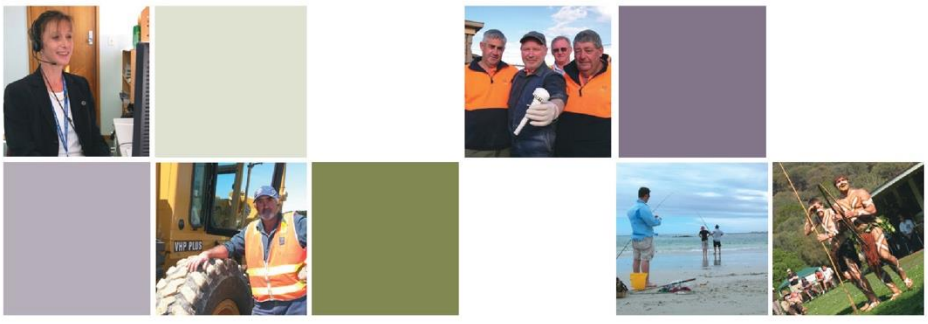
Moyne Shire Climate Adaptation Plan 2017

Moyne Shire - a safe, vibrant, liveable, and prosperous community



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This project was funded with the support of the Victorian Government's Department of Environment, Land, Water and Planning

Introduction

Moyne Shire is committed to preparing for the risks associated with a changing climate. Impacts experienced today, such as coastal erosion and flooding, are likely to become more frequent or intense in the future. Managing today's risks contributes to building resilience to a changing climate.

This Climate Change Adaptation Plan focuses on council operations and formalises Moyne Shire's approach to managing the impacts of a changing climate. The Plan outlines prioritised climate risks to council operations as well as risks to the community, and prioritises actions Council can implement.

Where risks cross organisational boundaries, Council is committed to working in partnership with other stakeholders.

Adaptation aims to enable people, businesses, infrastructure and the environment to cope with an increasingly variable and volatile climate.

Adaptation is a response to manage the risks of a changing climate.

1.1 Objectives

Moyne is committed to managing the more immediate climate risks, and to building resilience within the organisation to deal with other climate driven changes in future.

Moyne Shire will:

- Respond to identified priority climate risks.
- Integrate climate change into key strategies and policies to shape future decisions
- Build the awareness and capacity of staff to consider and respond to climate change risks.

1.2 Climate change policy commitment

To inform this plan, Moyne used peer reviewed science from the Commonwealth Science and Industrial Research Organisation (CSIRO), the Bureau of Meteorology (BoM) and the Intergovernmental Panel on Climate Change (IPCC).

Where available, state and regional specific information was used to provide more detail into how the local climate might change.

1.3 Key stakeholders and partners

Moyne Shire acknowledges its role in managing some of the impacts of climate change, however, the most effective climate change management requires a shared response from all levels of government, stakeholders and the community.

Changes in the climate will not respect shire or organisational boundaries, which is why this plan was developed in partnership with neighbouring councils and other members of the Climate Resilient Communities of the Barwon South West program. Members include the ten councils of the Barwon South West, the Corangamite Catchment Management Authority (CCMA), Barwon Water, and Wannon Water.

1.4 Guiding principles

Adapting to climate change affects the whole community. Responsibility for action to adapt is shared by all levels of government, agencies, business and organisations and the wider community. Coordinated action is necessary to increase the municipality's ability to adapt and be resilient to impacts.

The following principles underpin best practice adaptation planning:

- Adopt the precautionary principle and endeavour to adapt in advance of evidence of its need on the grounds that further delay could ultimately prove more costly to society and nature
- Promote inter and intra-generational equity to enable future generations the ability to meet their own resources needs.
- Adopt flexible and dynamic solutions with due regard to the inherent uncertainty in climate change projections
- Promote resilient and long-term action that increases the capacity of social, economic, and environmental systems to cope with shocks and stresses
- Use verified, reliable, up-to-date data to endorse accuracy and transparency in robust evidence based decision making
- Recognise the need for regional scale responses to effectively manage climate risks that are beyond an individual Council's jurisdiction.
- Encourage a partnership approach to engage and collaborate with stakeholders, businesses, government, industry and the community and share responsibility for action.

2. Changes in climate

2.1 A changing climate in the Barwon South West region

The climate has changed over time. Since 1950, average temperatures are more than 1 degree higher than in 1950 and average annual rainfall has reduced by over 100 mm. Over this time the region has also experienced a number of extreme weather events. Recent events include the 2016 Wye River bushfire, the millennial drought, and flash flooding in Geelong in February 2016.

The rate of climate change is set to increase over the coming years. By 2030, the climate of the region is expected to be hotter and drier.

Table 1 below outlines projections for climate of regional towns in 2030 and 2090. [1]

Table 1: Climate comparisons for towns of the Barwon South West

Town	By 2030 will resemble	And by 2090 will resemble
Colac	Mount Gambier	Wangaratta
Geelong	Horsham	Echuca
Warrnambool	Hamilton	Parkes
Portland	Goulburn	Bega

For Moyne Shire, the greatest increase in temperature and drying will occur at the northern and southern extremities of the Shire.

