather/emergency situations
- Compliance with Occupational Health Safety and Welfare (OHS&W) responsibilities with respect to Council members, employees and volunteers remains a high priority.

Health inspection and disease management

Councils' roles and responsibilities with regard to the *Food Act 2001* and pest and vector-borne disease management are expected to be challenged by predicted increases in extreme weather events. Rural Councils in particular, have consistently identified significant risk with meeting their requirements under the *Food Act 2001*. Demand on Councils' resources to meet the statutory responsibilities to undertake more routine auditing of food premises and response to disease outbreaks is expected to be unsustainable in a future climate. The severity of the situation with some rural Councils is highlighted by their inability to attract and retain qualified environmental health officers. At present, adaptation measures include increased delivery of education to food premise operators and the establishment of emergency response plans with neighbouring Councils to share delivery of services during high-demand periods.

The abundance in new pest species such as European wasps and vector-borne diseases such as Ross River Virus and Malaria is another common intolerable risk that has been identified across the sector. Local Government is likely to become increasingly involved in consultation with State Government agencies with regard to the roles and responsibilities associated with the prevention and control of new pests, together with the provision of additional vaccination programs.

Adaptation measures for Councils

- Develop and incorporate an extreme weather (heat) event guideline relevant to food safety
- Engage with relevant stakeholders and identify changes to vector-borne diseases as a result of increases in the frequency of extreme weather events
- Develop, in conjunction with other authorities, an environmental health strategy for the long-term management of vector-borne diseases
- Identify and complement public education and awareness programs for reducing illness from vector-borne and other diseases
- Engage with the LGA (and relevant Federal and State Government agencies) to ensure sector-wide understanding of the potential implications of climate change on the delivery of immunisation services and other public health requirements and to secure ongoing funding to meet community needs.

Home and community care

The Home and Community Care (HACC) program is a joint initiative between Federal, State and Local Governments that provides domestic assistance, personal care, transport and nursing services, in order to support vulnerable persons (and their carers) to be more independent, thereby reducing the potential for premature admission to supported residential care. Increases in extreme weather events will have an impact on Councils in terms of maintaining quality care in the face of increased demand for the range of services, together with the potential for increased liability in the event of heat-related health issues arising whilst providing the service. Adaptation measures have focussed on undertaking risk assessments of the functions performed, adjusting scheduling and introducing further mechanisms to ensure recipients are safe and properly supported.

Adaptation measures for Councils

- Engage with the LGA (and relevant Federal and State Government departments) to ensure equitable funding and the development of a consistent HACC service delivery model for the sector
- Engage with the LGA to ensure state-wide consultation in the development of a strategic direction regarding the provision of services to vulnerable groups during extreme weather events
- Undertake an analysis of Council's capacity to deliver emergency response and recovery services for extreme heat events and partner with relevant authorities/agencies where appropriate
- Engage with relevant providers including contractors to ensure climate change is considered in their business planning and incorporated in strategies for vulnerable groups.

Employees, volunteers (and other officers): safety and welfare

Climate change will impact on the occupational health safety and welfare factors that staff, volunteers and other officers face while undertaking their work-related tasks. These hazards are not limited to the outdoor workforce but extend to those who are accustomed to working in a controlled environment. Councils will need to consider the safety of their staff and others in the review and implementation of OHS&W policy, procedures and plans, together with diligent asset management planning, to provide the infrastructure and systems that ensure acceptable working environments. Investment at this level has the potential to be offset by reducing time lost as a result of staff and volunteer absences.

Adaptation measures for Councils

- Review and update inclement weather policy to establish a coordinated redirection of outdoor staff/volunteers to cool locations and/or to undertake alternative work
- Consider extreme heat events as a variable for business impact assessment as a component of business continuity planning
- Consider the development of seasonal focussed outdoor staff training program that can be successively implemented during extreme weather event periods
- Review outdoor staff personal protective clothing to ensure safety and comfort during extreme weather periods.

7. Council prosperity

Key points

- An understanding of major industry and sector climate impacts and risks will be important for Councils to lead their communities and make sensible decisions for community viability
- Long-term financial planning will need to incorporate an assessment of how climate change factors will impact on both individual Council and whole of sector business.

