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SHIRE OF MUNDARING

Local Climate Change Adaptation Action Plan



Foreword

The Shire of Mundaring recognises that our climate is changing and that there is a need for the Shire to adapt to both the changes that are already occurring, and the changes that are likely to follow in the decades to come.

The Shire also understands that some of the climate change impacts will develop slowly, while others will be in the form of big events. The Shire of Mundaring will need to adapt and be ready for these events.

Adaptation is about taking action to avoid, manage or reduce the consequences that will be brought about from climate events.

Adapting to climate change must be integrated into day to day planning and risk management activities of local government, and this discipline must be transferred within local communities.

The Shire of Mundaring, in partnership with the Eastern Metropolitan Regional Council (EMRC) and its local community, has developed the Local Climate Change Adaptation Action Plan (LCCAAP) to address impacts of climate change that will create various challenges for local government, impacting not only on the environment, but the Shire's business operations and communities.

This LCCAAP will complement and consolidate the implementation of the Shire's Strategic Directions: A Plan for the Future (2008-2012).

The LCCAAP provides a strategic framework for actions that target a number of key environmental areas and environmental threats.

The implementation of the LCCAAP will protect and enhance the environment as well as foster economic prosperity within Perth's Eastern Region.

Acknowledgements

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The Shire of Mundaring would like to thank its staff members, Councillors and community members for their contribution and support in this process.

The Shire would especially like to thank the following staff who provided input into the development of the Regional Climate Change Adaptation Action Plan (RCCAAP) and LCCAAP during two workshops held in February 2009:

- Shane Purdy, Director Infrastructure Services
- Toni Burbidge, Coordinator Environment and Sustainability
- Adrian Dyson, Manager Health and Community Safety
- Mark Luzi, Director Statutory Services
- John Devereux, Manager Planning Services
- Stuart Thiele, Senior Planning Officer - Strategic
- Brad Lukosius, Community Facilities Coordinator
- Jon Dooner, Senior Engineering Technical Officer
- Liam Noonan, Manager Design Services.

The actions included in this LCCAAP were identified by the above group and community members during the workshops held in 2009 and 2010.

The Shire would also like to thank members of EMRC and Greensense for their assistance in the LCCAAP development process.

Adoption and implementation of the LCCAAP will enable the Shire of Mundaring to establish local government leadership in the area of climate change adaptation and mitigation.

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Photography: Ryan Hepworth and Toni Burbidge



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Introduction

The Shire of Mundaring is located on the eastern fringe of Perth, Western Australia, approximately 35 kilometres from the Perth GPO and serves more than 30,000 residents.

Encompassing a total land area of 644 square kilometres, of which nearly half is National Park, State Forest or water catchments, the Shire comprises a number of townships and a mix of semi-rural hobby farms, lower-density rural use and public open spaces. The diverse and varied landscapes, activities and communities of the Shire are at risk from the impacts of climate change.

Scientists use computer models to predict climate change scenarios based on the amount of greenhouse gases in the atmosphere, along with other key indicators. Whilst there are no detailed climate change projections for Perth's Eastern Region, or the Shire of Mundaring, modelling undertaken at a broader scale (south-west Western Australia) can be applied to the Shire to give an indication of the likely impacts and magnitudes of climate related changes. The lack of detailed projections and scenarios for the region and the Shire is a constraint in undertaking precise impact assessment. However, this should not preclude climate change risk management activities being undertaken.

Scientific modelling indicates that the south-west of Western Australia, including the Shire of Mundaring, will continue to be affected by forecast reductions in rainfall, increased temperatures, increased extreme weather events, and further reductions in surface and groundwater resources.

These forecasted changes to the climate will create challenges for all levels of government, including the local government sector. Some of the key challenges for the Shire are likely to be the impacts on infrastructure, land use planning, population health, biodiversity, environmental health services, fire and emergency services, as well as parks and reserve management. Other key risks include changing economic viability of local industries, such as vineyards and orchards, or high energy or water use industries.

How Climate Change is likely to affect Perth's Eastern Region

Climate change impacts for 2030 have been predicted to include	Our predicted climate in 2070:
<ul style="list-style-type: none"> • WA will be hotter, particularly in inland regions. Expected average temperature will increase 0.5 to two degrees. 	<ul style="list-style-type: none"> • WA average temperature will continue to rise. Expected average temperature will increase up to three to four degrees.
<ul style="list-style-type: none"> • Annual average number of days above 35 degrees could increase from the current 28 days to 29 – 48 days. 	<ul style="list-style-type: none"> • Perth's annual average number of days above 35°C could increase from the current 28 days to 36 – 67 days.
<ul style="list-style-type: none"> • WA will be drier, particularly in the South West. Rainfall reductions of 2% to 20% in annual rainfall, with a 17% reduction in winter rain days and catchment runoff decreases of 5% to 40% are expected. 	<ul style="list-style-type: none"> • WA will continue to become drier, with rainfall reductions of 5% to 20%.
<ul style="list-style-type: none"> • Sea-level will increase by three to 17 cm. 	<ul style="list-style-type: none"> • Sea level will increase by 25 to 75 cm.
<ul style="list-style-type: none"> • More frequent heat waves per year. 	<ul style="list-style-type: none"> • More frequent heat waves per year.
<ul style="list-style-type: none"> • More frequent and severe droughts. 	<ul style="list-style-type: none"> • More frequent and severe droughts – up to 80% more droughts than current patterns.
<ul style="list-style-type: none"> • Increased bushfire risk. 	<ul style="list-style-type: none"> • Increased bushfire risk.
<ul style="list-style-type: none"> • Increased storm and flooding intensity. 	<ul style="list-style-type: none"> • Increased storm and flooding intensity.
<ul style="list-style-type: none"> • More frequent and intense tropical cyclone occurrences. 	<ul style="list-style-type: none"> • More frequent and intense tropical cyclone occurrences.

Source: CSIRO and BOM (2007), IPCC (2007) and IOCI (2005)

The Shire has already taken some steps to reduce its contribution to climate change by reducing or mitigating its greenhouse gas emissions through implementation of the Achieving Carbon Emissions Reduction (ACE_R) Program and commitment to undertake the WALGA Reporting Platform that will enable the Shire to track and report its greenhouse gas emissions, energy consumption, and energy production.

While mitigation continues to be important (as it is only through continuing to reduce carbon emissions that climate change trends can be slowed or even halted) it is now widely recognised that some climate change is happening now, is unavoidable, and that we will need to adapt to these changes.

Adaptation is about taking action to avoid, manage or reduce the consequences that will be brought about from climate change and extreme weather events. Effective adaptation also requires recognising and taking advantage of the opportunities that new markets and new skills may present.

This LCCAAP will ensure that the Shire has the knowledge to adapt to these changing circumstances and can continue to provide a quality lifestyle to the community.

The LCCAAP provides a suite of actions that the Shire can implement to adapt to the anticipated impacts of climate change.



Regional Strategic Framework for Climate Change Adaption

The current and potential impacts from climate change are both varied and extensive. In order to effectively adapt to the impacts of climate change, the Shire cannot act in isolation from the regional, state or national context.