Table 2: The changes by climate variable

Temperature **Regional change[2]**	What it means for Moyne
Historical change:[3] – 1.2 to 1.4 degrees since 1950 2030[4] forecast change[2]: – Average annual temperature 0.6 degrees warmer – Increase in number of days over 40 degrees – single days by 8 percent, and three consecutive days by 40 percent.	– Overall the Shire is getting warmer, coupled with a significant increase in extreme heat events. – The greatest increase in temperature will occur along the northern and southern boundary of the Shire.

[1] Using the BoM and CSIRO, Climate Analogue tool, based on RCP 8.5 and maximum consensus of models, http://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-analogues/analogues-explorer/

2 Changes are relative to the period of 1986-2005

[3] Unless otherwise stated, all historical changes have been taken from the Victorian Department of Environment, Land Water and Planning, 2016, Barwon South West – Climate Ready Victoria, http://www.climatechange.vic.gov.au/__data/assets/pdf_file/0005/323456/Barwon-South-West.pdf

[4] Unless otherwise stated, all future projections are from SimClim for Barwon South West region, based on IPCC AR5 report

Temperature **Regional change**	What it means for Moyne
2070 forecast change: – Warmer average temperatures, with summer increases expected to be 1.9 degrees – Increase in days over 40 degrees – single by 15 percent, three consecutive days by 67 percent.	Examples of assets/services in exposed areas include: – Sporting and recreation facilities drying out and potentially becoming unusable. – Decline of trees on public land, including avenues of honour. – Pressure on libraries, schools and public facilities for use as heat refuges. – Land values and potentially rates income may decrease.
Rainfall **Regional change**	What it means for Moyne
Historical change: – 100-200 mm less since 1950 2030 forecast change: – Lower average annual rainfall by 3 percent (more reductions occurring in spring) – 50 mm rainfall events increase by 3 percent 2070 forecast change: – Lower average rainfall by 7 percent – 50 mm rainfall events increase by up to 10 percent	– Overall the Shire is getting drier, coupled with an increase in extreme rainfall events. – The driest area will occur north east of Woorndoo. – The wettest area will occur in the southern coastal areas towards Peterborough. – Planning scheme overlays may need amending to remain in line with a changing environment. Examples of assets and services affected in exposed areas include: – Potable water shortages in Mortlake and Koroit. – Rainwater tanks will be exposed to less precipitation. – Change of mix of agricultural use and industries. – Increased frequency and severity of riverine flooding. – Multiple wetlands will receive less annual rainfall – Merri River, Kelly's Swamp and Moyne River. – Vegetation becoming drought stressed – Coastal infrastructure. – Increased pressure on stormwater infrastructure

Bushfire **Regional change**	What it means for Moyne
2030 forecast change:[5] – Fire conditions index (FFDI) increase by 7 percent – 'Severe' fire danger increase 20 percent. 2090 forecast change:[6] – FFDI increase by between 10 - 30 percent – Severe fire danger increase by between 40 – 100 percent	– Higher number of days where emergency services must be ready if an event was to occur. – More pre-season preparation – Increased vulnerability of those in bushfire prone areas. – Increased demand for relief centres
Sea level rise **Regional change**	What it means for Moyne
Historical change: – 22 cm since 1880 – At Williamstown risen by 7 cm since 1970[7] 2030 forecast change:[8] – Increase by between 0.07 to 0.19 m 2090 forecast change:[9] – Increase by between 0.27 to 0.89 m	– Greatest exposure to inundation will be along the Moyne River in Port Fairy. Examples of assets/services in exposed areas due to sea level rise, erosion, and increasing ocean temperatures: – Port Fairy disused tip site (risk of contamination – 271 private properties currently at risk and 444 private properties by 2080. – Port of Port Fairy. – Griffith Island will have access issues due to its isolation. – Yambuk. – Increased cliff erosion and estuary flooding at Peterborough.

[5] CSIRO and BoM (2015) Southern Slopes Cluster report: Climate Change in Australia, http://www.climatechangeinaustralia.gov.au/media/ccia/2.1.5/cms_page_media/172/SOUTHERN_SLOPES_CLUSTER_REPORT_1.pdf

[6] ibid

[7] BoM presentation, 14 July 2016

[8] CSIRO and BoM (2015) Southern Slopes Cluster report: Climate Change in Australia, http://www.climatechangeinaustralia.gov.au/media/ccia/2.1.5/cms_page_media/172/SOUTHERN_SLOPES_CLUSTER_REPORT_1.pdf

[9] ibid

3. Vulnerability of the Shire to climate change

Vulnerability refers to the degree to which a municipality is susceptible to changes in the climate and its potential impacts. Usually, climate change will exacerbate existing vulnerabilities. Vulnerability to climate change is determined by the exposure to the changes, and the sensitivity (susceptibility) to negative impacts from those changes, and capacity to do something about the exposure or susceptibility.

The social, economic and environmental vulnerabilities for the Moyne Shire are outlined below.

