PORT AUGUSTA CITY COUNCIL

Climate Change Adaptation Report

June 2011

Prepared for:

Port Augusta City Council

Facilitated and Developed by:
Local Government Association Mutual Liability Scheme

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The climate change risk management assessments contained within this report have been developed solely on the site-specific information supplied by Port Augusta City Council and have been prima facie accepted by the authors of this report and have not been independently verified for accuracy.

Use of this Report:

This report has been prepared for the Port Augusta City Council for the purpose of climate change risk management and adaptation planning.

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Table of Contents

EXECUTIVE SUMMARY

1 The purpose of the Local Government Climate Change Adaptation Program is to enhance resilience through the development and integration of adaptation strategies and measures into Council's Strategic Management Plans. The assessment of risks at the local level and the implementation of adaptation measures to treat risks has flow on effects that builds adaptive capacity for the future and enables an environment where Local Government and the community are better able to withstand climate change impacts.

2 The Program is conducted in a risk and strategic management environment to enable Local Government to make adjustments based on an awareness that climate conditions have changed or are about to change.

3 A consistent National approach has been adopted through the application of:

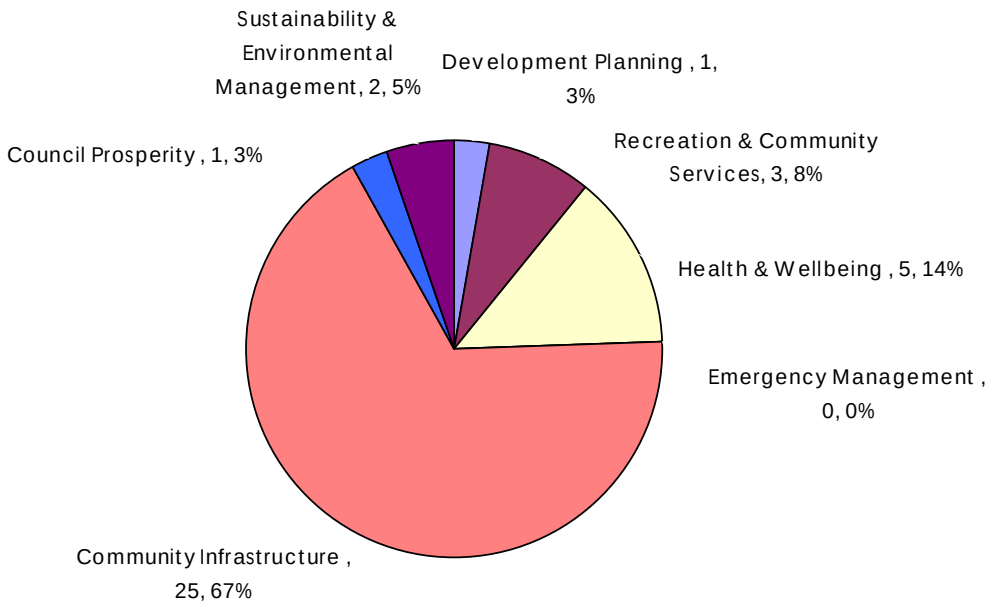
- *Climate Change Impacts and Risk Management: A Guide for Business and Government*, Australian Greenhouse Office, 2006 and the Australian Standard AS/NZS 4360, Risk Management;
- *Climate Change Adaptation Actions for Local Government,* Department of Climate Change 2009;
- Climate change Variables for South Australia identified in the *Climate Change in Australia: Technical Report* 2007 and endorsed by the Bureau of Meteorology, South Australian Regional Office, Climate Section.

4 The risk management results are a reflection of the dynamic engagement undertaken with Port Augusta City Council This specialist information, coupled with 20 years Local Government risk management experience and an extensive body of claims management data of the LGA Mutual Liability Scheme and partnerships with the Bureau of Meteorology has resulted in the delivery of sound Program outcomes. In addition, the outcomes have taken into consideration the lessons learned and risk trends from an analysis of the data from the numerous Metropolitan and Country Councils that have undertaken the Local Government Climate Change Adaptation Program.

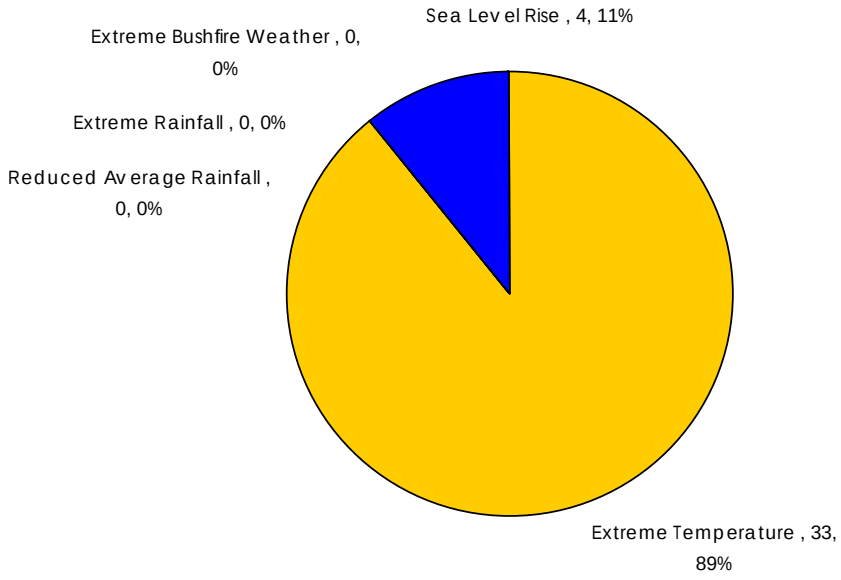
5 The Key Impact Areas for the Port Augusta City Council:

- Increase in dust nuisance
- Management and maintenance of sporting ovals
- Demand on Council resources for the city safe program
- Maintenance and costs for deterioration of infrastructure
- Increased costs for tree failures
- Failure of air-conditioning infrastructure
- Increased liability as a result of injury or death to HACC clients
- Inundation of shacks under freehold lease
- Loss of tourists leads to reduced revenue
- Loss of ground cover leads to stormwater runoff and erosion issues.

Key Impacts on Local Government Functions, Port Augusta City Council



Risk Distribution, Combined Extreme and High Risks, Port Augusta City Council



7 RECOMMENDATIONS

- Raise awareness of climate change risks with Council and the community to enhance decision-making and build community resilience as part of communication and consultation;
- Incorporate adaptation strategies and adaptation measures identified in Section 5 of this Report into Strategic Management planning;
- Include climate change risk management results into Council's risk management database;
- Monitor and review risk management context with regard to changes to climate change variables, operating environment, key business drivers, strategic management, capacity, capabilities and other relevant factors to identify new climate change risks and reanalyse all existing risks.