Council viability

The capacity of the land to sustain production, particularly in the agricultural, horticulture, viticulture and wine industries may impact on Council's capacity to sustain services over the longer term. Some Councils have acknowledged that reliance on an industry with a single focus may threaten long-term sustainability - in particular, employment and tourism - for economic growth. Whilst these industries are responsible for their own risk management and adaptation when it comes to climate change, it is important that Councils take a partnering approach for the development of short and long-term planning. Partnerships developed to address these issues will ultimately lead to community-based adaptation, better decision making, enhanced resilience and ultimately economic growth.

Adaptation measures for Councils

- Partner with relevant stakeholders, including the LGA and State Government to advocate for appropriate research on the impacts of climate change on the viability of the industries that Councils may rely on for ongoing sustainability
- Implement an industry engagement strategy to lead, support and partner climate adaptation strategies within the community
- Monitor and review relevant information on the sustainability of industry and adjust planning controls to enable efficient industry adaptation and to forecast the rezoning of unviable land
- Continue to work in partnership with the SA State Government to progress the *30 Year Plan for Greater Adelaide.*

Financial sustainability

Introducing adaptation measures into Councils' strategic management and business plans will have an impact on Councils' budgets. Cost has been identified as key risk impact area, mainly due to the influence that this has on the management of assets/infrastructure. Councils will require more rigorous financial risk assessment to successfully address the impacts of climate change.

Adaptation measures for Councils

- Ensure long-term financial plans consider increased costs caused by climate change factors
- Undertake a review of Council fleets and, where practicable, develop plans to convert to alternate energy efficient vehicles
- Incorporate a program to update the energy and water efficiency of Council-owned buildings into the review of Council asset management plans
- Establish a building asset renewal plan that triggers a cost-benefit analysis of actions to improve energy and water efficiency at each point of the building life-cycle
- Set minimum standards for controlled environment efficiency and performance
- Review financial procedures to incorporate the ability to monitor increased costs resulting from climate change.

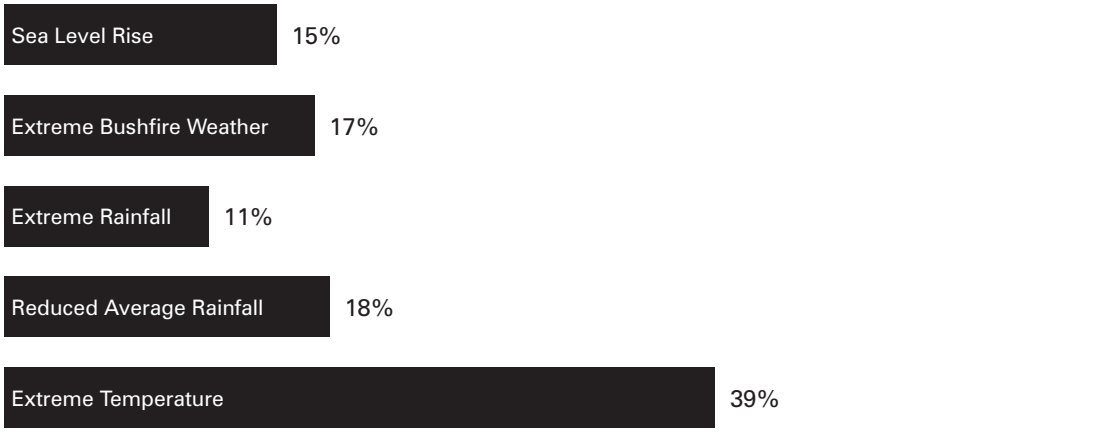
Summary of risks

Overview

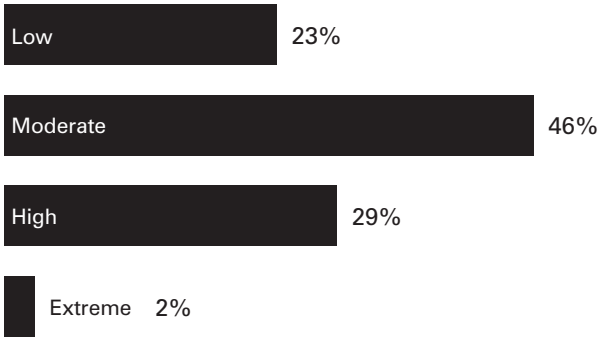
The increasing impact of climate risks for Local Government are spread across a variety of strategic and operational areas. These are not limited to financial, liability or legal exposures. Local Government has a risk frequency trend that reflects its diverse role as a tier of government. Risks associated with financial management and sustainability are identified as the most important risk area for Councils.