3.1 Social vulnerabilities

As a result of climate impacts, the social vulnerabilities the Shire is facing include:

- Elderly will be sensitive to heat stress and potentially isolated with little accessibility to shops and services.
- Maternal and childcare services.
- Loss of commercial and residential property value and income in coastal inundated areas.
- Increased planning scheme restrictions limiting land use.

3.2 Economic vulnerabilities

The dairy industry throughout Moyne Shire will be particularly sensitive to economic pressures as drier and hotter conditions may lead to decreased productivity. Road infrastructure in heat exposed areas may melt more frequently which will in turn affect economic activity and maintenance costs. The water and power infrastructure will be put under greater stress as the demand for water and electricity increases.

Rural areas may experience the greatest economic vulnerability to these impacts, due to their dependence on roads, water and power for economic return.

3.3 Environmental vulnerabilities

The environmental vulnerabilities to climate impacts across the Moyne Shire include:

- Underground aquifers across the Local Government Area become depleted (Southern Water responsibility) due to reduced recharge.
- Wetlands and bird reproduction disrupted across the area by a hotter, drier climate and changed rainfall patterns.
- Red Gum areas declining due to water shortages.
- Increased risk of grass fire and bushfire activity.

4. Risk assessment

4.1 Approach

A risk assessment approach was followed to inform the development of the Climate Change Adaptation Plan and focus council efforts on the highest priority climate change risks.

The risk assessment approach followed the Australian Standard - AS5334: 2013 Climate change adaptation for settlements and infrastructure — A risk based approach. AS 5334 references the globally recognised risk management approach outlined in ISO 31000:2009 Risk management- Principles and guidelines.

The risk assessment process identified and assessed risks over the immediate (0-5 years) and longer (5-60 years) term. It is also important to understand if risks interact with each other to create additional or amplified consequences. Therefore, a risk interdependency analysis was completed, investigating potential cumulative effects and/or additional consequences that arose between the risks.

Details of the risk management approach is outlined in Appendix A: Risk procedure. This includes details of the risk criteria – likelihood and consequence matrices – that were used to rate climate change risks.

4.2 Prioritised Risks

Moyne has prioritised risks from across a range of asset classes – infrastructure, open space, buildings and community wellbeing.

Table 3: Priority risks

Priority risk	Asset	Rating 0-5 years	Rating 6-50 years	Council control
Decreased potable water supply for community use[10]	Community wellbeing	Medium	Extreme	Low
Increase in flood damage to council coastal assets (including marinas and boat ramps)	Infra	Low	High	Medium
Increased pressure on private building resources e.g. cooling loads due to declining water availability and potential increases in energy prices	Buildings	Medium	High	Low
Damage to tourism attractions/facilities reducing tourism opportunities from sea level rise, other climate variable changes	Industry	Negligible	High	Low

[10] The different supplies for potable and irrigation water were noted such as using recycled water from dairy factory to water sports fields as is done in Leongatha. Currently, local clubs manage the watering of ovals and they are not thinking about climate change or potential for declining rainfall.

Priority risk	Asset	Rating 0-5 years	Rating 6-50 years	Council control
Increased damage to private coastal buildings from sea level rise and storm surge.	Buildings	Low	High	Low
Damage to Council (non-building) assets from bushfires and floods.	Infra	Medium	Medium	High
Increase in heat stress and solar exposure to the community leading to increased illness.	Community wellbeing	Low	Medium	Medium
Increase in heat stress, related sickness or absence and solar exposure to council staff delivering services.	Community wellbeing	Low	Medium	High
Degradation of parks and reserves due to lack of water.	Parks & Rec	Medium	Medium	High

Of these priority risks three are rated as having high Council control:

- Damage to council assets from bushfires and floods.
- Increase in heat stress, related sickness or absence and solar exposure to council staff delivering services.
- Degradation of parks and reserves due to lack of water.

Four are rated as having low Council control:

- Decreased potable water supply for community use.
- Increased pressure on private building resources.
- Damage to tourism attractions/facilities.
- Increased damage to private coastal buildings.

5. Adaptation actions

5.1 Adaptation action occurring already

The Shire is already responding to the more immediate risks of climate change – such as coastal inundation and erosion.

Coastal inundation and flooding

To better understand future sea level rise and inundation in Port Fairy, Moyne Shire has completed a Local Coastal Hazard Assessment of the Port Fairy coastline. This study is directly informing the Port Fairy Coastal and Structure Plan and the Port Fairy Coastal Climate Adaptation Plan.

The Council has constructed and extended a 300m Wave Energy Dissipation Structure at the former tip site on East Beach. Three sections of the East Beach rock seawall totalling approximately 300m in length have been upgraded to protect against the increased potential of damage to private coastal buildings and the town in general as a result of sea level rise and storm surge.

Following a sea storm in 2014, Moyne Shire was successful in securing flood recovery funding to carry out repair works on the Martins Point footpath, Southcombe Park footpath, Griffith Island car park and the Peasoup timber pathway.