1 Introduction

1.1 Background

There is an extensive body of peer-reviewed scientific research that the earths climate is changing. The Fourth Assessment Report of the IPCC 2007a, indicates that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising average sea level. Global greenhouse emissions have grown since pre-industrial times, with an increase of 70 percent between 1970 and 2004, and a very high confidence that this warming has occurred as a result of human activities (IPCC 2007a).

Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions (IPCC 2007b). There is no alternative but to undertake adaptation planning, even in an environment of extensive mitigation. It is not a case of planning for a different stable climate future, but of building the capacity and flexibility to cope with whatever evolving climate may bring (Lemmen et al 2008).

Adaptation has the benefit of reducing damages and increasing community resilience (Fankhauser 1998, Smit et al 2001). It is a sensible and attainable planning strategy that is based on an understanding of climate change science and on a rigorous assessment of the impacts various climate change variables will have on Local Government business.

The nature of Local Government, its services and functions, means it will feel the impacts of climate change considerably. Potential Strategic Risks to the Local Government Sector include:

- Increased public liability exposure exacerbated by climate change impacts;
- Inadequacy of land use planning, development assessment and building regulation;
- Increased costs associated with the management of assets;
- Public safety and health issues caused by extreme weather events and temperatures;
- Higher insurance costs as a result of increased claims;
- Poor reputation as a result of failing to manage community expectations;
- Increased Resource management issues to meet statutory responsibilities.

Risk management is an effective tool for dealing with climate change as it offers the flexibility and robustness to deal with levels of uncertainty (Jones 2003). Responding to climate change involves an iterative risk management process that includes both mitigation and adaptation, taking into account actual and avoided climate change damages, co benefits, sustainability, equity and attitudes to risk (IPPC 2007b). It is a system, governed by a recognised Australian Standard (AS/NZS 4360) which has long been established within Local Government and is supported by a best practice database specifically designed for managing risk.

1.2 Scope

The purpose of the Local Government Climate Change Adaptation Program ('the Program') is to enhance resilience through the development and integration of adaptation strategies and measures into Council's Strategic Management Plans. A resilient social-ecological system in a desirable state has a greater capacity to continue providing us with the goods and services that support our quality of life while being subjected to a variety of shocks (Walker and Salt 2006). This has particular relevance to Local Government as the assessment of risks at the local level and the implementation of adaptation measures to treat risks has flow on effects that builds adaptive capacity for the future and enables an environment where Local Government and the community are better able to withstand climate change impacts.

The Program is an Key Area of Focus defined in the South Australian Local Government Sector Agreement pursuant to the *Climate Change and Greenhouse Emissions Reduction Act 2007*, 4 June 2008.

1.3 Objectives

- To integrate adaptation strategies and measures into Council's Strategic Management Plans;
- Undertake a climate change risk management process for Council, based on Australian Standard AS/NZS 4360;
- Provide council with a Climate Change Risk Management and Adaptation Report.

1.4 Assumptions and Limitations

The LGA Mutual Liability Scheme acknowledges that there is a level of uncertainty regarding climate change projections for South Australia. The best data available at the time has been used for risk management and continues to be validated by the Bureau of Meteorology, Climate Section, South Australia Regional Office.

The Program is conducted in a risk and strategic management environment to enable Local Government to make adjustments based on an awareness that climate conditions have changed or are about to change.

Mitigation strategies, including the activities associated with the Carbon Pollution Reduction Scheme are out-of-scope of this Program.

It is acknowledged that the Program will benefit the continual improvement of sustainability and environment objectives of the Local Government Sector.

1.5 Relevance to Legislation and State Policy

The following subsections of the *Local Government Act 1999* are linked to Climate Change Risk Management and Adaptation:

Section 6 Principal Role of Council

6 c) to encourage and develop initiatives within its community for improving the quality of life of the community

Section 7 Functions of Council

7 (a) to plan at the local and regional level for the development and future requirements of its area;

(c) to provide for the welfare, well-being and interests of individuals and groups within its community;

(d) to take measures to protect its area from natural and other hazards and to mitigate the effects of such hazards;

(e) to manage, develop, protect, restore, enhance and conserve the environment in an ecologically sustainable manner, and to improve amenity;

(f) to provide infrastructure for its community and for development within its area (including infrastructure that helps to protect any part of the local or broader community from any hazard or other event, or that assists in the management of any area)

Implementation of adaptation measures by Local Government will play a part in meeting the South Australian Government's Greenhouse Strategy (2007 – 2020) objectives:

2.1 To increase our understanding of risks, vulnerabilities and opportunities;

2.2 To build resilient communities;

2.3 To improve hazard management and minimise risks.

1.6 Liability

Climate Change is not necessarily a liability risk to Local Government. However failure to consider and assess the possible implications of Climate Change, against the key functions of a Council, could lead to major liability exposures. Local Government is responsible for many decisions, policies and programs that may be effected by the impacts of Climate Change. The relevant risk therefore is a Council's failure to reasonably take into account the likely effects of Climate Change. Such an action – or inaction – may result in a person, company or community suffering some form of financial loss, asset loss, personal injury, etc that leads to a negligence based claim.

2 Overview of Council

2.1 About the Council

The first European discovery of Port Augusta by Matthew Flinders in 1802 led to the expansion of land leases through the flinders Ranges. In the 1850's MP Thomas Elder sought to survey the harbour and layout the township. Jetties, churches and hotels designed by Thomas Burgoyne, which existed during the regions population expansion are still around today. Over the course of the next fifty years the Pichi Richi Pass was utilised for delivering tea and sugar supplies to the port and each September a minimum of 300 tonnes of wool was sent to the London sales. In 1864 at the peak of the dry period, which lasted three years, camels were brought in to assist in agricultural production. In spite of the drought period in the 1870s wheat crop production quadrupled. Eventually the drought became too burdensome on the harvests and as a result rail was depended upon for the regions income. The vast rail network extended through the Nullarbor Plain to Western Australia, this rail network became a crucial contributor to Australia's war effort. During the 1940s Japanese aircraft lookouts were positioned at the towns high water towers and trenches were dug. Because of the essential war contribution of the rail workers they were not allowed to enlist in the war. After the war Port Augusta became a centre for light industry and the site of an electrical plant. Forty percent of South Australia's power can be attributed to the two major power stations in the region, NRG Flinders and Thomas Playford. These megawatt power stations completed in 1985 provide five hundred megawatts of power to Adelaide residents. By the mid 1950s Port Augusta had also become a central hub for outback Australian education with the development of the School Of The Air in 1958 at the Royal Flying Doctors base. The world famous education base for isolated children has since evolved into an internet based learning centre. Known as a rail town with the inaugural running of the Ghan in 2004 and Pichi Richi historical natural gauge rail from Port Augusta to Quorn. Port Augusta is also exploring new avenues of tourism and education. The development in aquaculture and Aboriginal education are primary examples of this expansion.