During the risk analysis phase, an assessment was undertaken to determine risk trends for intolerable (Extreme and High) risks in Local Government functions, as determined by the *Local Government Act 1999*. Other identified high risks for Councils emanating from climate change is the management of assets (community infrastructure) and development planning, in particular as a result of dealing with the impacts from extreme temperature events, reduced average rainfall and sea level rise.

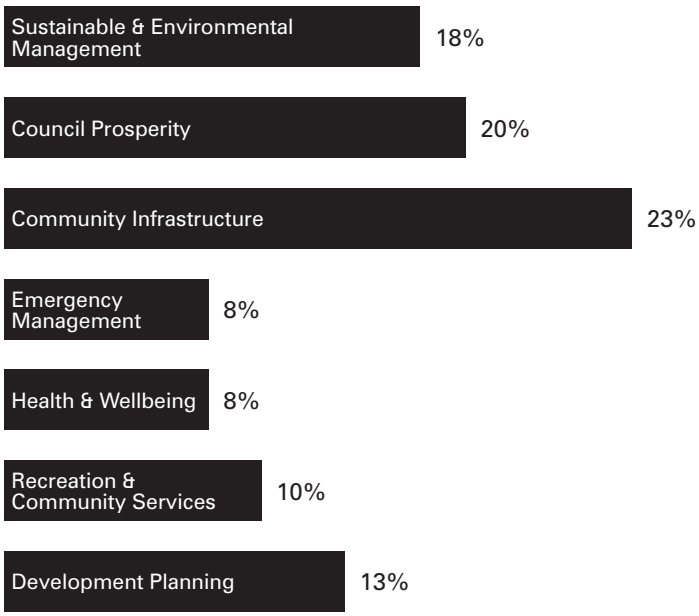
Climate Change Variables (High & Extreme Risks)



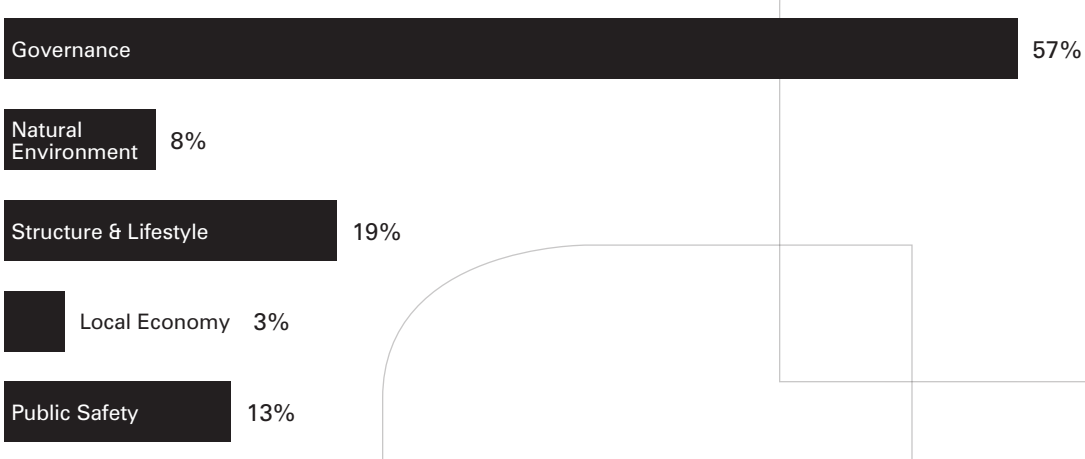
Risk Ratings



Seven Functions of Local Government (High & Extreme Risks)



Risk Rating Criteria (Perspectives)



Moving to a climate-resilient sector

The application of the LGAMLS CAP is supporting South Australian Local Government to better understand the climate-related risks to their communities and to develop adaptation strategies to create more resilient communities in the future.

The initial program has confirmed that a common risk-based assessment framework can be applied across 29 Councils, with diverse locations, to identify key risks on both an individual and sector-wide basis. This systematic framework, combined with in-depth engagement with local community leaders, provides a strong basis for both individual and whole-of-sector decision-making.