For this reason the Shire of Mundaring, along with EMRC and its five other member Councils, collaborated to undertake a comprehensive risk assessment to identify potential impacts and risks from climate change for Perth's Eastern Region. In addition, actions that could better prepare the region to adapt to the pressures of climate change were identified. This formed the basis of a Regional Climate Change Adaptation Action Plan (RCCAAP) outlining what needs to be done at the regional level to adapt to climate change.

To consolidate and complement the work done at the regional level, the Shire has developed this Local Climate Change Adaptation Action Plan (LCCAAP). While the RCCAAP identifies actions which benefit from a regional approach, the LCCAAP focuses on actions related to the Shire's operations

that are local in nature and/or partner with the community. This will ensure that climate change adaptation is integrated into the day to day planning and risk management activities of the Shire and its communities.

The relationship between the RCCAAP, the LCCAAP and the wider state and national context is described in the diagram below. The alignment of local and regional planning, within the wider context, will ensure a well planned and comprehensive approach for adapting to the challenges that are presented by climate change.

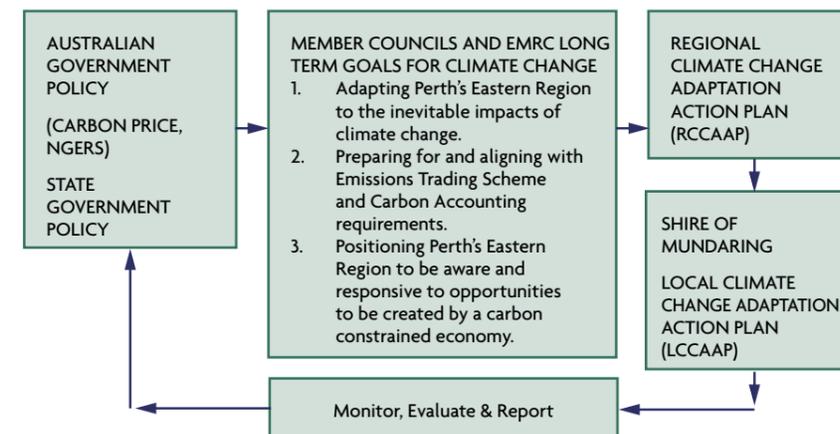
The collaborative approach applied to create and publish the RCCAAP 2009-2013, paved the way forward for EMRC and member Councils to take climate change to the next step and provided a foundation for localised climate change adaptation action planning and an

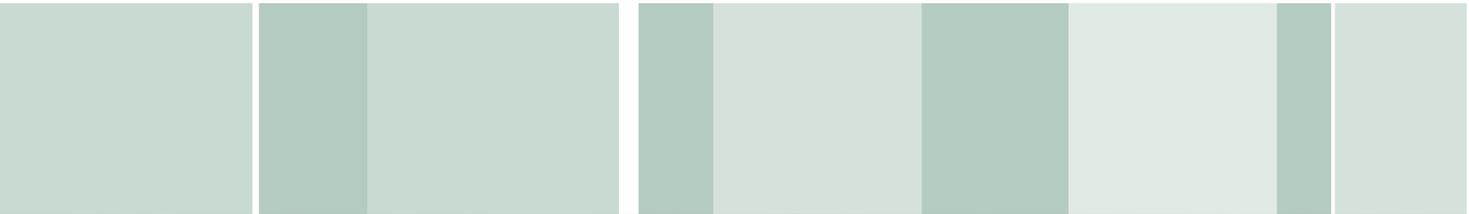
opportunity for community engagement into the action planning process.

The Shire of Mundaring provided leadership by engaging its community in the climate change risk and adaptation process. This enabled the Shire to establish a LCCAAP reflecting community views on the actions the Shire needs to undertake to adapt to climate change. The Shire of Mundaring was the first local government in Perth's Eastern Region to undertake climate change adaptation workshops with its community. This is highly innovative and recognised by the EMRC as a project that needs to be showcased and widely promoted to other local governments.

During the climate change adaptation process there were 25 representatives of the local community involved in the climate change risk assessment and adaptation action planning sessions. Community members had an opportunity to participate in risk rating, action planning and generating new ideas to tackle local climate change issues. The list of these new ideas is included in Appendix A, which presents a valuable resource for the Shire in the adaptation process.

To consolidate staff and community workshop outcomes, the Shire undertook data evaluation and analysis to generate a detailed picture of the Shire's risk profile and to prioritise adaptation actions to address identified risks.





Strategic Objectives

The Shire's Strategic Directions: A Plan for the Future (2008-2012) key strategic objectives are:

1. Promote and support sustainable development.
2. Protect, manage and enhance the natural environment.

To reflect these objectives, the Shire of Mundaring aims to implement a range of climate change adaptation and mitigation measures in order to better prepare, protect and inform its residents and rate payers for anticipated impacts of climate change.

These objectives will be achieved through the application of a best practice risk management framework that sets strong, clear goals and is underpinned by sustainable principles that drive all actions outlined in this plan.

Aim & Principles

The aim of the LCCAAP is to provide a risk management approach and to clarify and develop local policy and planning actions to enable the Shire to adapt to the issues of climate change.

The LCCAAP will address key issues by aiming for the Shire to:

- prepare itself and take necessary action so that it can adapt to the expected impacts of climate change with minimal impact to its operations and community;
- promote resilience and support local communities to partner with the Shire to improve the management of the local environment and community public assets;
- encourage transport, planning and building systems that support low emissions and accommodate a changed climate; and

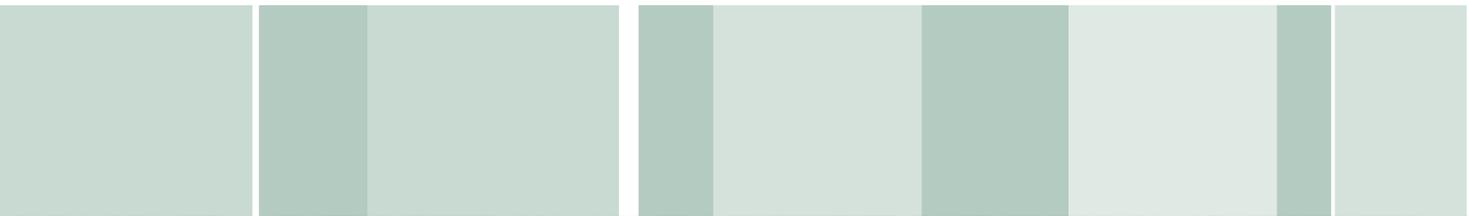
- support disadvantaged communities to adjust to the cost of a low emissions economy to reduce climate change impacts on these communities.

The following principles will underpin all future planning of initiatives relating to climate change adaptation while also addressing the key drivers for change.

The key principles are to:

- continue to seek knowledge and improve our understanding of future climate change and expected impacts;
- engage with the community and other stakeholders in planning for climate change;

- ensure that risks from climate change impacts are minimised and benefits to the community are maximised;
- ensure that the Shire's planning schemes and development plans for commercial and residential development reflect the principles of future proofing for climate change;
- ensure that local initiatives are supportive of the RCCAAP actions that are taken at a regional level; and
- ensure community awareness and engagement occurs during the planning and implementation processes.