2.2 Council Structure

The elected Councillors of Port Augusta City Council, as a body, are responsible for identifying community needs, setting policy and objectives to meet those needs, and establishing priorities based on competing demands and available resources. Decisions are made at full Council meetings, and may be based on recommendations from the Council Committees, which are established to consider the various aspects of Council's range of responsibilities.

It is the responsibility of the Chief Executive Officer, Mr Greg Perkin, together with Council staff, to implement the Council's policy framework and strategic plans into an ongoing program of activities for the management and operation of Council's responsibilities.

2.3 Framework for Climate Change Strategy development in Council

Climate change is a futures issues and logically, strategic management planning provides an approach for adapting to the impacts. The forthcoming Port Augusta City Council, Strategic Management Plan review will provide a good foundation for climate change adaptation across all functions of Council and enable synergies to be achieved with existing community partnerships for reducing carbon emissions. Consideration of climate change risk management and adaptation from this perspective enables a systematic approach to planning to build resilience to all aspects of business. One of the most significant challenges faced by Council will be that of long-term financial sustainability, given the impacts and risks to asset management and the need to plan and invest in mitigation infrastructure.

Key challenges for input into the Strategic Planning process include:

- Managing the expectations of the community in relation to services and infrastructure to meet the changes in environmental conditions;
- Understanding the spatial effects of sea level rise/storm surge and its effects on asset management and social wellbeing;
- Meeting the City's tourism and population objectives;
- Planning for the City's future infrastructure requirements to mitigate sea level rise;
- Supporting the agricultural sector as viability of land declines;
- Conserving water and energy;
- Maintaining the quality of recreational reserves and public open space while managing water use;
- Maintaining water quality in Council waterways;
- Land use planning;
- Maintaining biodiversity.

The climate change risk management results will provide a valuable data source to inform the future strategic management planning of Council.

3 Program Methodology

3.1 Program Overview

The Program has adopted a consistent National approach through application of the following:

- Climate Change Risk Management aligned to *Climate Change Impacts and Risk Management: A Guide for Business and Government*, Australian Greenhouse Office, 2006 and the Australian Standard AS/NZS 4360, Risk Management;
- *Climate Change Adaptation Actions for Local Government,* Department of Climate Change 2009;
- Climate change Variables for South Australia identified in the *Climate Change in Australia: Technical Report* 2007 and endorsed by the Bureau of Meteorology, South Australian Regional Office, Climate Section.

The methodology is consistently applied to all Councils participating in the Program.

3.2 Risk Management and Adaptation

The Australian Standard: Risk Management, AS/NZS 4360:2004 was selected as the preferred framework for assessing climate change risks, Appendix 1. The standard has the benefit of dealing with climate change uncertainty, together with providing a framework that is not only mainstreamed within Council but a framework which has the capacity to deal with new climate change information with efficiency and accuracy. The strengths of the standard's application to climate change adaptation are described in Table 3. It is important to note the relationship between AS/NZS 4360:2004 and *Climate Change Impacts and Risk Management: A Guide for Business and Government* - the principle guidance for Climate Change Risk and Adaptation in Australia. In particular, the guide specifies Nationally consistent consequence and likelihood scales, together with the risk priority matrix used for risk analysis and evaluation.

To determine Port Augusta City Council's climate change risk priorities, workshops were held which engaged a diverse cross-section of staff. Business Units engaged included Corporate and Community Services, Environment & Infrastructure Services, Planning & Regulatory Services, Finance, Governance, Human Resources, Waste Management and Environmental Health.

The deliverables for the workshops were to:

- Identify risks for the climate change variables of Extreme Temperature, Reduced Average, Extreme Rainfall, Extreme Bushfire Weather and Sea Level Rise (refer Section 4.1)associated with each Business Unit;
- Describe the Consequence and Likelihood the risk would have given the current control measures in place by Council, assign a priority level based on the likelihood and consequence of the risk; and

- Develop potential adaptation measures and strategies to treat the intolerable or unacceptable risks – Extreme and High Risks.

Following the workshops Extreme and High risks and their treatments (adaptation measures) were aligned to the functional areas of Development Planning, Recreation and Community Services, Health and Wellbeing, Emergency Management, Sustainability and Environmental Management, Community Infrastructure and Council Prosperity. Key Recommendations have also been identified.

The following table summarises the engagement undertaken with Council:

Port Augusta City Council Program Summary		
Activity	Milestones & Activity Measures	Date Undertaken
Workshop 1	Context (Basic science, Legal, Adaptation Principles)	29/07/2010
Workshop 2	Risk Identification	29/07/2010
Workshop 3	Risk Analysis, Evaluation and Treatment (Adaptation)	12/08/2010

The risk management results are a reflection of the dynamic engagement undertaken with the relevant Council. This specialist information, coupled with 20 years Local Government risk management experience and an extensive body of claims management data of the LGA Mutual Liability Scheme and partnerships with the Bureau of Meteorology has resulted in the delivery of sound Program outcomes. In addition the outcomes have taken into consideration the lessons learned and risk trends from an analysis of the data from the numerous Metropolitan and Country Councils that have undertaken the Local Government Climate Change Adaptation Program.