The scope of the CAP does not extend to analysing the steps that would be required to implement the identified adaptation measures. However, the following steps would be critical to implementing a comprehensive climate-resilient strategy at local and or state-wide levels:

- Create an inclusive local community effort
- Recognise the different roles for each stakeholder, including all tiers of government, communities, the business community and individuals
- Define current and target priorities for adaptation measures
- Address existing obstacles to implementing adaptation measures, such as policy frameworks, organisational capabilities and legislative barriers
- Encourage sufficient funding from State and/or Federal governments.

While this report is by no means the complete answer to the complex problems faced by Councils from increased climate-related risk, it starts to provide a practical catalogue of climate-related risks at both local and state-wide levels and provides a foundation to support leadership, governance, policy making and decisions. This foundation will ensure that Local Government in South Australia is better placed to build well-rounded and robust communities, notwithstanding future climatic impacts.

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Appendices

Appendix 1 - Predicted changes to the South Australian climate

Temperature

South Australia is likely to see only marginal average annual temperature increases in the order of 0.9˚C (CSIRO 2007). This is not likely to present significant issues for Local Government business. However, extreme temperature will present some challenges, with an increase in the number of days over 35˚C and a 20-30 percent increase in the number of warmer nights during the summer months.

As a consequence of clearer skies during Autumn, Winter and Spring, there is likely to be an increase in risk of frosts (pers. com. Ray, D, 4 September 2007).

Rainfall

Annual average rainfall is predicted to decline. It is expected that there will be significant seasonal variations with major declines occurring during Winter and Spring. In addition to this, rainfall decline in the Murray-Darling Basin (Victoria and New South Wales) needs to be given recognition due to the contribution to the Murray River in-flows and subsequent river health in South Australia.

Extreme rainfall events are expected to increase by 3 percent by 2030, however this is not expected to change the average recurrent intervals for stormwater design significantly.

Wind

Globally, an increase in wind speeds is predicted. However, in South Australia the magnitude of average wind speed increase is of little concern, with minimal impact to Local Government. Climate change is likely to increase the incidence of and strength of sea breezes which may influence activities and operations for coastal Councils.

Sea level rise

Sea level rise is often considered as a long-term problem. However the impacts may be experienced now, as only small rises have the potential to impact on coastal flooding, erosion and sand drift. South Australian Councils have already experienced damage to infrastructure as a result of coastal inundation and erosion. What makes this climate change variable even more significant is the fact that it is difficult to measure and forecast. The IPCC 2007 gives a central estimate of global sea level rise of 35cm by 2100 with a further additional contribution from the melting of land-based ice sheets, possibly 10–20cm. This equates to an increase of 18cm by 2030 for South Australia.

There is a high degree of uncertainty regarding the contribution that the large ice sheets of the Arctic and Antarctic (which are currently locked in place by floating masses of ice known as ice shelves) will have on sea level rise. There is a potential for a further 50–100cm rise as a consequence of accelerated thinning and melting of the ice shelves.

Minor rises in sea level (as predicted) are significant to coastal Councils as storm surge (increase in water level above the high tide mark during storms) will exacerbate the impacts.

Bushfire weather

Very high and extreme bushfire weather is of concern as, should a fire ignite under these conditions, the likelihood of control is poor and consequences to the community and the environment are severe. Analysis suggests that very high and extreme bushfire weather conditions may become a much more common event (Lucas et al 2007).

Severe thunderstorm

The Bureau of Meteorology (BOM) classifies severe thunderstorms as any storm which produces any of the following:

- Hail stones > 2 cm
- Wind Gusts > 90 km/h
- Flash flooding
- Tornado.

South Australia has experienced cool season tornados (Cummins, Snowtown, Tarlee: 21 July 1995; Coulta, Wattle Park: 18 May 2002; and Karoonda: 10 June 2005). Climate change is projected to have positive impacts. A reduction in the number of tornados during the period, May to October, is likely, due to less favourable conditions for their formation (CSIRO 2007). Furthermore, the incidence of large hail is likely decrease.