Priority Risk Areas

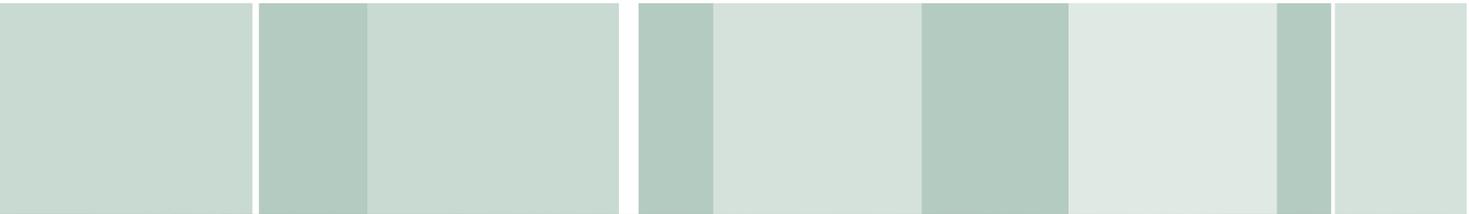
Eight priority risk areas, which contain actions for implementing climate change adaptation, have been identified. These align with the priority risk areas identified in the RCCAAP for Perth's Eastern Region.

The eight Priority Risk Areas, listed in no particular order, are found in the table below.

Priority Risk Areas	
1	Infrastructure Failure and Loss
2	Impacts on Essential Services (Power Loss and Water Availability)
3	Watercourse Damage and Loss
4	Increasing Bushfires
5	Loss of Ecosystems and Provision of Public Open Space
6	Decline in Population Health and Wellbeing
7	Economic Challenges and Opportunities
8	Changing Leadership and Development Requirements

Note: Some actions cross over more than one priority risk area.

Consolidated staff and community workshop outcomes have been evaluated and analysed and are presented in the identified eight priority risk sections.



Risk Analysis

A risk matrix was applied to establish risk prioritisation values. A risk matrix presents combinations of consequence and likelihood, and aligns them to a risk level.

Risk Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	Medium
Rare	Low	Low	Low	Low	Medium

Following this matrix, an impact that is almost certain to occur, which has a moderate consequence, is considered to be a high risk. While an impact that is unlikely to occur, and has a minor consequence, is considered to be a low risk. The definitions for each risk level are presented below.

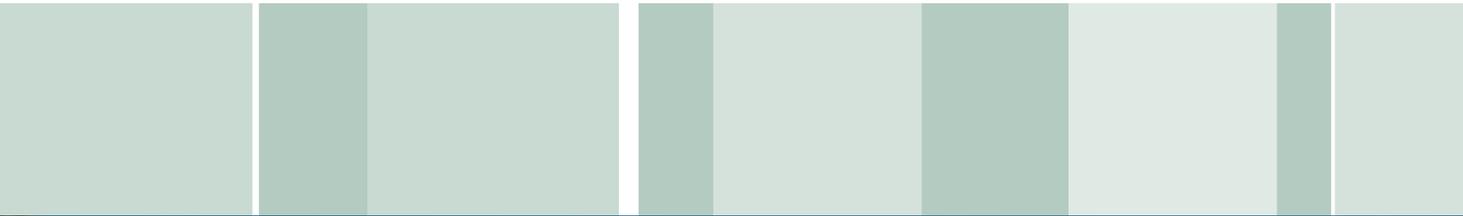
EXTREME priority risks demand urgent attention at the most senior level and cannot be simply accepted as part of routine operations. Actions required to treat an extreme priority risk are likely to be beyond the standard operational procedures and require additional human and/or financial resources.

HIGH priority risks are the most severe that can be accepted as part of routine operations, but they will be the responsibility of the most senior operational management. Senior management will be responsible for ensuring that adaptation actions towards management of the risk are implemented.

MEDIUM priority risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action and maintained under review.

LOW priority risks will be maintained under review, but it is expected that existing controls will be sufficient.

In general, EXTREME and HIGH priority risks need to be treated immediately or subject to more detailed analysis. LOW priority risks on the other hand, may be set aside with no further action to treat them apart from routine reviews to ensure that there has been no change that would make them more severe.



Timeframes

The timeframes link to the Shire's planning and budget cycles and were selected based on an understanding of the local context in which the action would be implemented. This plan will address each of the priority risk areas in turn and identify the actions necessary to achieve the objectives.

Timeframe	Time
Immediate	2012-2013
Short term	2012-2014
Medium term	2012-2016
Long term	2012-2026

Monitoring and Review

The LCCAAP will be monitored annually to determine progress against the plan.

A review will be undertaken in 2013/14 to identify future action that might be needed. This review will coincide with a major review of the RCCAAP and will take into account any changes to climate change action at a regional scale.

PRIORITY RISK AREA 1 - Infrastructure Failure and Loss

Priority Risk Area 1 - Infrastructure Failure and Loss

The provision and maintenance of infrastructure is one of the core responsibilities of local government and is vital for making the environment more practical and accessible for the community. The Shire's built environment positively contributes to the quality of life of residents, the image of the Shire and its economic vitality. It comprises public infrastructure (eg roads, footpaths, right-of-ways, street lighting, drainage, parks, and bushland) and public facilities (eg Shire's buildings for community use).

Climate change factors such as drought, bushfires, extreme rainfall and flooding, extreme temperatures, acid sulphate soils and increased stream bank erosion will have the potential to further impact upon this physical infrastructure. Infrastructure including roads,