Bushfire management

In order to prepare for bushfire events, a range of prevention and preparedness plans and activities have been completed. A Peterborough Township Protection Plan has been produced, and Places of Last Resort have been established at Hawkesdale, Koroit, Mortlake, Panmure and Peterborough. These 'safer places' are municipal council designated buildings or spaces that may be able to provide some protection from radiant heat during a bushfire.

Climate change is becoming a consideration in the development of the Municipal Emergency Management Plan and the Municipal Fire Management Plan.

Climate change

The Moyne Shire Environmental Sustainability Strategy highlights several measures that are being taken against climate change, particularly to protect the tourism industry. These include:

- Improving coastal management of Crown land reserves and protecting biodiversity values between Warrnambool and Port Fairy.
- Being the first Council to develop a 'Biodiversity and Land Capability' study to inform Planning Scheme Amendments to protect biodiversity values and productive agricultural land.
- Protecting cultural sites and enhancing biodiversity at the Crags Coastal Reserve.
- Considering climate change with municipal emergency management documents.

The Strategy also highlighted the Shire's achievements in preparing and implementing a Sustainable Water Use Plan to achieve water savings across Council services and businesses. This Plan has helped to reduce the vulnerability of the community's wellbeing and insured against the risk of a decreasing potable water supply for community use. Council has also replaced high energy street lights with energy efficient LED lights and replaced 48 High Bay lights in Council facilities with LED lights. Bottled water coolers have been replaced in Council facilities with filtered water from mains supply to reduce use of plastic bottles, track emissions and use of fossil fuels for delivery.

5.2 Adaptation actions

1. Build adaptation knowledge and capability of Council staff

- Develop and implement adaptation training to increase staff understanding of adaptation and embed adaptation action across Council.
- Incorporate climate change into risk assessment process for new buildings and roads.
- Incorporate climate change consideration into project and budget development processes, including the project management framework currently in development.

2. Foster community resilience to heatwaves and extreme weather

- Develop and implement a heatwave community education program to support vulnerable communities to cope with rising temperatures and extended heatwaves.
- Review Municipal Public Health & Well-being Plan to incorporate climate change consideration.

3. Leverage new tourism opportunities

- Work collaboratively to investigate opportunities to promote tourism in the region

4. Managing impacts of climate change on Council assets and staff:

- Review and expand code red policy to include all severe/extreme weather events.
- Incorporate consideration of climate change into new Open Space strategy.
- Undertake turf management and heatwave planning with sporting clubs.
- Include climate change consideration during the development of master plans for recreational reserves, in particular upcoming plans for Gardens Oval and Victoria Park.
- Investigate energy and water efficiency measures at Council swimming pools.

5. Continue to tackle sea level rise and coastal inundation

- Complete Port Fairy Coastal and Structure Plan.
- Complete Port Fairy Coastal Climate Adaptation Plan.

6. Embedding climate change consideration into emergency management

- Raise awareness amongst the Municipal Emergency Management Planning Committee about the potential impacts of climate change.
- Incorporate climate change consideration into next review of the Municipal Emergency Management Plan.

6. Implementation plan

Action	Action activities	Timelines	Action owner and partnerships	Resources required
Build adaptation knowledge and capability of Council staff	Develop and implement adaptation training to increase staff and Councillor understanding of adaptation and embed adaptation action across Council.	2017	Environment & Regulatory Services	
Build adaptation knowledge and capability of Council staff	Incorporate climate change into risk assessment process for new buildings, roads and other assets.	2020	Assets	
Build adaptation knowledge and capability of Council staff	Incorporate climate change consideration into project and budget development processes, including the project management framework currently in development.	2018	FMT	
Foster community resilience to heatwaves and extreme weather	Develop and implement a heatwave community education program to support vulnerable communities to cope with rising temperatures and extended heatwaves.	2019	Community Services & Community Safety	

Action	Action activities	Timelines	Action owner and partnerships	Resources required
Foster community resilience to heatwaves and extreme weather	Review Municipal Public Health & Well-being Plan to incorporate climate change consideration.	2018	Community Services & Environmental Health	
Leverage new tourism opportunities	Work collaboratively to investigate opportunities to promote tourism in the municipality region.	2020	Corporate Business & Tourism	
Managing impacts of climate change on Council assets and staff	Review and expand code red policy to include all severe/extreme weather events.	2018	Environment & Regulatory Services and Organisation Development	
Managing impacts of climate change on Council assets and staff	Include consideration of climate change into new Open Space strategy development.	2019	Recreation & Community Development	
Managing impacts of climate change on Council assets and staff	Undertake turf management and heatwave planning with sporting clubs.	2019	Recreation & Community Development	

Action	Action activities	Timelines	Action owner and partnerships	Resources required
Managing impacts of climate change on Council assets and staff	Include climate change consideration during the development of master plans for recreational reserves, in particular upcoming plans for Gardens Oval and Victoria Park	2018	Recreation & Community Development	
Managing impacts of climate change on Council assets and staff	Investigate energy and water efficiency measures at Council swimming pools	2019	Recreation & Community Development	
Continue to tackle sea level rise and coastal inundation	Complete Port Fairy Coastal and Structure Plan.	2018	Planning	
Continue to tackle sea level rise and coastal inundation	Complete Port Fairy Coastal Climate Adaptation Plan.	2017	Environment & Regulatory Services	
Embedding climate change consideration emergency management	Raise awareness amongst the Municipal Emergency Management Planning Committee about the potential impacts of climate change.	2018	Community Safety	
Embedding climate change consideration emergency management	Incorporate climate change consideration into next review of the Municipal Emergency Management Plan.	2019	Community Safety	

Appendix A: Risk Assessment Procedure

Introduction

Barwon South West Councils have many diverse risks. It is important that all activities undertaken are done so by using a Risk Management based approach. This risk assessment and the associated documents within the Risk Management Framework aim to provide the guidance and documentation to enable all staff to adopt this approach.