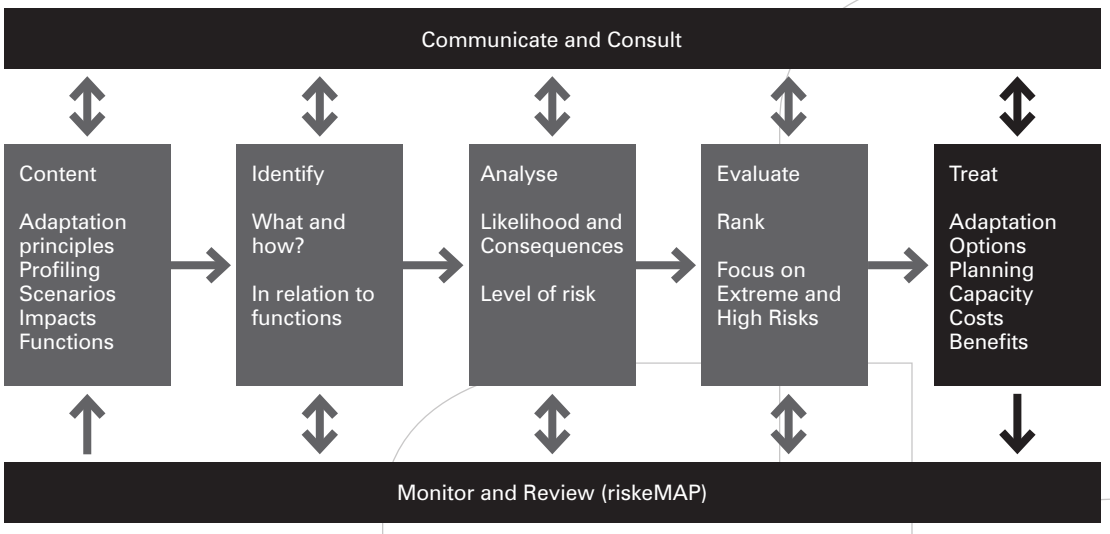
Appendix 2 - Risk management framework

Benefits of using Australian Standard: Risk Management, AS/NZS 4360:2004

The Australian Standard: Risk Management, AS/NZS 4360:2004 was selected as the preferred framework for assessing climate change risks. Using this Standard's as the basis for the CAP's risk management framework has a number of benefits, in that it:

- is recommended by the Department of Climate Change and identified as an option by the *Climate Change in Australia: Technical Report 2007*
- promotes *Fire and Emergency Services Act 2005* of climate risk adaptation within enterprise risk management
- requires minimal training
- integrates with quality management, business continuity and business excellence systems
- is used by Councils for other business areas (ie, emergency management, bushfire management and OHS&W)
- is dynamic, responsive to change and incorporates mechanisms to treat uncertainty
- has also formed the basis for the Draft International Standard of Risk Management (ISO 31000)
- is a robust framework supported by a best-practice online risk management assessment tool and database.
- facilitates continual improvement of an organisation.

Climate Change Risk Management Framework



Appendix 2 - Risk management framework (cont.)

Consequence table

Outcome or impact of an effect consistent with AGO 2006:

Consequence rating	Maintain public safety	Protect and enhance the local economy	Protect existing community structures and the lifestyle enjoyed by the people of the region	Sustain and enhance the physical and natural environment	Ensure sound public administration and governance
Catastrophic	Large numbers of serious injuries or loss of lives	Regional decline leading to widespread business failure, loss of employment and hardship	The region would be seen as very unattractive, moribund and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decay and cease to be effective
Major	Isolated instances of serious injuries or loss of life	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely
Moderate	Small numbers of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure
Insignificant	Appearance of a threat but no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	There would be minor instances of public administration being under more than usual stress but it could be managed

Appendix 2 - Risk management framework (cont.)

Likelihood table

This table describes the framework of probability and frequency of the effect consistent with AGO 2006:

Likelihood rating	Recurrent risks	Single events
Almost certain	Could occur several time per year	More likely than not: probability greater than 50%
Likely	May arise about once a year	As likely as not: 50/50 chance
Possible	May arise once in ten years	Less likely than not but still appreciable: probability less than 50% but still quite high
Unlikely	May arise once in ten to 25 years	Unlikely but not negligible: probability low but noticeably greater than zero
Rare	Unlikely during the next 25 years	Negligible: probability very small, close to zero.

This is a conditional likelihood and is used all assessments under the assumption that the climate change scenario will occur.

Risk prioritisation matrix

The detailed methodology underpinning the Program's framework uses a risk prioritisation matrix to evaluate a selection of priority outcomes and applicable adaptation measures for each anticipated risk - spanning governance, legislative, infrastructural, technological and behavioural and solutions. This matrix has been tailored since the Program's launch in mid-2008.