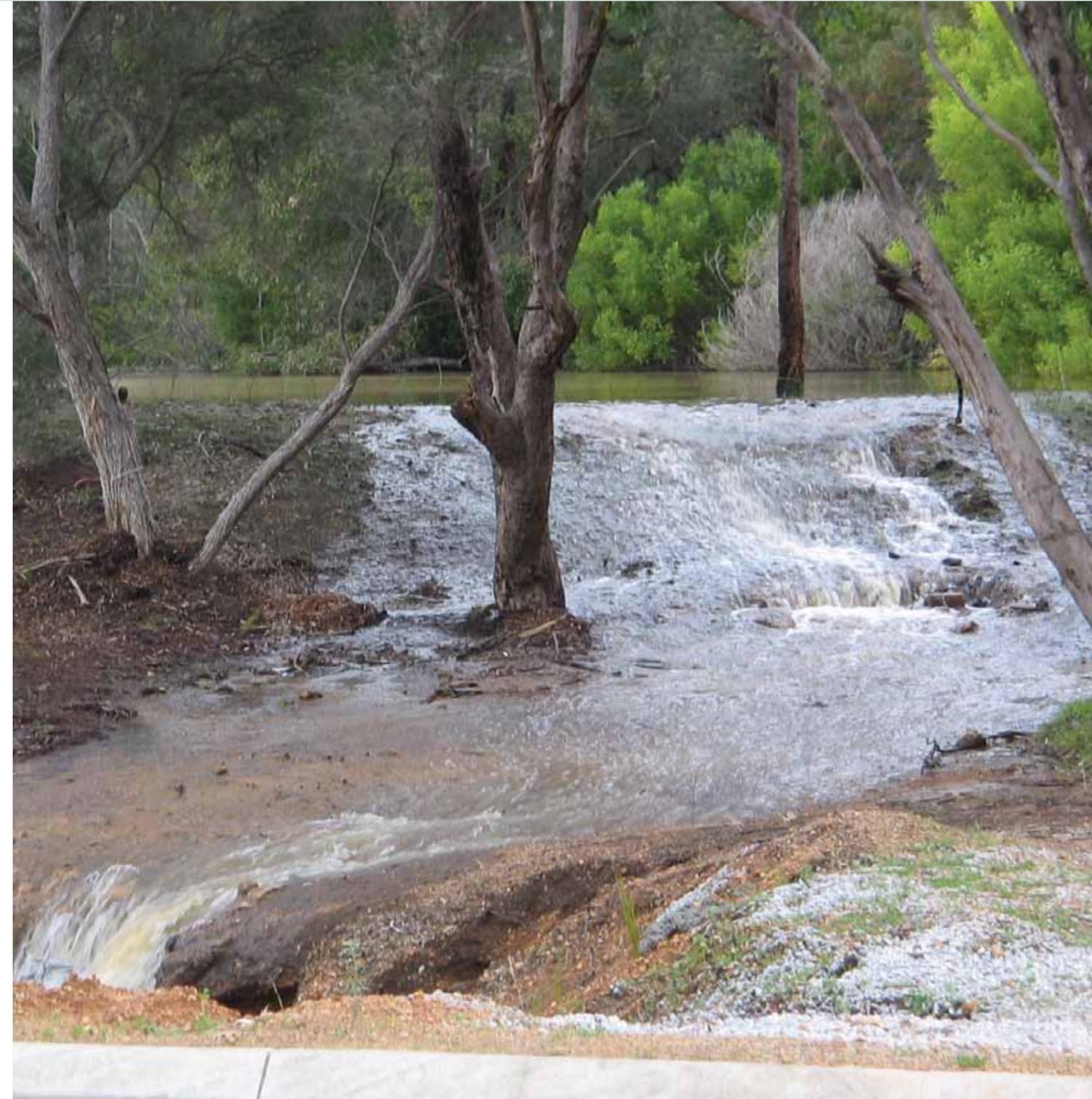
building and drainage, may all require higher costs for maintenance, more frequent repair and maintenance schedules and additional costs for upgrading. Similarly, consideration needs to be given to changing requirements in relation to higher building and construction standards when planning for and maintaining assets.

The Shire must be able to respond to any possible infrastructure failure in an effective and timely manner to ensure that there is minimal impact on local residents and the Shire's operations. This requires knowledge of the potential climate change impacts, vulnerability of infrastructure, likelihood of failure and appropriate response management plans.

Objective(s)

- To ensure that the Shire's infrastructure is resilient to the impacts of climate change.
- To ensure the Shire is able to respond in the event of infrastructure failure.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
1.1 Conduct community education about drainage and flooding events in the Shire	Immediate	High	Infrastructure
1.2 Design infrastructure appropriately in floodway.	Immediate	Medium	Infrastructure Design
1.3 Write to Department of Water and request flood modelling for the hills.	Short	High	Infrastructure/ Planning
1.4 Identify risk areas for flooding in the Shire.	Immediate	High	Infrastructure/ Planning
1.5 Review effluent disposal controls potentially affected by flood situations.	Medium	High	Health / Infrastructure
1.6 Review insurance for the Shire with relation to flooding.	Short	Medium	Corporate Services
1.7 Adopt new special control areas in the Town Planning Scheme for flood prone land.	Medium	Medium	Planning and Statutory Services
1.8 Ground truth all creek lines and tributaries to ascertain condition assessment mapping.	Medium	Medium	Environment with Swan River Trust
1.9 Conduct asset pick up infrastructure in floodway and monitor.	Medium	Medium	Infrastructure Design



PRIORITY RISK AREA 2 - Impacts on Essential Services

Priority Risk Area 2 - Impacts on Essential Services

Power and water services are essential for the Shire’s operations and business, community sectors, households and residents. Interruption to or loss of these services for any period of time can have severe repercussions.

Disruption to electricity and fuel supplies may result in increased electricity and fuel costs; lack of access to air conditioning and lighting; and disruptions to medical equipment, refrigeration and commercial equipment, resulting in various negative health and financial consequences.

Increased temperatures and decreased rainfall have reduced water availability in the south-west of Western Australia. This has implications for residential, rural and industrial/commercial water use and could result in increasing costs and further restrictions being placed on water consumption.

The provision of power and water are essential services provided for by the state government, and as such, the Shire has limited ability to influence future proofing of these services other than through advocacy.

The RCCAAP details a comprehensive range of advocacy actions that focus on pursuing positive and sustainable outcomes for the provision of these services in Perth’s Eastern Region. While EMRC will take the lead in advocating for the region, the Shire will provide support and strength to these advocacy campaigns.

In addition, the Shire can take steps to ensure that it has the capability to cope with disruptions to these essential services with minimal impact on its operations and the community.

Objective(s)

- To reduce the risk to the Shire from loss of power by undertaking appropriate energy management practices.
- To reduce the risk to the Shire from reduced water availability by undertaking appropriate water management practices.



Action Required	Timeframe	Risk Level	Responsible Service Area(s)
2.1 Water Availability			
2.1.1 Education in primary schools for water conservation issues.	Short	High	Environment/ State Govt
2.1.2 Investigate and monitor best-practice water saving measures at high water use sites	Medium	High	Infrastructure - Parks and Community Services Recreation
2.2 Power Loss			
2.2.1 Continue to maintain back-up power at Shire facilities.	Medium	High	Infrastructure - Assets

PRIORITY RISK AREA 3 – Watercourse Damage and Loss

Priority Risk Area 3 - Watercourse Damage and Loss

The Shire's watercourses play a vital role in collecting and distributing water, sustaining ecosystems and contributing to water supply. They support a high diversity of living organisms and play an important role in many physical, biological and chemical processes. The Shire's watercourses are an important feature of the natural environment and as such, it is critical that their health and viability is maintained.

In addition to the existing pressures from land use activities and loss of vegetation, climate change will add further pressure by increasing erosion and subsidence, sedimentation, flooding and creating potential acid sulphate soils.

The Shire's drains and watercourses are already being impacted by altered seasonal flows leading to flooding of low lying areas and altered biodiversity. The consequences of increased periodic watercourse flooding events include:

- damage to infrastructure;
- higher risks to public safety and therefore higher costs for management eg signage for peak events, temporary road and park closures and diversion of traffic;
- higher costs for storm water drainage maintenance, repairs and upgrades; and
- higher emergency management and response costs.

Erosion and subsidence poses a significant risk to infrastructure, vegetation and habitat along waterways. It also can be a risk to public safety and amenity. Rigid building structures along the watercourses such as dual use paths, bridges and retaining walls are at risk from erosion and subsidence.