Purpose

The purpose of these procedures is to define the roles and responsibilities, monitoring and reporting requirements for the management of risks within Barwon South West. These procedures are intended to be an information reference and contain the minimum principles and procedures of a basic risk management process to assist Council departments in adopting a consistent approach to risk management. The application of these procedures at line management level will encourage better practice and provide support to Directors, managers and officers who have Risk accountability in the implementation of effective risk management practices at all levels within Barwon South West Council.

Risk management Process

The Risk Management process to be followed within Barwon South West is in accordance with the AS5334:2013 *Climate change adaptation for settlements and infrastructure — A risk based approach*. This is a significant development as it provides a standard methodology for approaching climate change adaptation in the built environment. AS 5334 references the globally recognised risk management approach outlined in ISO 31000:2009 *Risk management- Principles and guidelines* (as shown in Figure 1).

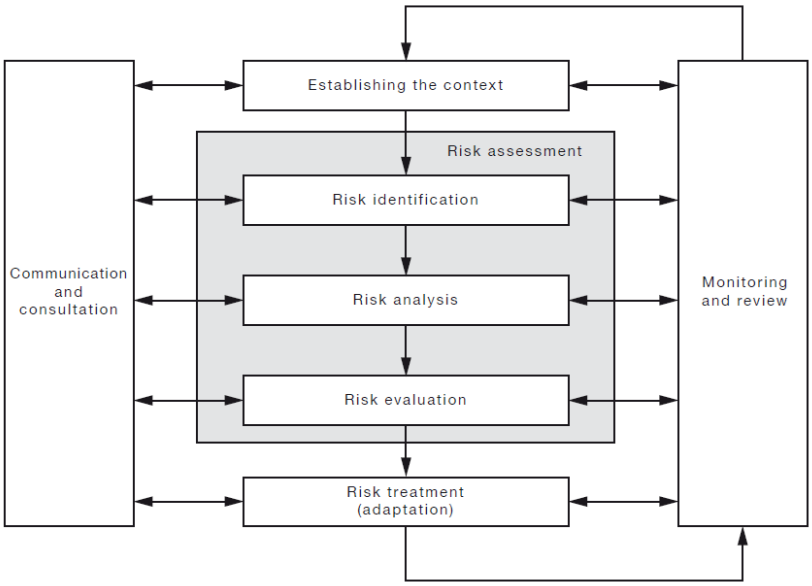

Figure 1. Risk Assessment approach (adapted from AS/NZS ISO 31000)

Adaption (Risk Treatment)

AS 5334 provides specific guidance on the consideration of climate change impacts and assessment of adaptation options. The guidance of AS 5334 has informed the development of this Climate Change Risk Assessment, ensuring that the process follows current best practice approaches to climate change adaptation (as shown in Figure 2 below).