Figure 3.2, Climate Change Risk Management Framework

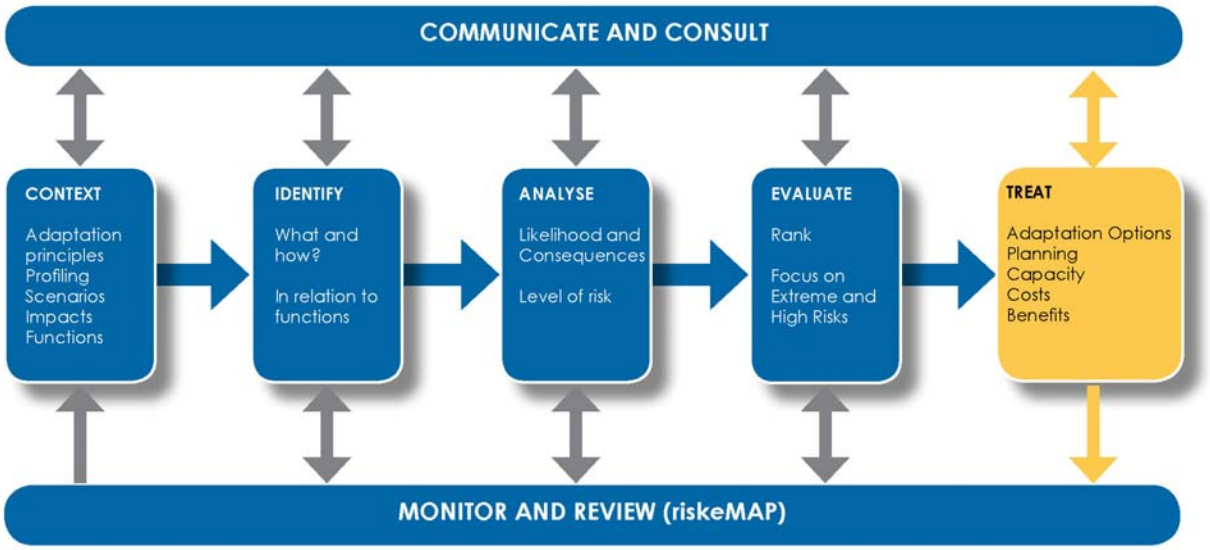


Table 3.2, Strengths of applying the Australian Standard: Risk Management to Climate Change Risk Assessment and Adaptation

Australian Standard: Risk Management AS/NZS 4360:2004	
Strengths - Climate Change Risk Assessment and Adaptation	
Recommended by the Department of Climate Change	Currently used by Council for other business such as emergency management, bushfire management and Occupational, Health and Safety
Identified as a option by the Climate Change in Australia: Technical Report 2007	Dynamic, responsive to change and incorporates mechanisms to treat uncertainty
Promotes mainstreaming of climate change adaptation as part of enterprise risk management	It is the best practice Australian Standard that has formed the basis for the Draft International Standard of Risk Management (ISO 31000)
Accounts for new information	Robust framework supported by a best practice online risk management assessment tool and data base
Minimal training requirements	Allows for consistency
Integrates with quality management, business continuity and management and business excellence	Facilitates continual improvement of an organisation

4 Climate Change

4.1 Climate Change Variables for South Australia

The variables listed in Table 4.2 were selected as the most appropriate for application to Local Government climate change adaptation. The best estimate of change based on the Climate Change in Australia, Technical Report 2007 modelling have been adopted. 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. A more detailed account of the predicted changes to the South Australia Climate can be found in Appendix 2.

Variable		Current	2030 A1B Change (best estimate)
Adelaide			
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

4.2 Climate Change Variables for the Port Augusta City Council

The following Climate Change Variables were selected for undertaking the Climate Change Risk Management process with Council.

- Extreme Temperature
- Reduced Average Annual Rainfall
- Extreme Rainfall
- Sea level Rise
- Extreme Bushfire Weather

4.3 Sensitivity Assessment for Sector

The following is an assessment of the factors that influence the Sensitivity of the Local Government Sector to climate change:

Sensitivity Assessment	South Australian Local Government
Council are required to undertake varied roles and responsibilities defined in South Australian Legislation including: ▪ *Local Government Act 1999* ▪ *Food Act 2001* ▪ *Public and Environmental Health Act 1987* ▪ *Fire and Emergency Services Act 2005* ▪ *Development Act 1993* ▪ *Environment Protection Act 1993*	
Primary responsibility for making decisions rests with the Council's elected members.	
Expectations, perceptions, values and beliefs of the community are major elements of Council's Community Leadership function. Furthermore, local government and companies in general are susceptible to shifts in the social trends of media coverage and public opinion that drive policy agendas (TCIA 2006).	
Council financial management is influenced by rate-based revenue.	
Council are responsible for land use planning and are the relevant authority for development planning and building assessment.	
Council owns and manages a range of Community Infrastructure and assets of varying condition and age.	
Councils construct, own and maintain a sealed and un-sealed road network.	
Council owns and manages stormwater and drainage systems.	
Community Wastewater Management Systems are operated by forty-five (45) Councils in South Australia.	
Responsible for the care and maintenance of parks, reserves, sporting fields and other recreation facilities.	
Home and community care services for elderly and other vulnerable people are delivered by Council.	
Council is responsible for natural resource and environmental management.	
Food and public health inspections are undertaken by Council resources.	
Council provides an approval system for the management of events within the Council area.	
Council is involved in the promotion of economic development.	
Water availability is influenced by the state of the Murray Darling Basin and Reservoir catchments.	
Bushfire building protection areas are designated in thirty-nine (39) Councils.	
Thirty-three (33) of South Australia's Councils have coastal geography.	

4.4 Adaptive Capacity of the Sector

Local Government is in a strong position to effect adaptation measures through its Strategic and Business Planning processes and because it has established Standards, Systems and information to manage climate change risks and legislative responsibilities that demand action. There is scope for modifying systems to increase Local Government capacity to cope with changes in climate conditions.

Adaptive Capacity	South Australian Local Government
The roles, responsibilities and objectives of Councils, established in the *Local Government Act 1999* are compatible with and enhance climate change risk management and adaptation planning.	
Council has 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*.	
Councils understand the values, beliefs, expectations and socio-economic profile of the community.	
Councils have established consultation and communications plans for the collection and dissemination of information within the community.	
Opportunities exist for mainstreaming climate change into Strategic Management Plans, established under Section 122 of the *Local Government Act 1999*.	
The LGA Mutual Liability Scheme supports Councils in a comprehensive Risk and Claims Management Program.	
Councils are supported by the Local Government Association and a State network of Councils to provide leadership and to advocate and guide legislative change.	
Councils are supported by the LGA Asset Mutual Fund for damage and loss to Council Assets in accordance with the fund rules.	
Councils have Emergency Management experience in undertaking prevention, preparedness, response and recovery for a range of hazards, especially bushfire and flood.	