Drought conditions are likely to exacerbate erosion and downstream sedimentation. Higher sediment loads enter watercourses following extreme rainfall or bushfire events, both of which are projected to increase with climate change. Changed climatic conditions are also likely to produce conditions that favour riparian and aquatic weeds and algal blooms (Australian Government Department of Climate Change, 2009). Sedimentation may also lead to increased blockage of gutters and drains.

The Shire's watercourses are used for both public and private extraction and provide important environmental flows supporting wetlands and groundwater dependent vegetation. Falling groundwater tables and pressure for a high density development in and around waterways, have the potential to expose potential acid sulphate soils (PASS).

The Shire's watercourses are an invaluable environmental and community asset that will be under significant threat unless adaption measures are implemented.

Objective(s)

- To reduce the impact of the drainage system on the Shire's watercourses.
- To support and facilitate the community in the rehabilitation and management of watercourses.
- To identify and increase the Shire's understanding of the condition and threats to watercourses.
- Ensure the Shire's planning and development activities create a positive impact on watercourses.



Action Required	Timeframe	Risk Level	Responsible Service Area(s)
3.1 Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS)			
3.1.1 Assist friends groups and catchment groups in rehabilitation of Shire land and watercourses.	Short	Medium	Environment
3.1.2 Use Private Land Conservation Awareness and Eastern Hills Catchment Management Program (EHCMP) Officers to educate private property owners.	Short	Medium	Environment
3.1.3 Map salinity in the Shire.	Medium	Medium	Environment/others
3.1.4 Improve mapping of Acid Sulphate Soils (Ground Truth).	Medium	Medium	Environment/others
3.1.5 Incorporate updated mapping in Local Planning Strategy to avoid disturbance of Acid Sulphate Soils.	Medium	Medium	Statutory Services - Strategic Planning
3.2 Foreshore Erosion and Subsidence			
3.2.1 Develop a guideline for waterway management in the Shire.	Short	Medium	Environment/ Infrastructure
3.3 Sedimentation			
3.3.1 Incorporate Water Sensitive Urban Design principles in statutory planning.	Immediate	Low	Statutory Services - Strategic Planning
3.3.2 Conduct asset pick up for maintenance and replacement of infrastructure (drains).	Short	Low	Infrastructure - Design
3.3.3 Provide training programs for Shire staff regarding drain maintenance and environmental issues.	Short	Low	Environment/ Infrastructure
3.3.4 Enforce compliance issues of no stormwater discharge from structures onto neighbours' property. Use water flow restriction devices and best practice to ensure minimal impact to watercourses.	Short	Low	Building
3.3.5 Advocate to State Government for assistance in information on dams.	Medium	Medium	Environment

PRIORITY RISK AREA 4 – Increasing Bushfires

Priority Risk Area 4 - Increasing Bushfires

Bushfire has the potential to take lives and destroy infrastructure and property. Risks to the Shire include injury to staff involved in fire-fighting or to residents in the local areas, damage to infrastructure and facilities and disruption to services.

Bushfires create higher costs through loss and damage of both public and private infrastructure, loss of natural vegetation and the loss of the significant community and local government investment in environmental management.

Bushfires also create significant environmental impacts including loss of vegetation, loss or displacement of fauna, erosion, sedimentation of watercourses, air pollution, which can impact on health, and the release of greenhouse gases.

The bulk of scientific evidence argues that the magnitude and intensity of bushfires has risen and is expected to rise even further as a result of climate change. The Shire needs to plan and prepare for this increase in bushfires, including the need for increased management and prevention activities.

Objective(s)

- Undertake appropriate planning and management activities to ensure the Shire and its residents are prepared in the event of a bushfire.
- Ensure that the Shire takes necessary action to minimise the risk of potential bushfires.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
4.1 Insert bushfire information in rates notice and new resident welcome pack.	Immediate	High	Community Safety/ fire
4.2 Conduct community workshops.	Immediate	High	Community Safety/ fire
4.3 Incorporate Local Planning Scheme Provisions for development in bushfire hazard areas.	Immediate	High	Statutory Services - Strategic Planning
4.4 Spread the corporate knowledge of the Shire of Mundaring's Emergency Response Plan.	Immediate	High	Community Safety/ fire
4.5 Understand involvement of Local Emergency and Management Committee (LEMC) and the Bushfire Advisory Committee.	Immediate	High	Community Safety/ fire
4.6 Provide information on acceptable burning practices in the Hills (e.g. green waste).	Immediate	High	Community Safety/ fire
4.7 Continue an Awareness Program re bushfires as per FESA guidelines.	Short	High	Community Safety/ fire
4.8 Review evacuation procedures and safe havens in accordance with the Emergency Management Act (2005)	Short	High	Community Safety/ fire
4.9 Apply or Implement AS 3959 – Building Houses and additional requirements.	Immediate	High	Planning/Building
4.10 Audit escape routes for residents in the Shire.	Medium	High	Community Safety/ fire; Planning
4.11 Implement changes to escape routes.	Medium	High	Community Safety/ fire; Planning
4.12 Install fire fighting systems to new infrastructure to Code.	Medium	High	Infrastructure; Community safety/ fire
4.13 Apply subdivision conditions to new developments as per best practice for fire fighting purposes.	Medium	High	Planning; Community safety/ fire
4.14 Implement construction requirements for new infrastructure to meet AS 3959 in bushfire prone areas.	Medium	High	Building



PRIORITY RISK AREA 5 – Loss of Ecosystems and Provision of Public Open Space

Priority Risk Area 5 - Loss of Ecosystems and Provision of Public Open Space

The Shire's natural ecosystems are already under stress, and climate change will add further pressures. Natural ecosystems are important to all aspects of life as they provide ecosystem services essential for all life, as well as supporting regional industries and economies.

The Shire has a rich diversity of natural environments made up of streams, wetlands, forests and woodlands, with a unique display of endemic flora and fauna, all on the Shire's doorstep.

The Shire encompasses a total land area of 644 square kilometres, of which nearly half is National Park, State Forest or water catchments, which the Shire is committed to preserving and enhancing.

Reduced rainfall and changed temperature regimes may result in local native species being unable to breed or survive in their current habitats. Failure to build resilience into our natural ecosystems to help them to adapt to climate change will result in far reaching consequences, with many animal and plant species being lost forever.

A natural environment is also essential for the health and well being of local communities by providing recreational opportunities. Climate change presents a real challenge for maintaining the current level of provision and amenity of sporting, recreational and leisure facilities.

The Shire is required to balance finite resources against the community's expectations for increasing access to high quality public open spaces, while

also complying with a range of statutory obligations being placed upon them by state and federal agencies relating to aspects of public open space provision. Falling groundwater levels and reduced groundwater allocations, increasing evaporation and urban expansion are also set to present a significant challenge for governance, policy development and management concerning the ongoing provision of irrigated sports grounds, public open spaces, verges and medians.

