Colac Otway Shire Council

Climate Change Adaptation Plan 2017- 2027

Climate Resilient Communities of the Barwon South West

Final | 19 April 2017

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 17
1 Nicholson Street
East Melbourne VIC 3002
Australia
www.arup.com

Contents

This project was funded with the support of the Victorian Government. It was delivered under the Climate Resilient Communities of the Barwon South West Project, which consisted of 10 Councils and a range of partners, including the of Department of Environment, Land, Water and Planning (DELWP), catchment management authorities and water authorities.

1 Introduction

Colac Otway Shire is committed to building a resilient community by being best prepared for the risks and impacts of a changing climate. With impacts such as declines in water supply, and an increased number of high bushfire risk days and heatwaves already being experienced, it is important for Colac Otway Shire Council to manage and monitor potential risks to its operations.

This Climate Change Adaptation Plan (CCAP) formalises the approach of Colac Otway Shire to managing the impacts of a changing climate on Council operations. The CCAP outlines our priority risks, completed adaptation actions and identifies actions that we are committed to delivering over the next ten years to respond to the changing climate. Where there are risks that cross-organisational boundaries, we are committed to working in partnership with other relevant agencies and community to respond.

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

Adaptation aims to enable the Council's people, businesses, infrastructure and environment to cope with an increasingly variable and volatile climate. Given the potential broad-ranging impacts of climate change in our shire, adaptation is essential.

1.1 Objectives

The CCAP seeks to achieve the following objectives over the next 10 years:

- Provide clear, prioritised actions for Council to increase the resilience of services and assets against climate change.
- Introduce a risk based approach for managing climate change in Council operations.
- Raise awareness of the needs, challenges and opportunities that climate change presents for Council and of the local actions being undertaken to adapt.
- Partner with key agencies, land managers and stakeholders to inform decision making and enable integrated action for high risks which are outside of council control alone.
- Monitor, learn from and review climate change adaptation plans and actions in the municipality.

1.2 Climate change policy commitment

To inform our response, Colac Otway Shire relies on 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, Colac Otway Shire also uses state and regional specific information, to provide more detail about how the local climate might change. Where local information is used we will look for published and peer reviewed scientific data, government reports or guidelines, or data used by government authorities in decision-making.

1.3 Key stakeholders and partners

We acknowledge our role in managing some of the impacts of climate change, however, the most effective climate change adaptation requires a shared response from all levels of government, stakeholders and the community.

Changes in our climate will not respect Shire or organisational boundaries, which is why we have developed the CCAP with input from a range of partners, including the CMA's, water authorities and the Department of Environment, Water, Land and Planning (DELWP).

We will continue to work with these partners as we develop and deliver actions that will help to manage common climate change risks, to ensure that the most effective and efficient approach is being followed.

2 Changes in climate

2.1 A changing climate in the Barwon South West Region

The climate has changed. Since 1950, average temperatures are over 1 degree higher than in 1950 and average annual rainfall has dropped by over 100 mm.

Changes in our climate are set to increase over the coming years. By 2030, the climate of the region is expected to be hotter and drier. Figure 1 below shows the average temperature and rainfall for Colac, to be similar to that of present day Mount Gambier in 2030 and Wangaratta in 2070.