4.5 Potential Impacts for Local Government

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 of the elderly, sick and economically disadvantaged	
Increase in dog and cat management issues	
Increased visitation to swimming pools, beaches and council–owned infrastructure that provides cooling	
Change in community behaviour where less business is undertaken during normal business hours or increase in preference to utilise information technology	
Cancellation of community and sporting events	
Increased security and vandalism issues during summer	
Increase in health issues and incidence where stop-work criteria are met for local government employees and contractors	
Spontaneous combustion of waste management cells	
Decrease in the integrity of exposed building materials, increasing maintenance and replacement costs	
Decrease in the integrity of road pavement, increasing maintenance and replacement costs	
Overheating of local government equipment (fixed and mobile), increasing maintenance and replacement costs	
Increased incidence of falling tree limbs from large Eucalypt species	
Increase in peak demand for energy for cooling during summer	
Potential for power black-outs and implementation of business continuity plans	
Increase in food and water-borne diseases	
Dams, lakes and other water bodies susceptible to algal blooms	

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

Extreme Rainfall	Potential Impacts
Flooding of council buildings and infrastructure	
Flooding of council facilities and recreation areas	
Damage to council buildings and infrastructure (stormwater, roads, bridges)	
Increased incidence of Ross River Virus	
Emergency management for flooding events	
Development planning in flood prone areas	

Sea Level	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 system becomes redundant due to failure of system	
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
Damage to local government infrastructure, parks and recreational facilities	
Use of local government infrastructure 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*	
Use of high bushfire risk equipment by local government and contractors on days of a Total Fire Ban	
Management of barbeques located on local government reserves	
Increase in number of permits for lighting and maintaining fire issued by Local Government Authorised Officers	
Increase in volume of Hazard Assessment under the *SA Fire and Emergency Services Act*	
Replenishment of local government water supplies following bushfire	
Management of park and roadside vegetation	
Development Planning under the Bushfire Management Planning Amendment Report	

5 Climate Change Risk Management Results

Extreme and High climate change risks are presented as they demand to be urgently addressed as part of Council's strategic management planning. A total of eighty two (82) Climate Change Risks were identified by Port Augusta City Council. Of the total risks identified, thirty seven (37) were classified as High and extreme climate change risks associated with development planning, emergency management, community infrastructure and Council prosperity risk. Almost ninety percent (90%) of the Extreme and High Risks can be attributed to potential impacts arising from sea level rise.

The Lower priority risks (classified as low or medium)are included in Appendix 3. These risks are considered to be acceptable and do not need further treatment at this stage.

The results of the Climate Change Risk Assessment have been uploaded in the online Local Government risk management data management system, to achieve a consolidated South Australian Climate Change Risk Management database and provide a foundation for the development of sector approaches to adaptation in South Australia.

Figure 5.1, Key Impacts on Local Government Functions, Port Augusta City Council

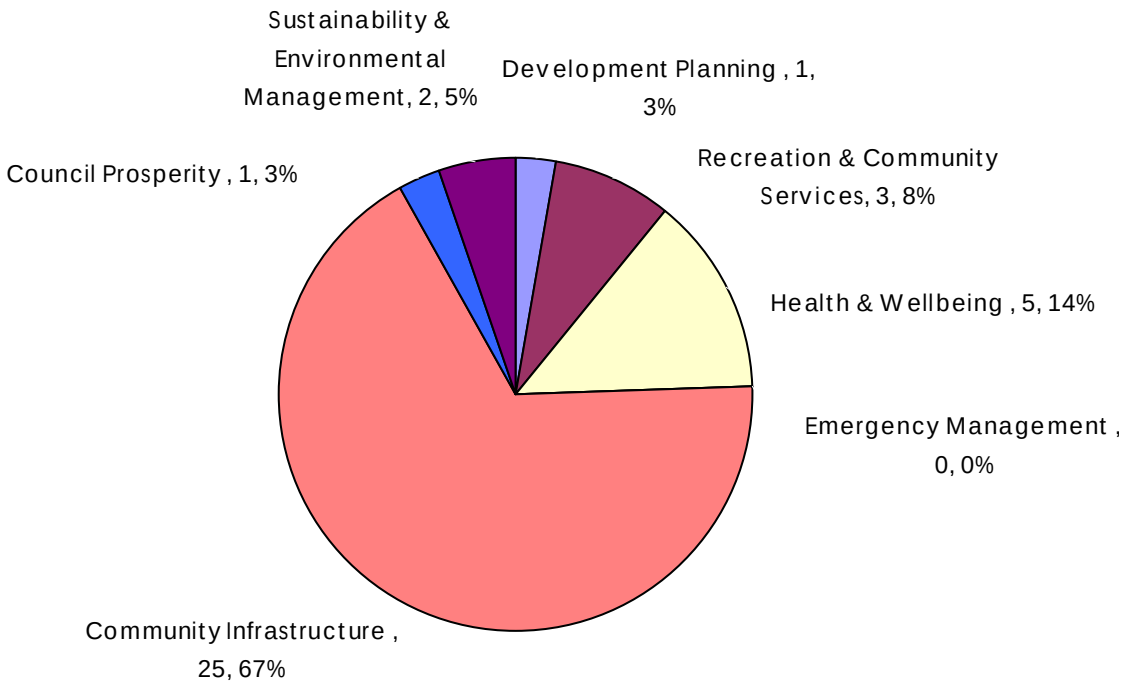


Figure 5.2, Climate Change Risk Ratings, Port Augusta City Council

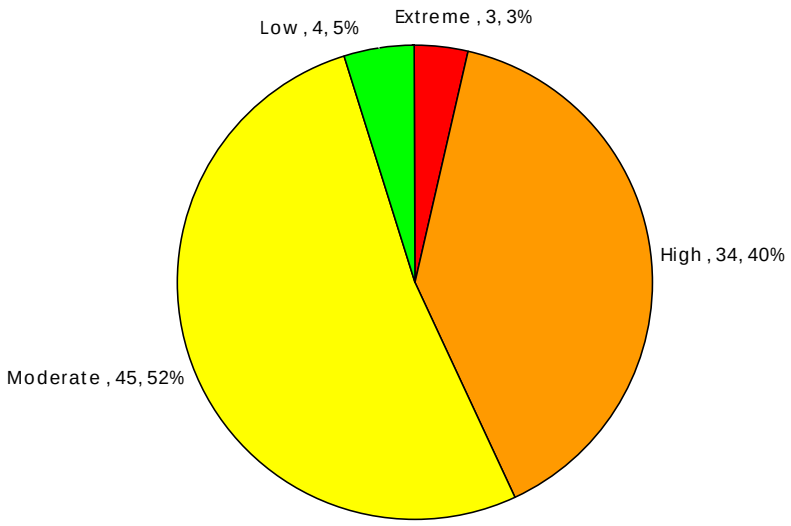


Figure 5.3, Risk Distribution, Combined Extreme and High Risks, Port Augusta City Council