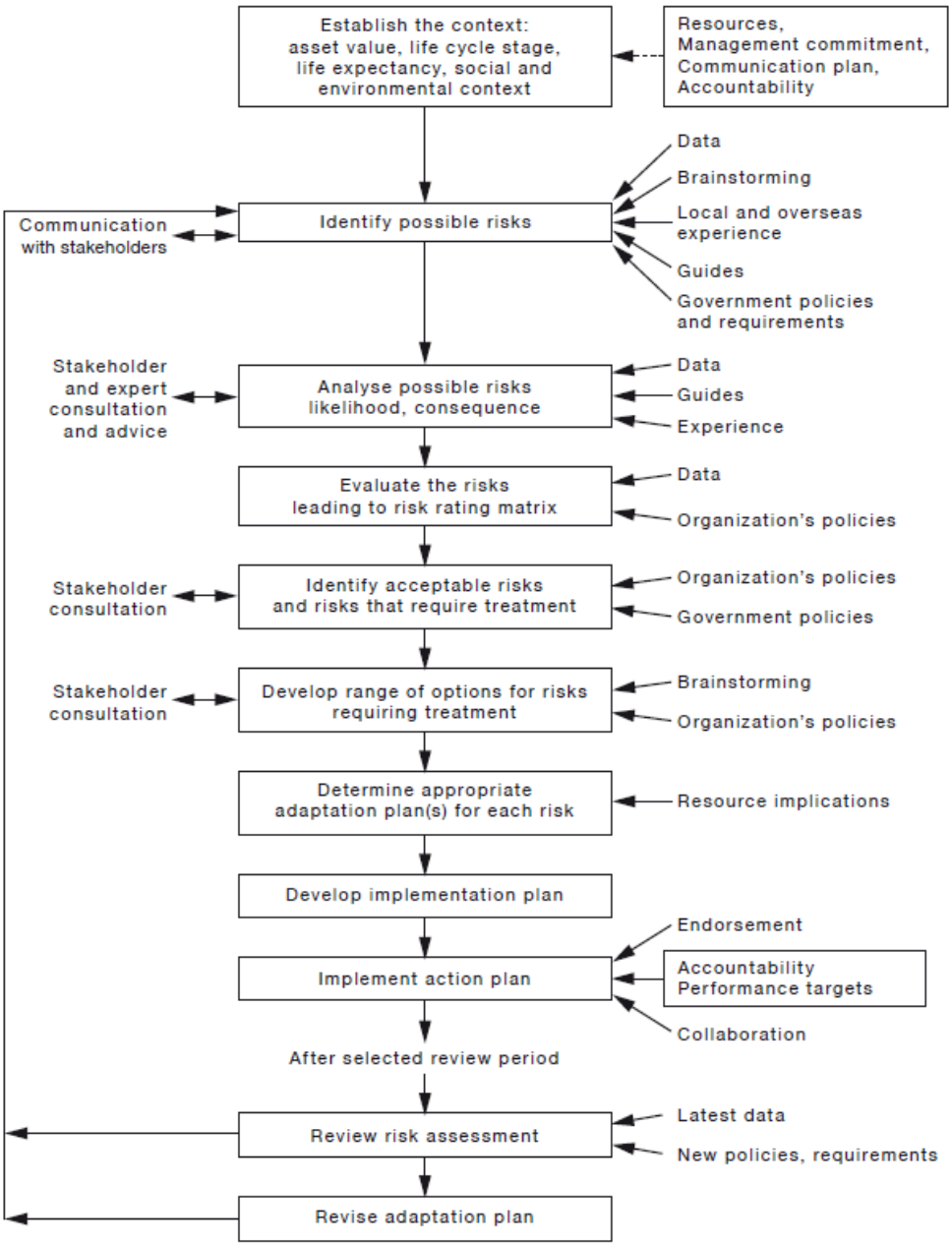

Figure 2. Risk Assessment Process (AS 5334-2013)

Risk Criteria

Risk criteria are the likelihood and consequence ratings that are used in order to assess the level of the risk to determine whether treatment is required.

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Likelihood

All areas within Barwon South West will utilise the likelihood rating system shown below when analysing risks.

Table 1. Likelihood Table

Likelihood	Descriptor	Recurrent or event risks	Long term risks
Almost certain	Could occur several times per year	Has happened several times in the past year and in each of the previous 5 years – or –Could occur several times per year.	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated.
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years – or – May arise about once per year	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated.
Possible	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year – or – May arise once in 25 years	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated.
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years – or- May arise once in 25 to 50 years	Has a 10–30% chance of occurring in the future if the risk is not mitigated.
Rare	Maybe once in a lifetime	Has not occurred in the past 5 years – or – Unlikely to occur during the next 50 years	May occur in exceptional circumstances, i.e. less than 10% chance of occurring in the identified time period if the risk is not mitigated

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Consequence

As with likelihood for risk assessments to be effective a structured approach is required across the organisation to assessing consequence. Table 2 below is a qualitative method of estimating the consequences of the identified climate change risk. Not all risks may pose negative impacts, some may have positive impacts. The positive impacts will be captured under the beneficial category.

Table 2 Consequence Table

Consequence Descriptor Abbreviation	Residents Private Property (RP)	Economic (EC)	Human Health and Wellbeing (HH)	Social/Cultural (SC)	Political/ Reputation and Liability (PL)	Environment and Open Space (EO)	Infrastructure Service (IS)	Council Financial and Resourcing (FR)
Beneficial	Will have positive impacts on private property with no cost to the council.	Will have positive impacts on the regional economy e.g. increase in tourism, or increased productivity in a primary product	Positive impact to human health and wellbeing e.g. favourable conditions for some medical conditions.	Positive impact on community social fabric or cultural values including, amenity, indigenous sacred sites, multicultural values or places of historical significance	Positive impacts for Council or Councillors.	Positive impact on the natural environment e.g. favourable conditions for other species Increased quality or access to open space or parks and reserves	Positive impact on infrastructure e.g. less maintenance required.	No cost to council may have a financial gain.
Negligible	No private property damage.	No impacts on the broader economy. Business as usual. Minor shortfall relative to current forecasts.	No impact to human health and wellbeing. No loss of lives. No chronic health effect requiring medical treatment	No impact to community social fabric or cultural values including, amenity, indigenous sacred sites, multicultural values or places of historical significance.	No changes to management required. No potential for legal ramifications from impact. No negative implications for Council or Councillors. No impact on reputation.	No adverse impact on natural environment. No change in the quality or access to open space or parks and reserves	No infrastructure damage, little change to service	Cost to council below $50,000. Increase in annual operating costs less than 0.5% Additional work for current employee but manageable