Likelihood	Consequence				
	0 - 10 Insignificant	11 - 30 Minor	31 - 50 Moderate	51 - 70 Major	71 - 100 Catastrophic
71 - 100 Almost Certain					
51 - 70 Likely					
21 - 50 Possible					
11 - 20 Unlikely					
0 - 10 Rare					

Key	Low	Medium	High	Extreme

Appendix 2 - Risk management framework (cont.)

Elements at risk

Councils have the opportunity to define their own 'elements at risk'. This may be in the form of the organisational structure or functional areas. As a default, the following are suggested in accordance with AGO 2006:

- Infrastructure and property services
- Recreational facilities
- Health services
- Planning and development
- Natural resource management
- Water and sewerage services.

Adaptation classification

According to the IPCC 2007b, adaptation measures can be classified in terms of Policy, Managerial, Technological and Behaviour forms. To provide direction to adaptation planning within Council, an adaptation framework has been developed:

Policy	Managerial	Technological	Behavioural
Legislation	Control	Infrastructure	Information
Regulation	Operations		Awareness
Policy	Planning		Education
Statutory planning	Logistics		Public warning
Compliance	Leadership		
Enforcement			

Glossary

Adaptation

Adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

(Planned) adaptation

Adaptation that 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.

Adaptation assessment

The practice of identifying options to adapt to *climate change* and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility

Adaptive capacity

(in relation to climate change impacts)

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.

Anthropogenic

Resulting from or produced by human beings.

Climate change

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the *United Nations Framework Convention on Climate Change (UNFCCC)*, which defines 'climate change' as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global *atmosphere* and which is in addition to natural climate variability observed over comparable time periods'.

Climate (change) scenario

A plausible and often simplified representation of the future climate, based on an internally consistent set of climatologically driven relationships and assumptions of *radial forcing*, typically constructed for explicit use as input to climate change impact models. A 'climate change scenario' is the difference between a climate *scenario* and the current climate.

Erosion

The process of removal and transport of soil and rock by weathering, mass wasting, and the action of streams, *glaciers*, waves, winds and underground water.

Extreme weather event

An event that is rare within its statistical reference distribution at a particular place. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and droughts.

Greenhouse effect

The process in which the absorption of infrared radiation by the *atmosphere* warms the Earth. In common parlance, the term 'greenhouse effect' may be used to refer either to the natural greenhouse effect, due to naturally occurring greenhouse gases, or to the enhanced *(anthropogenic)* greenhouse effect, which results from gases emitted as a result of human activities.

Habitat

The locality or natural home in which a particular plant, animal, or group of closely associated organisms lives.

(climate change) Impacts

The effects of climate *change* on natural and *human systems*. Depending on the consideration of *adaptation,* one can distinguish between potential impacts and residual impacts: ***Potential impacts***: all impacts that may occur given a projected change in climate, without considering adaptation.

Invasive species and invasive alien species (IAS)

A species aggressively expanding its range and population density into a region in which it is not native, often through out competing or otherwise dominating native species.

Mitigation

An *anthropogenic* intervention to reduce the anthropogenic forcing of the *climate system*; it includes strategies to reduce *greenhouse gas sources* and emissions and enhancing *greenhouse gas sinks*.

Mortality

Rate of occurrence of death within a population; calculation of mortality takes account of age-specific death rates, and can thus yield measures of life expectancy and the extent of premature death.

Resilience

The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning; the capacity for self-organisation; and the capacity to adapt to stress and change.

Glossary

Sea-level rise

An increase in the mean level of the ocean. *Eustatic sea-level rise* is a change in global average sea level brought about by an increase in the volume of the world ocean. *Relative sea-level rise* occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. In areas subject to rapid land-level uplift, relative sea level can fall.

Stakeholder

A person or an organisation that has a legitimate interest in a project or entity, or would be affected by a particular action or policy.

Sustainable development

Development that meets the cultural, social, political and economic needs of the present generation without compromising the ability of future generations to meet their own needs.

Vector-borne diseases

Diseases that are transmitted between hosts by a *vector* organism (such as a mosquito or tick); e.g., *malaria, dengue fever* and leishmaniasis.

Vulnerability

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of *climate change*, including *climate variability* and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its *sensitivity*, and its adaptive capacity.