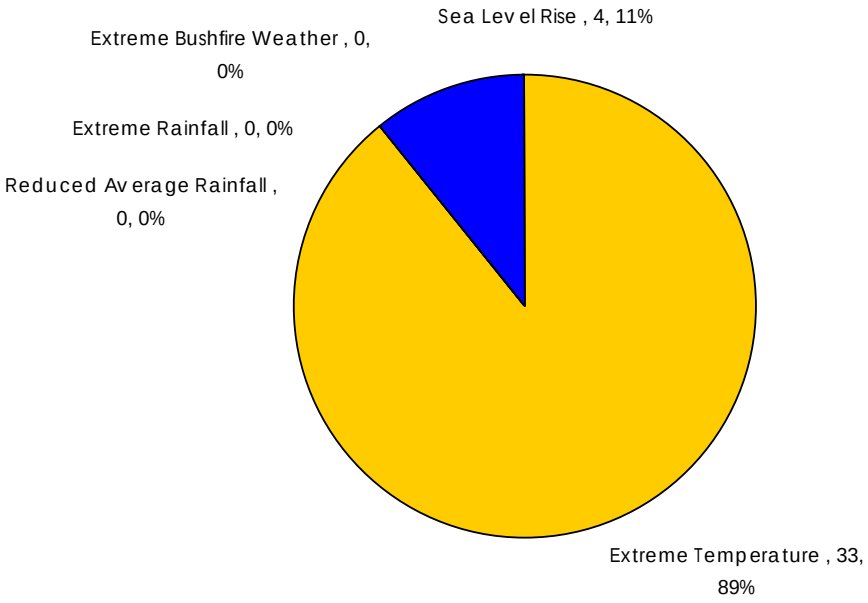


*Figure 5.1,5.2,5.3 analyses those risks identified as 'High' and 'Extreme' from the seven functions of Local Government. Every risk is accounted for as a entirely new risk when assessed from a new Perspective or 'Success Criteria' of Public Safety, Local Economy, Sustainability and Environment, Structures and Lifestyle and/or Admin and Governance.

5.1 Development Planning

5.1.1 Risks and Adaptation

Alignment to Strategic Management Plan
Goal area 4: Infrastructure & asset management. **Goal Area 6:** Organisational effectiveness. **Sub Goal 4.2:** Plan for the provision of additional infrastructure to meet the needs of our growing city. **Sub Goal 6.1:** A professional effective, efficient and customer focussed organisation responsive to the needs of the community.

Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Increased management to consider dust issues in planning consents in response to community expectations.	Refer to Environmental Protection Authority (Regulations).	• Engage with Environment Protection Authority and other relevant stakeholders to present a register of risks and alternatives to negotiate a plan to secure the permanent placement of an EPA officer in the Region; • Engage with the Department of Planning and Local Government to initiate a review of the effectiveness and performance of the development policy and process as it relates to the Environment Protection Authority and Native Vegetation Council.

5.2 Recreation and Community Services

5.2.1 Risks and Adaptation

Alignment to Strategic Management Plan			
Goal Area 2: Image of City. **Sub Goal 2.1:** A positive and progressive image of our city.			
Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Increased maintenance and costs associated with managing sporting ovals due to extreme temperature and reduce rainfall.	Waterproofing the City; Arid Smart Gardens; Water Sensitive Urban Design advice; Sport and Recreation Master Plan; School sharing.	• Develop an engagement plan to encourage sporting clubs to establish summer sporting ground operations policies that aim to preserve the ongoing condition of playing surfaces; • Consider the development a project brief that engages the community and investigates the feasibility for the centralisation of sporting facilities; • Undertake a review of public open space and playing surface service level models and ensure condition assessment criteria is aligned to ground treatment options, climate impacts and relevant policies and procedures for amending the use.

5.3 Health and Wellbeing

5.3.1 Risks and Adaptation

Alignment to Strategic Management Plan			
Goal 1: Community Development. **Sub Goal 1.1:** Our community feels safe.			
Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Increased demands for Council resources for City Safe program to deal with transient people located around the foreshore.	Substance misuse; Mobile Assistance Program; Dry Zone; City Safe - bottled water; PAYS (youth services)	• Engage with the Port Augusta Alcohol Management Group to ensure all stakeholders have a common understanding in relation to the potential impacts on community services as a result of ongoing extreme heat events and to improve compliance with sale of alcohol to intoxicated people; • Review research and other literature, as to the most appropriate methods of engaging and educating relevant groups on maintaining safety during extreme heat.
High	Increased Environmental Health Officer demands for inspecting food businesses affected by power failures.	Thermo program for community and shop owners.	• Engage with the Local Government Association of SA to initiate a review that addresses the sectors' capacity to deliver statutory responsibilities for environmental health, ensuring special consideration is given to the ability of meeting these services in rural and semi arid locations of the State; • Develop a strategy for the training, accreditation, recruitment and retention of Environmental Health Officers in partnership with the LGA and Department for Health; • Undertake a review of Environmental Health operational response plans to ensure that deliverables can be exercised under high peaks in demand for services: Explore opportunities for the recruitment of a trainee/cadet EHO or shared officer with adjoining Councils.

High	Increased demand of EHO for public advice and education relating to food safety in extreme heat conditions.	Thermo program for community and shop owners.	• Engage with the Local Government Association of SA to initiate a review that addresses the sectors' capacity to deliver statutory responsibilities for environmental health, ensuring special consideration is given to the ability of meeting these services in rural and semi arid locations of the State; • Develop a strategy for the training, accreditation, recruitment and retention of Environmental Health Officers in partnership with the LGA and Department for Health; • Undertake a review of Environmental Health operational response plans to ensure that deliverables can be exercised under high peaks in demand for services: Explore opportunities for the recruitment of a trainee/cadet EHO or shared officer with adjoining Councils.

5.4 Community Infrastructure

5.4.1 Risks and Adaptation

Alignment to Strategic Management Plan
Goal Area 4: Infrastructure & Asset Management. **Goal Area 6:** Organisational Effectiveness. **Sub Goal 4.1:** Sustainable and effective maintenance, management and enhancement of the City's existing infrastructure assets. **Sub Goal 4.2:** Plan for the provision of additional infrastructure to meet the needs of our growing city. **Sub Goal 6.1:** A professional effective, efficient and customer focussed organisation responsive to the needs of the community. **Sub Goal 6.2:** Optimise the use and management of the Council's financial and physical resources.

Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
Extreme	Interruption to service delivery due to power outage and lack of ability to respond to community needs (e.g. library/civic centre if used as a refuge in extreme heat wave events).		• Develop and maintain a Business Continuity Management Plan.
Extreme	Increased liability exposures arising from failures of footpath and kerbing infrastructure.		• Review and update footpath and kerbing inspection regimes to allow for higher rates of inspection during summer and heat wave events; • Review works schedules and adjust plans to enable rapid response to footpath trip hazards; • Continually improve infrastructure design standards to enhance infrastructure resilience an reduce inspection frequency.
High	Increased maintenance and cost related to degradation of bitumen roads and aerodrome pavement.	Product trials	• Develop asset management plan that takes into consideration the impacts of long term exposure of bitumen to extreme temperature and make adjustments to resealing time frames;

			• Initiate a engagement program that consistently provides a mechanism for the exchange of road condition information and quality audit results; • Undertake continual review and research of bitumen additives to improve resilience; • Investigate road construction techniques and asset management planning arrangements for jurisdictions operating in arid/desert environments; • Ensure that the results of the bitumen product trials are actively promoted within the Local Government sector, including the Annual Roads Conference.
High	Increased maintenance and cost related to greater deterioration of infrastructure (e.g. painted surfaces).	Currently defining service levels; Environmental and cultural design specifications (paving); Street tree planting guide.	• Initiate a program of community consultation to understand the needs, expectations and beliefs in relation to asset/infrastructure service levels; • Review community consultation against measures of environmental deterioration to develop adjusted service level models for all Council assets and to inform the development of specifications that build a higher resilience to extreme heat.
High	Increased cost of dealing with tree failures and additional maintenance requirements.	Tree inspection regime; Removal of inappropriate tree plantings; Planting policy.	• Finalise development of tree policy; • Planting zones; • Develop and implement an education program that highlights Councils environmental sustainability initiatives and encourages the community to create their own arid smart gardens.
High	Loss of amenity and aesthetics of trees due to increased decline/death.	Tree inspection regime; Removal of inappropriate tree plantings; Planting policy.	• Finalise development of tree policy; • Planting zones; • Develop and implement an education program that highlights Councils environmental sustainability initiatives and encourages the community to create their own arid smart gardens.
High	Increased demand for staff resources and risk of liability claims from trees shedding branches.	Tree inspection regime; Removal of inappropriate tree plantings; Planting policy;	• Develop a plan and procedure with relevant assessment criteria and performance indicators for the inspection of trees; • Develop a community education strategy for informing the

			public on tree hazards and methods for modifying behaviour under changing environmental conditions.
High	Increased risk of damage to infrastructure/vehicles due to tree limb failure.	Tree inspection regime; Removal of inappropriate tree plantings; Planting policy;	• Develop a plan and procedure with relevant assessment criteria and performance indicators for the inspection of trees; • Develop a community education strategy for informing the public on tree hazards and methods for modifying behaviour under changing environmental conditions.
High	Failure of air-conditioning infrastructure resulting from heat waves requires increased resources to respond and repair (e.g. nursing home, child care centre).	Air conditioning split systems.	• Review and update asset management plans to include a program to improve the energy efficiency and thermal comfort of buildings to meet relevant standards (This review should consider the feasibility of applying window treatments such as double glazing, blinds or shutters); • Undertake a review of air management systems for energy efficiency and ongoing performance in extreme heat events.
High	Increased liability as a result of illness or death of vulnerable clients (nursing home/child care) and other HACC programs due to failure of Council infrastructure.		• Develop and maintain a Business Continuity Management Plan.
Sea Level Rise Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Increased liability, management and resources to deal with potential flooding of 280 shacks under freehold lease.	Freehold lease agreement.	• Develop and implement a community education and awareness program that considers the likelihood and consequences of sea level rise, storm surge and coastal erosion, together with the mitigation measures that have been or are proposed by Council; • Engage with the Local Government Association to advocate for appropriate clarification on lease arrangements be provided to lease holders by State Government.
High	Council may have isolation of sections of the township due to flooding of western approach to bridge.		• Engage with the Department for Transport, Energy and Infrastructure (DTEI) to understand cross jurisdictional issues with regard to inundation of road approaches to the bridge and the coordination of planning for potential improvements

			through the DTEI road management plan; • Review current levee system for its impact and potential for further upgrade and integration into traffic management protection; Engage with the Zone Emergency Management Committee to advise of potential isolation of western township during inundation event.

5.5 Council Prosperity

5.5.1 Risks and Adaptation

Alignment to Strategic Management Plan			
Goal Area 2: Image of City. **Goal Area 3:** Economic Development. **Sub Goal 2.1:** A positive and progressive image of our city. **Sub Goal 3.1:** Economic Growth for long-term benefit.			
Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Potential for loss of revenue from reduced visitation of tourists in hotter environment.		• Engage with Flinders Ranges Outback Tourism to share understanding of climate impacts on Council business and ensure there is appropriate consideration of this on tourism trends and integration into regional tourism marketing strategy; • Develop an internal strategy for the promotion of Port Augusta as a premier arid tourist destination and leader in arid climate adaptive economic development.

5.6 Sustainability and Environment

5.6.1 Risks and Adaptation

Alignment to Strategic Management Plan
Goal Area 4: Infrastructure & Asset Management. **Goal Area 5:** Environmental Management. **Sub Goal 4.1:** Sustainable and effective maintenance, management and enhancement of the City's existing infrastructure assets. **Sub Goal 4.2:** Plan for the provision of additional infrastructure to meet the needs of our growing city. **Sub Goal 5.1:** Effective management and maintenance of the City's unique natural and built environment.

Extreme Temperature (No. Days >35˚C) Risks			
Rating	**Risk**	**Current Controls**	**Adaptation Measures**
High	Loss of ground cover leads to increased resources for stormwater runoff and erosion issues.	Stormwater Management plan (in development).	• Develop and implement an Integrated Water Resource Management (IWRM) Plan to sustainably develop, allocate and monitor the District/Regional water resources in the context of social equity, economic prosperity and environmental management; • Engage with the local Government Association of SA to broker research and funding for reclaimed water infrastructure projects as part of IWRM; • Undertake further research and analysis to identify appropriate species and methods for revegetation and landscaping of priority sites.

6 Key Recommendations

- Raise awareness of climate change risks with Council and the community to enhance decision-making and build community resilience as part of communication and consultation;

- Incorporate adaptation strategies and adaptation measures identified in Section 5 of this Report into Strategic Management planning;

- Include climate change risk management results into Council's risk management database;

- Monitor and review risk management context with regard to changes to climate change variables, operating environment, key business drivers, strategic management, capacity, capabilities and other relevant factors to identify new climate change risks and reanalyse all existing risks. And their risk related databases for the completion of a RiskeMAP tool for outsourcing to Local Government Clients.

7 Glossary

IPCC 2007b

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 climatological relationships and assumptions of *radiative 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.

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

Disease 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.