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Consequence Descriptor Abbreviation	Residents Private Property (RP)	Economic (EC)	Human Health and Wellbeing (HH)	Social/Cultural (SC)	Political/ Reputation and Liability (PL)	Environment and Open Space (EO)	Infrastructure Service (IS)	Council Financial and Resourcing (FR)
Minor	Cost to council of $50,000 to $200,000. Isolated private property damage (10% of residents in compartment). No permanent damage. Some minor restoration work required.	Individually significant but isolated areas of reduction in economic performance relative to current forecasts. Temporary impact, with no long term implications impeding trade. Seasonal disruption to a primary product of marginal significance to the regional economy.	Minor first aid required. Slight impact and threat to human health and wellbeing. No loss of lives. Injury to staff member results in lost time under 10 days. Chronic health effect requiring medical treatment for >1-2% of population at-risk	Localised disruption to community wellbeing, amenity and social networks over a small area for a period of weeks Small negative impact on community social fabric Community feels threatened by impact in a minor way, but can tolerate a reactive management plan.	General concern raised by regulators requiring response action Inadequate probity being exercised. Minor/isolated concerns raised by members of public, customers, suppliers. Low concern for reputation of Council.	Minor impacts on small areas of natural environment, with short term recovery projected. No indirect impacts to wider biodiversity of areas. Minor management required. Required to notify EPA and / or contained temporary pollution. Seasonal deterioration in the quality of an open space or a park or reserve	Localised infrastructure service disruption. No permanent damage. Some minor restoration work required. Early renewal of up to 5% by value of total council infrastructure. Need for new/modified ancillary equipment.	Cost to council of $50,000 to $200,000. Increase in annual operating costs 0.5% to 1% Additional 1 FTE required

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Consequence Descriptor	Residents Private Property	Economic	Human Health and Wellbeing	Social/Cultural	Political/ Reputation and Liability	Environment and Open Space	Infrastructure Service	Council Financial and Resourcing
Abbreviation	(RP)	(EC)	(HH)	(SC)	(PL)	(EO)	(IS)	(FR)
Moderate	Cost to council of $200,000 to $2.5m. Isolated private property damage (10% within compartment) in areas with low socio-economic residents (i.e. low income – ignoring asset levels). Private property damage recoverable by maintenance and minor repair. Some private property damage (20%) in areas without economic disadvantage.	General reduction in economic performance relative to current forecasts. Major investment slows in a specific locality Tourism trade is moderately affected with limited access to local industry. Seasonal disruption to a primary product of significance to the regional economy.	Negative impacts on human health and wellbeing for staff and general public. Injury to staff member results in lost time over 10 days. Hospital admission for check-up. No permanent damage and no lives lost. Chronic health effect requiring medical treatment for 2-5% of population at-risk	Major disruption to community wellbeing, amenity and social networks over a locality for a period of months. Some impact to community social fabric of cultural values including physical damage to indigenous sacred sites, multicultural values or places of historical significance.	Investigation by regulators. Changes to management actions required. Public/media negative attention. Coverage by local papers, with some coverage in Melbourne papers. Local community concern demonstrated through letters of complaint and small protests. Customer/supplier concern. Reputational risk.	Damage to natural environment, with interacting impacts for wider biodiversity. Potential for threat to endangered flora and fauna through indirect impacts. Significant release of pollutants. Residual pollution requiring clean-up. Large environmental footprint. Remedial management required, with minimal long term damage. Seasonal deterioration in the quality and access to open space or parks and reserves across the region	Limited infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair. Early renewal of 5% to 10% by value of total council infrastructure.	Cost to council of $200,000 to $2.5m. Increase in annual operating costs 1% to 5% Additional 2-4 FTEs

Major	Cost to council of $2.5 to $5m. Some private property damage (20% within compartment) in areas with low socio-economic residents (i.e. low income – ignoring asset levels). Extensive private property damage requiring major repair. Some private property damage (30%) in areas without economic disadvantage.	Investment stagnated. Region not growing with respect to tourism, arts or culture. Tourism is significantly affected, with some long term damage to reputation of local industry. Local traders are unable to operate for over a week, with some permanent impact. Seasonal disruption to more than one primary product of significance to the regional economy.	Emergency status due to major injury to staff or a member of the public. Injury to staff member results in lost time over two weeks. Threat to other members of the public or staff. Potential for ongoing danger to members of staff and public. Chronic health effect requiring medical treatment for > 5-10% of population at-risk.	Reduced quality of life within community. Severe impact to community social fabric, amenity, community wellbeing, and social networks over a wide area for up to two years. Significant loss or damage to objects of cultural/heritage significance. This includes loss of large areas of cultural significance without potential for conservation.	Notices issued by regulators for corrective actions. Changes required in management. Senior management responsibility questionable. Threat of legal action against Council. High public/media and community concern with coverage in State newspapers, news coverage. Council subject to formal inquiry/sanctioned	Major damage to natural environment, including high impact to biodiversity across the catchment. EPA likely to charge. Major release of toxins/water resulting in high compensation or reconstruction costs. Significant threat to species, including endangered flora and fauna, with potential for permanent damage to ecosystems. Excessive environmental footprint Chronic deterioration in the quality and access to open space or parks and reserves across the region	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. Early renewal of 10% to 20% by value of total council infrastructure.	Cost to council of $2.5 to $5m. Increase in annual operating costs 5% to 10% Additional 5- 10 FTEs