Objective(s)

- Continue and improve the Shire's biodiversity and ecosystem protection and enhancement activities.
- Provide public open space that meets the community's needs and reflects the local ecosystems and environmental conditions.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
5.1 Implement Local Biodiversity Strategy.	Short	High	Environment
5.2 Implement Private Land Conservation Strategy.	Short	High	Environment
5.3 Continue support of Eastern Hills Catchment Management program (EHCMP) and volunteers.	Short	Medium	Environment
5.4 Consider weed control strategies in the Environmental Management Strategy and State of the Environment reporting.	Short	Medium	Environment
5.5 Review recreation types in the Shire and investigate alternative sporting surfaces.	Medium	Extreme	Recreation/Leisure
5.6 Investigate alternative water sources for ovals.	Medium	Extreme	Infrastructure parks
5.7 Review Public Open Space Strategy.	Medium	High	Planning and Statutory Services
5.8 Consider future landscaping guidelines based on change in species range.	Medium	High	Environment
5.9 Create watercourse hierarchy document policy incorporating into Public Open Space revision.	Medium	Medium	Environment/planning
5.10 Consolidate Shire sporting facilities and seek opportunities to share these with the Department of Education facilities (e.g. district facilities).	Long	Extreme	Recreation/Leisure



PRIORITY RISK AREA 6 – Decline in Population Health and Wellbeing

Priority Risk Area 6 - Decline in Population Health and Wellbeing

There is a growing recognition that climate change is having and will have further significant impacts on human health and populations. The increase in people suffering from disease and injury due to heatwaves and severe weather events such as floods, fires and storms, will lead to ever increasing issues with mental health and stress and displaced and homeless people.

There may be an increased workload for the Shire's Health Services and management requirements to deal with potential health risks associated with a changing climate including increased risk of vector, food and water borne disease as seasonal epidemics such as Ross River Virus spread south with changing climatic conditions; and increased injury levels sustained as a result of more frequent extreme weather conditions (eg floods, cyclones, gales etc).

There may be consequences for Shire facilities that may not have adequate heating and especially cooling, for example, with childcare facilities. There may also be additional occupational health and safety concerns, particularly for outdoor workers.

Displaced populations were identified as being a high risk to local government services and operations, with climate change possibly resulting in increased urban immigration on a regional, national and international level. Rising sea levels could see "climate refugees" relocate to Australia with consequences for the Shire, such as increased pressure for social services and social issues. Pressure to develop current undeveloped lands may also result, with a need to meet increasing housing pressure.

Objective(s)

- To ensure that appropriate planning and policy mechanisms are in place to facilitate the management of increased health risks as a result of climate change.
- To ensure that appropriate policy, procedures and infrastructure are in place to protect the health and well-being of the Shire's staff and the community.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
6.1 Population Health			
6.1.1 Utilise existing State Government education packages and distribute to the elderly or vulnerable in the Shire.	Short	Low	Community Services/Health
6.1.2 Develop a Heat Event Response Plan and alert system for the Shire.	Medium	Low	Community Services/Health
6.1.3 Prioritise shade in urban design (e.g. physical structures and passive shade).	Medium	Low	Infrastructure; Parks; Planning
6.2 Displaced People			
6.2.1 Develop a community education program for flood/fire	Short	Medium	Community Services/Health



PRIORITY RISK AREA 7 – Economic Challenges and Opportunities

Priority Risk Area 7 - Economic Challenges and Opportunities

Apart from the obvious environmental and physical impacts, climate change will also impact on business, industry, employment and the cost of resources, creating both economic challenges and opportunities. The Shire's role in dealing with these challenges and opportunities is two-fold. Firstly, to maximise the efficiency of the Shire's operations so as to minimise the impact of rising resource costs. Secondly, to help its communities adapt to these new challenges and opportunities.

Increased resource costs are already impacting, and will further impact on many aspects of the Shire's operations and services, including energy costs, water costs, road construction, building construction and waste management. This is in addition to the costs of adapting to climate change and the costs of participation in a carbon trading system. The Shire's residents are already experiencing, and will further experience financial challenges

from the increased costs of energy, water, fuel, food and services. It is important that the Shire minimises any costs that it may have to pass on to local residents and rate payers.

Business and industry within the Shire may experience displacement due to climate change impacts. Industries that require high inputs of carbon/energy and imported materials will be vulnerable, whereas industries requiring low levels of imports and carbon energy will yield opportunities, such as service industries including health and education.

The growing role of local government in fostering economic development provides it with the mandate to support adaptation and innovation by existing industries. It will be necessary to facilitate a change in the industry mix in order to better match the altered climatic, economic and planning and regulatory conditions, and to attract new industries offering solutions to climate

change. The Shire has a competitive advantage given its inland location from vulnerable coastal conditions and the spread of existing residential, commercial and industrial areas. Employment self sufficiency and self containment rates are also much better than other corridors of Perth's metropolitan area. On the other hand, there is limited scope to develop additional commercial or industrial land in the Shire, and limitations in local public transport network services may in turn limit employment self-sufficiency and self-containment.

Objective(s)

- Implement a range of resource efficiency measures to reduce costs.
- Ensure the appropriate planning and policy mechanisms are able to support business to adapt to the impacts of climate change.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
7.1 Continue to implement ways to be water and energy efficient to decrease costs to the Shire	Short	Low	Environment/ Infrastructure
7.2 Review all sources of funding for the Shire.	Short	Low	Community Services Grants Officer/ corporate services
7.3 Continue to improve bushfire safety in the Shire suburbs (e.g. re AS 3959).	Medium	Medium	Community Safety/ fire
7.4 Advocate to State Government for improvements to public transport.	Medium	Medium	Infrastructure / Community Services / Planning



PRIORITY RISK AREA 8 – Changing Leadership and Development Requirements

Priority Risk Area 8 - Changing Leadership and Development Requirements

The Shire's operations cover an extensive range of activities and extremely large asset portfolios. It is inevitable that most of these activities and assets will be impacted further by climate change. The decisions that will come with climate change adaptation will be unprecedented, and the Shire's decision makers will need to show both leadership and innovation.

In meeting the increasing challenges that climate change will bring, the Shire must be prepared to formally embed climate change into mainstream management and governance decision making. This means that climate change impacts and risks must be explicitly recognised and incorporated across all of the Shire's plans and procedures.

A broader issue for climate change adaptation will be to understand the legal liabilities that all levels of government will

be faced with. This will require clarification of issues and associated legal responsibilities such as disclaimers and insurance requirements to protect local government from litigation as a result of climate change events. Insurers will also need to be transparent on matters of indemnification in order to make a level playing field for all. Liability issues are an emerging concern, with the climate risk group, an advisor to government and business, advising that developers and local governments may face risk litigation for negligence if they fail to factor climate change into planning.

The Shire has many active environmental groups working to restore and protect its significant environmental bushland and wetland areas. These groups participate in on-ground activities (tree planting, rubbish collection and weed control), research (flora

and fauna surveys), educational programs and strategic natural resource planning. The participation and involvement of the community in the management, rehabilitation and protection of the natural environment is a key component in environmental management. The Shire will need to continue to nurture and support this community participation, as it will be an invaluable asset in climate change adaptation.

Objective(s)

- To build community and institutional capacity to meet the challenges of further expected climate change impacts.
- To ensure the Shire has a clear understanding of its legal responsibilities related to climate change and insurance.