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9 Appendices

9.1 Appendix 1, Risk Management Framework

Climate Change Scenarios

Climate scenarios are plausible descriptions, without ascribed likelihoods, of possible states of the world (IPCC 2007a). The mid range emissions scenario of A1B has been selected for the risk assessment process. It describes a world which has a peak in the population at 2050 and a balance between fossil energy sources such as oil and gas and renewable sources such as wind, solar and geothermal. It is a storyline that can reasonable expect success from the implementation on adaptation measures. The summary characteristics of this A1B storyline are found in the following Figure:

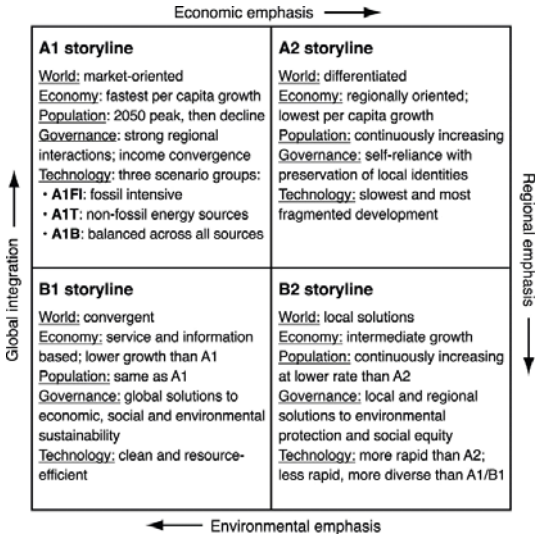

Figure 10.1, Characteristics of Climate Change Scenarios (IPCC 2007a)

Climate Change Variables

The variables listed in the following Table were selected as the most appropriate for application to Local Government climate change adaptation. The best estimate of change based on the Climate Change in Australia, Technical Report 2007 modelling have been adopted. 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.

Variable		Current	2030 A1B Change (best estimate)
Adelaide			
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

Success Criteria

Success criteria can be best described as long term objectives, and provide a perspective from which to conduct a risk assessment. In many cases a single climate change risk is assessed from a number of perspectives. The following success criteria linked directly to the *Local Government Act* and in accordance with AGO 2006 were adopted as part of the risk management framework:

- 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.

Risk Analysis

The Local Government Climate Change Adaptation Program Risk Management 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.

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

Likelihood Table

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

LIKLIEHOOD	CONSEQUENCE						
	0 – 10 Insignificant	11 – 30 Minor	31 – 50 Moderate	51 – 70 Major	71 – 100 Catastrophic	KEY	
71 – 100 Almost Certain						EXTREME	
51 – 70 Likely						HIGH	
21 – 50 Possible						MEDIUM	
11 – 20 Unlikely						LOW	

	0 - 10 **Rare**						

Elements at Risk

Council will have the opportunity to define there 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			

Typical information requirements for adaptation measures are described by Niang-Diop et al 2004. These include the following parameters:

- Description (Objectives, barriers to implementation, capacity to implement and sustain, social acceptance)
- Estimated Cost
- Benefits

RiskeMAP®

All risk management data (context, risks, consequence, likelihood and evaluation) will be recorded in RiskeMAP® to enable constant monitoring and review. This is important due to uncertainty surrounding climate change and the ever evolving information on scenarios and potential impacts.

During the implementation of this project the LGA Mutual Liability Scheme will establish a Climate Change Risk Management "Champion" with Council to ensure ongoing management of the data. This will be in most cases be the Risk Manager or Risk Officer.

9.2 Appendix 2, Predicted Changes to 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 there is predicted to be an increase in wind speeds. 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 35 cm by 2100 with a further additional contribution from the melting of land-based ice sheets, possibly 10 to 20 cm. This equates to an increase of 18 cm 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, currently locked in place by floating masses of ice (ice shelves) will have on sea level rise. There is a potential for a further 50 to 100 cm 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 storm) will exacerbate the impacts.

Bushfire Weather

Very High and Extreme bushfire weather is of concern as should a fire ignite under these conditions, then the likeliness of control is poor and consequences to the community and the environment is 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 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, Karoonda - 10 June 2005). Climate change projected to have positive impacts. There is likely to be a reduction in the number of tornados during the period, May to October, due to less favourable conditions for their formation (CSIRO 2007). Furthermore there is likely to be a decrease in the incidence of large hail.

9.3 Appendix 3, Moderate and Low Climate Change Risks

Extreme Temperature (No. Days >35˚C) Risks	
Moderate	Increased Council resources to introduce a greater level of sustainability planning policy into the Development Plan.
Moderate	Council may not have adequately considered the temperature tolerances of materials used in land developments (eg. roads) which can lead to increased costs/maintenance once handed over to Council.
Moderate	Inability to achieve sustainability due to minimal restriction on the use of heat conductive materials within Council's planning policy.
Moderate	Increased demand for provision of appropriate facilities (eg. lighting) for sporting clubs to operate at night due to extreme heat.
Moderate	Increased obligations for Council to determine the suitability of venues for particular purposes e.g. playing surfaces fit for permitting certain uses.
Moderate	Increased liability exposures for Council arising from inappropriate lease or contract conditions involved in Council owned facilities.
Moderate	Increased resources to meet demand for swimming pool facilities.
Moderate	Loss of productivity of staff due to more frequent activation of inclement weather policy during heatwaves.
Moderate	Increased incidences of power outages leads to increased demand for temporary power sources and change to procedures for responding to outages.
Moderate	Increased maintenance to deal with building cracking impacts of tree root intrusion.
Moderate	Inability of staff to be able to perform normal duties due to power failure/extreme heat and therefore inability to provide essential services.
Moderate	Potential for loss of revenue from death of seedlings prepared for sale at the Arid Lands.
Low	Increased exposure to liability from snake activity in public areas/parks/Arid Lands.
Low	Loss of tree infrastructure may lead to changes to wind profile, resulting in damage to Council and community infrastructure.

Reduced Average Rainfall Risks	
Moderate	Increased patronage and demand for public parks leading to increase demand for maintenance.

Extreme Bushfire Weather Risks	
Moderate	Increased demand for emergency response planning by regulators for Councils aged care and child care programs/facilities to determine appropriate response during catastrophic fire days.
Moderate	Loss of service delivery as a result of staff not attending work due to home bushfire preparedness duties.

Sea Level Rise Risks	
Moderate	Increased demand for review/update/change of Development policy to be able to respond to anticipated impacts of sea level rise, eg. shack developments.
Moderate	Potential for liability exposure as a result of boat ramp being lower than levee bank.
Moderate	Loss of amenity value for foreshore properties due to current or future levee wall height.
Moderate	Lack of clarification of Council's role in responding to flooding emergencies in relation to hazard leader (SES) leads to poor decisions and increased costs.
Moderate	Increased demand for Council resources to prepare simple and effective emergency management and response plans in line with State agencies.
Moderate	Increased community expectations of Council as a community leader in a flood management situation.
Moderate	Increased demands on Council to provide technical advice and practical support in an emergency.
Moderate	Increased cost, planning and maintenance to assess and maintain the levee system.
Moderate	Increased resources to manage and inspect levee system and coastal walkways due to increased erosion.
Moderate	Increased demand for inspection, maintenance and resources to manage recreational jetty infrastructure.