Catastrophic	Cost to council >$5m. Some private property damage (>20% within compartment) in areas with low socio-economic residents (i.e. low income – ignoring asset levels). Substantial permanent damage to private property. Some private property damage (>30%) in areas without economic disadvantage.	Major investment stagnated. Regional decline leading to widespread business failure, loss of employment and hardship. The region would not be viewed as an attractive tourist, arts or cultural destination. Tourism trade is extensively effected, with significant reduction in visitors to the area projected for the next 2 years. Long term decline of more than one primary product of significance to the regional economy.	Single or multiple deaths. Serious injury to one or many members of the public or staff, including disability and permanent damage. Chronic health effect requiring medical treatment for 10-15% of population at-risk.	Community ability to support itself severely impaired. Widespread loss of objects of cultural/heritage significance. Severe disruption to community wellbeing, amenity and social networks over the whole area or a large part of it for a period of many years. Extreme impact to social fabric of community with community values compromised.	Major policy shifts. Change to legislative requirements. Full change of management control. Legal action against Council undertaken. Significant public/media and/or community outrage with ongoing coverage in State newspapers and media outlets. National coverage in the media. Public pressure to curtail operations of Council.	Extreme impact to natural environment with extensive damage to wider biodiversity of catchment. Major release of toxins to environment resulting in long term damage. Extensive remedial action required immediately to prevent further damage to biota. Restoration and breeding programs required to manage ongoing survival of flora and fauna. Complete loss of one or more species. Permanent deterioration in the quality and access to open space or parks and reserves across the region	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service. Loss of infrastructure support and translocation of service to other sites. Cost associated with transferring services required from other areas of Council. (Is this relevant to council infrastructure?) Early renewal of greater than 20% by value of total council infrastructure.	Cost to council >$5m Increase in annual operating costs >10% Additional 10 + FTEs required

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Risk identification

The aim of risk identification is to develop a comprehensive list of events that may occur and, if they do, are likely to have an impact on the objectives of Barwon South West. When identifying risk a sensible approach needs to be taken. Identifying hundreds of risks will make it virtually impossible to effectively manage them; identifying only a handful will increase the likelihood that Barwon South West will experience significant issues that take it outside its tolerance levels.

Risk Analysis

The main objective of risk analysis is to separate the minor acceptable risks from the major ones, and to provide data to assist in the evaluation and treatment of the risk. Not all risk may have negative outcomes, some risk may have positive outcomes and this is captured by the beneficial column outlined in Table 3 below.

Risk Matrix

To ascertain the overall risk level for a particular risk, the likelihood and consequence scores for the risk are extrapolated into the matrix below.

Table 3 Likelihood x Consequence risk matrix.

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

Risk Interdependency

Post risk identification and assessment, it is important to understand if risks interact with each other to result in additional or amplified consequences. Interdependency could be represented by:

Cumulative effect: risks that when considered together (i.e. occurring over a similar period) increase the existing consequences of the individual risks.

For example, a bushfire occurring during a period of drought, which requires drawing on water storages to be fought, places further strain on water storages for the catchment.

Additional consequence: where new consequences are derived from the interaction of the two risks

For example, heavy rains on catchments that have already been de-vegetated by fire causing dramatic effects on raw water quality in storages. Or a flood event directly after a bushfire, resulting in flooding of surrounding residential areas that are usually protected by vegetation.

To determine interdependencies, the following process was undertaken.

Post risk assessment, the high and extreme risks were collated to determine if any risks presented an interaction with each other. In the instance where the risk assessment workshops did not produce any high or extreme risks, a conversation with the PMG representative determined the risks that would be pushed into the interdependency activity. In an instance where a risk was not rated high or extreme, but was deemed significant enough to determine interdependency with other high or extreme risks, it was pushed through to the interdependency activity. In all instances, the PMG representative, along with the project team decided on the final risk interdependency list. The number of risks tested for interdependency varied per council. Some worked with 13 risks and some worked with five.

An interdependency matrix was used with an opportunity to investigate the interdependency between each risk. A conversation was facilitated between the cross-council workshop participants in small groups as to whether additional consequences could arise as a result of the risk interaction that could change the rating of the original risk.

If an interaction presented itself, it was noted in the matrix. If there was no interaction (i.e. events were unlikely to occur together or were similar enough to hold similar consequences), no interaction was noted. Participants came back together as a larger group to discuss the common interdependencies. The noted interdependencies were used by the project team to gauge whether the original risks required an increased rating (e.g. additional consequences were noted or interaction posed a cumulative effect) and each council risk register was updated accordingly. Final council risk reporting reflected this process.

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