Action Required	Timeframe	Risk Level	Responsible Service Area(s)
8.1 Continue to seek information and then inform the Shire and provide education to staff, councillors and community.	Immediate	Low	Office of CEO / Environment
8.2 Develop a survey to establish community expectations about adapting to climate change.	Short	High	Community services
8.3 Develop and adopt a Communication Strategy to assist in the above point.	Short	High	Community services
8.4 Provide leadership and governance re climate change.	Short	High	All
8.5 Continue support of Shire's volunteer programs.	Ongoing	High	Environment/Community Services
8.6 Incorporate Scheme provisions on bushfire hazard and flooding.	Short	Low	Statutory Services - Strategic Planning
8.7 Audit insured Shire facilities to determine whether action is required.	Medium	Low	Corporate services
8.8 Increase volunteer group support by creation of a volunteer plan.	Long	Extreme	Environment/Community services/HR
8.9 Adopt Shire Climate Change Adaptation Action Plan/Policy to show internal commitment.	Long	High	Environment/Council
8.10 Educate Shire staff and community in an ongoing commitment.	Long	High	All
8.11 Investigate opportunities to convert and utilise facilities for sustainability purposes.	Ongoing	Low	Statutory Services





Acronyms and Abbreviations

ACE _R	Achieving Carbon Emissions Reductions
AS	Australian Standard
ASS	Acid Sulfate Soils
BOM	Bureau of Meteorology
CPRS	Carbon Pollution Reduction Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DSR	Department of Sports and Recreation
EHCMP	Eastern Hills Catchment Management Project
EMRC	Eastern Metropolitan Regional Council
FESA	Fire and Emergency Services Authority
GPO	General Post Office
IOCI	Indian Ocean Climate Initiative
IPCC	International Panel for Climate Change
LCCAAP	Local Climate Change Adaptation Action Plans
LEMC	Local Emergency and Management Committee
NGERS	National Greenhouse and Energy Reporting System
PASS	Potential Acid Sulphate Soils
RCCAAP	Regional Climate Change Adaptation Action Plan
SRT	Swan River Trust
WALGA	WA Local Government Association

Glossary

Adaptation	Making adjustments to existing activities and practices so that vulnerability to potential impacts associated with climate change can be reduced or opportunities realised.
Adaptation Action	Specific tasks required to ensure that the adaptation measure is implemented.
Acid Sulphate Soil	A soil with naturally occurring sediments that contain sulfides that have or may have the potential to generate sulfuric acid when exposed to air.
Algal Bloom	The proliferation of either macro algae (seaweed) or surface scum accumulation or brightly coloured water due to microalgae (phytoplankton).
Climate Change	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.
Disease Vectors	An organism that does not cause disease itself but that transmits infection by conveying pathogens from one host to another, serving as a route of transmission.
Mitigation	Climate change mitigation are measures or actions to decrease the intensity of radiative forcing in order to reduce global warming. Mitigation is distinguished from adaptation, which involves acting to minimize the effects of global warming.
Resilience	The ability of human or natural systems to withstand, recover from or adapt to significant pressures and stresses without losing their essential characteristics.
Riparian	The area of land bordering a waterway, where the structure, function and composition of the landscape are influenced by the waterway.

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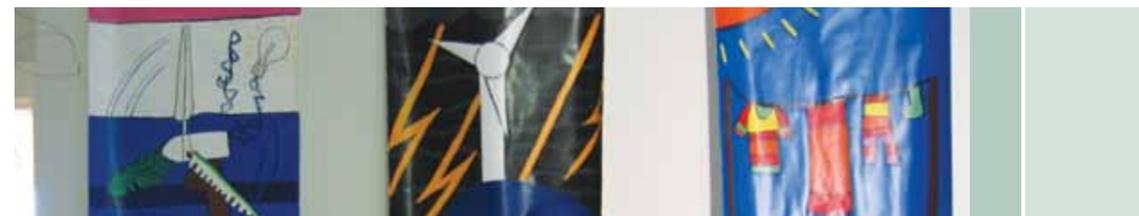
Appendix A

Note: This list of climate change adaptation actions was generated by the Shire's community during an adaptation action workshop through a brainstorming session to address identified risks that the Shire may face due to climate change. During this session all participants were given an opportunity not only to generate the ideas that will assist the Shire in the climate change adaptation process but also to vote on the preferred ideas to highlight the priority of the action. The workshop participants were limited to 3 votes only, therefore some proposed actions were left without a single vote. The number of votes allocated to the action indicates the implementation priority level that will be considered by the Shire's staff during the adaptation process and review of the LCCAAP.

Category	Idea	Votes
Environment	Develop existing townsites and maintain bushland & open area & farmland.	6
Infrastructure	Encourage infill development in existing townsites and protect existing bushland and farmland.	6
Infrastructure	Update planning rules to all new houses to include mandatory installation of required equipment to generate solar power, and, harvest/ utilize rain water and grey water.	5
Bushfire	Roof sprinklers on automatic system.	4
Environment	Ensure connections between green spaces to allow species migrations.	3
Environment	Free or low-cost travelling mulch to reduce burning-off, green waste, air pollution, and to help with plantings.	2
Environment	Bridle path maintenance requires community input. Consider incentives from Shire for volunteers.	2
Environment	Preserve water by encouraging greywater use and rain water collection. Set goal for Shire to become "water neutral, 2020".	2
Environment	Increase collaboration of Shire with DEC & DSR regarding strategies for green spaces for recreation purposes.	2
Environment	Conduct "Carbon Audit" for the Shire of Mundaring. Then 'manage the balance'.	2
Infrastructure	Require ongoing community engagement. Not 'ad hoc'.	2
Infrastructure	Improve rail infrastructure and reduce trucks on roads. Encourage establishment of the local growers market to reduce food miles.	2
Bushfire	Education from FESA on how to burn private properties to reduce fire hazards	2
Community	Support integration of new people into community to help people to work together during emergencies (eg a 'Welcome to our community information pack').	2
Community	Avoid disruption to electricity supply by increasing local solar generated electricity in each locality to be 'power positive' by 2020.	2
Community	Community facility - air-conditioned - recreation. Benefits to handicapped, overweight, elderly during times of high heat stress.	2
Community	Establish of local 'neighborhood watch(or similar program) to support vulnerable members of community during storms, bushfires etc.	2
Environment	More public education regarding weeds.	1
Environment	Reduction in disturbance to soil and removal of natural vegetation.	1
Environment	Dam creeks to slow down flow and create swamps/wetlands.	1
Infrastructure	Encourage solar power in community with funding for batteries (like the EMRC Perth Solar City initiative).	1
Infrastructure	Increased use of rainwater tanks for gardens. Education programs. Subsidies to support introduction.	1
Infrastructure	Move power and phone lines to underground services.	1
Infrastructure	Underground power lines.	1
Infrastructure	Car pooling scheme for commuters.	1
Infrastructure	Increase collaboration with community. 'Top down' management of land and infrastructure counters community effort to address climate change.	1
Infrastructure	Install bicycle racks at the Shire office and encourage more bicycle riding in town.	1
Infrastructure	Large amount of state owned land currently forces over development to generate revenue for the Shire. The Shire needs to: 1. Reduce revenue requirements; 2. Find other sources of revenue; and 3. Obtain return for State for maintenance of state land.	1



Category	Idea	Votes
Infrastructure	Reduce influence of State Administrative Tribunal. Devolve environmental control to Shire and community.	1
Infrastructure	Community based insurance company. Not reliant on large corporations.	1
Infrastructure	Houses, suburbs and cities should be well designed to implement solar positive principles, water sensitive design and community conviviality. This may be achieved by higher density public transport and more support for pedestrian and cycling infrastructure.	1
Bushfire	Ensure no cul-de-sac's exist in any new subdivisions and an opening of existing no-through roads where ever possible enhance escape routes.	1
Bushfire	Develop township bushfire protection plan to: 1. Control burn plan for total community; 2. Assistance with burns; and 3. More coordination with DEC & FESA.	1
Bushfire	Modify building requirements in high bushfire risk areas - wooden houses, pole homes, tile roofs etc.	1
Community	More planning/control of residential burns to manage air quality.	1
Community	Bury power supply lines between main lines and house.	1
Community	Building regulations - mandatory passive solar radiation.	1
Community	Find ways to reduce instances where the environment and/or 'character' suburbs unnecessary because of a perceived trade off between safety and the environment/character.	1
Environment	Record, monitor & enhance resilience of keystone species.	0
Environment	Community education in creating habitat for local species.	0
Environment	Water quality. Promote residents to buy water tanks with filters. Consider incentive (eg \$100 off rates).	0
Environment	Subdivision. Restraints on clearing bushland. Promote good greenbelt corridors.	0
Environment	Preserve water by changing drainage systems so that water is contained in reservoirs and does not flow to the sea.	0
Environment	The Shire to investigate the use of natural pesticides and herbicides and reduce use of toxic chemicals.	0
Environment	Map the shire from the point of view of environmental relationships. Show where the various pressures will apply (eg population, environmental stress etc) and the resultant risk to that area of cumulative pressure.	0
Environment	Change golf course to nine holes to use less water.	0
Environment	Compliance in planning - river and stream bank protection.	0
Environment	Tip fees drive people to dump rubbish in natural reserves. Need more education and more encouragement of recycling.	0
Environment	Investigate potential for NRM funding for care and restoration of crown land in region.	0
Environment	Ongoing fauna surveys.	0
Environment	Protection of habitat through minimization of clearing.	0
Environment	Carbon emission reduction by way of community tree planting days.	0
Environment	Shire to spray more verges to control weeds.	0
Environment	Reduce automobile dependence to reduce carbon emission.	0
Environment	Well planned housing. Needs to close its system by recycling, reusing, recovering etc.	0
Environment	Promote planting of endemic species (reduce bushfire risk).	0
Environment	Improve infrastructure planning to manage the risk of power failure could cause sewerage outlets and the resulting pollution of creeks.	0
Environment	For the 'Restore the canopy' program, provide information to the community on fire vulnerability as well as water resilience.	0
Environment	Expand green spaces to better ensure survival of remaining species.	0
Environment	More effort to control unwelcome species - corellas, pines, rabbits, rainbow lorikeets.	0
Environment	Seek more funding from State and Federal government to conserve biodiversity. Could this include funding for residential projects such as helping people create more frog ponds?	0
Environment	Work in collaboration with Department of Health on establishing mosquito management plan for the region	0



Category	Idea	Votes
Environment	Integrate composting into waste pick up service. Reduce 'green bin' to fortnightly and increase 'blue bin' (composting) to be weekly.	0
Environment	Encourage the use of more ecologically sustainable toilets (eg EcoSen composting toilets).	0
Environment	Educate public so they can identify at risk areas and species. Project to monitor species populations.	0
Environment	Establish green waste collection system for regions of higher population density (eg blocks < 4000m2).	0
Environment	Establish Riparian Zones (20m) for all creeks and streams.	0
Environment	Implement a 'tip shop' to recover items which may be re-used.	0
Infrastructure	Ensure that Shire planning is truly 'integrated'.	0
Infrastructure	More support for friends groups to keep planting.	0
Infrastructure	Maintain/enhance riparian zones and vegetation.	0
Infrastructure	Better cross-agency coordination. Local government and community groups are planting seedlings, while other government agencies are cutting down trees.	0
Infrastructure	Encourage renewable energy generation.	0
Infrastructure	Negotiate with insurance companies to provide lower insurance rates for people who demonstrate more sustainability (eg bushfire protection, water/energy self-sufficiency).	0
Infrastructure	More enforcement of stormwater management compliance.	0
Infrastructure	Council to arrange large mobile generator to improve energy security in the area (eg power station in a truck).	0
Infrastructure	Provide information to people on how to live 'off the grid'.	0
Infrastructure	More sustainable power supplies. More underground power.	0
Infrastructure	Cut down on heating and cooling.	0
Bushfire	Require at risk properties to have sprinklers on rood.	0
Bushfire	Provide more support (physical aid) to clear and maintain areas around land (especially for elderly residents).	0
Bushfire	Provide community shelters/gathering points.	0
Bushfire	More road verge maintenance.	0
Bushfire	Free/low-cost travelling mulchar to reduce amount of green waste.	0
Bushfire	State and federal government rely on arsonists to conduct their un-controlled burning.	0
Bushfire	Set planning restrictions regarding the distance of foliage from house/building.	0
Bushfire	Reward or discount rates for volunteers.	0
Bushfire	Require water tanks and generators.	0
Bushfire	Review of burning requirements and communication education on correct burning procedures.	0
Bushfire	Shire tree canopy program; Friends group planting	0
Community	More education regarding health risks from reduced air quality.	0
Community	Make the Shire an educational center for climate change adaptation and mitigation strategies based on community engagement in a practical sense.	0
Community	Different parts of the Shire act as 'backup' for other parts in case of displacement due to emergency.	0
Community	Bury power lines to address risk to power supply.	0
Community	Recharge aquifers with treated sewerage water.	0
Community	Develop friends groups for first planting for different direction and groups not connected to reserve.	0
Community	Use the resource which is 'community' better (eg to reduce the need for external consultants and/or permanent shire staff).	0
Community	Build a recreation center with air conditioning. Also can be used to house displaced people from fire or flood events.	0
Community	Educate community about risks of water borne diseases and pests.	0
Community	To address risk of heat stress. Encourage more cold water dispensers in town areas (eg encourage shops to provide cold water).	0
Community	Plan additional land to house displaced people (climate change refugees).	0

Category	Idea	Votes
Community	To address risk of heat stress provide a flyer our with rates telling people how to cope with extreme hot days.	0
Community	Free/low-cost travelling mulchar to reduce amount green waste and improve air quality.	0
Community	Community education on maintenance of rainwater tank.	0
Community	Extend community fire plan to deal with other kind of emergencies (eg flood and storm).	0
Community	'Adopt a family' scheme to house displaced people.	0
Community	Education on how to burn rubbish with minimal smoke to reduce air pollution.	0
Community	Community alert/communication plan to notify people during emergencies. Run regular 'whole of community' drills (eg test homeowners' fire plans).	0
Community	Provide community gardens and encourage community responsibility and ownership.	