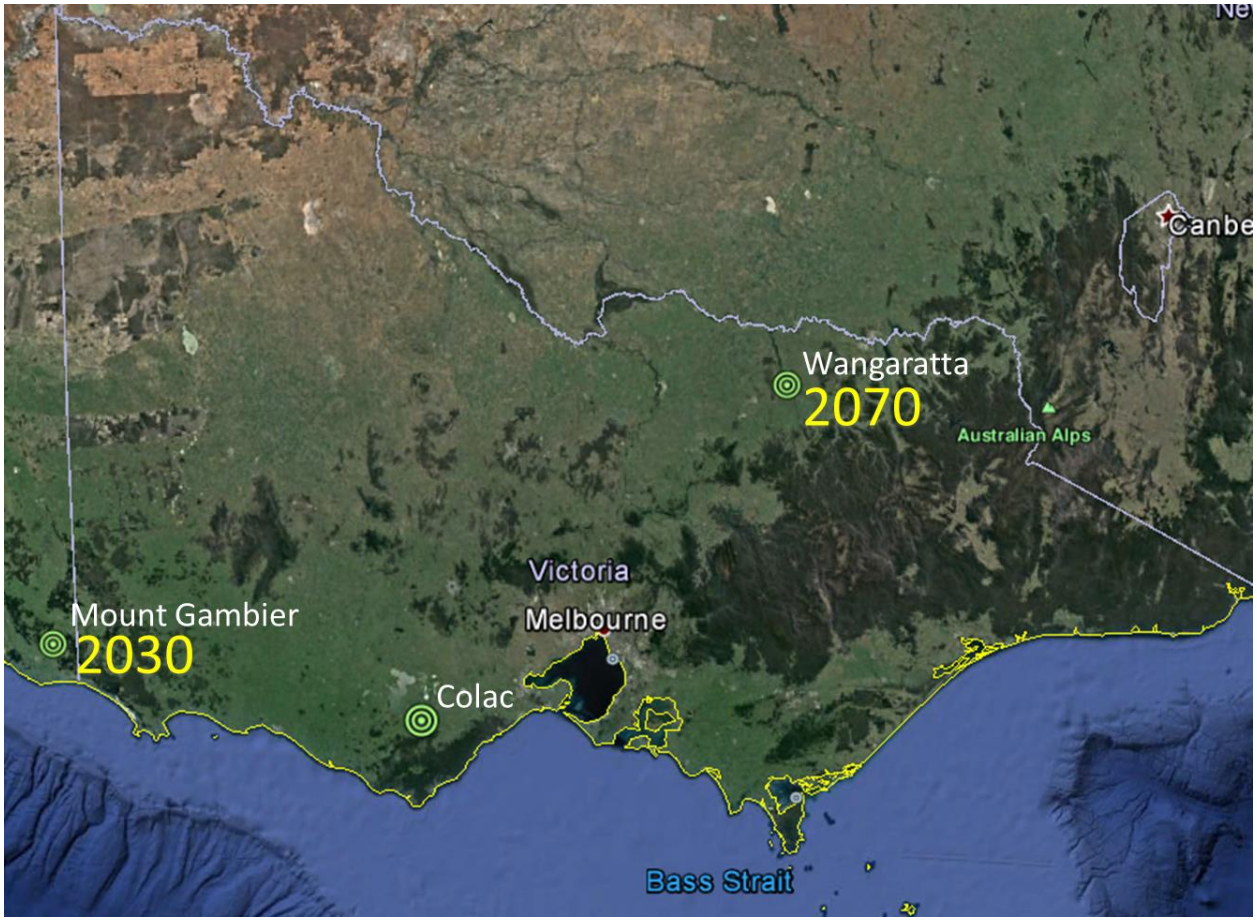

Figure 1 Climate analogues for Colac in 2030 and 2070.

The Colac Otway Shire has two very different climate patterns in the future for the north and south, with the Otway Ranges influencing the south of the Shire. The greatest increase in temperature and drying will occur in the districts within and to the north of Colac where the most sensitive populations live. Coupled with this, the districts to the north east of Colac also have the highest economic and environmental sensitivities.

More detail about the changes of each climate variable are outlined in Table 1 below.

Table 1 Regional climate change projections for the south west region.

Regional change	Temperature	Rainfall	Bushfire	Sea level rise
Historical change[1]	• 1.4- 1.6°C increase since 1950	• 100-200mm decrease since 1950	• n/a	• 22cm rise since 1880 • 7cm rise in Williamstown, since 1970.
2030 forecast change[2]	• 0.6°C increase in average temperature (less in winter) • More days above 40°C single days by 8% and 3 consecutive days by 40%	• Average rainfall 3% lower (highest decrease in Spring). • 3% increase in rainfall events in excess of 50mm.	• 7% increase in Fire conditions index (FFDI).[3] • 20% increase in 'severe' fire danger.	• 0.07-0.19m rise.
2070 forecast change	• 1.9°C increase in average temperature in summer (less in winter) • More days above 40°C- single days by 15% and 3 consecutive days by 67%	• 10% increase in rainfall events in excess of 50mm.	**2090 forecast change**[4] • 10-30% increase in Fire conditions index (FFDI). • 40-100% increase in 'severe' fire danger.	• 0.27-0.89m rise.
What this means for Colac Otway	• Warmer weather, and significantly more extreme heat events. • The northern areas of the Shire (north of Lake Corangamite and Colac) will experience the greatest	• Shire is drier in general, with a decrease in extreme rainfall events • Northern areas of the Shire will be driest (north of Lake Corangamite and Colac). • High terrain areas of the Shire,	• Increase in number of days that emergency services must be 'fire-ready'. • More pre-season preparation required. • Increased vulnerability of those in bushfire prone	• Barham River in Apollo Bay will have the greatest exposure to inundation, which will impact the Great Ocean Road and the Apollo Bay Caravan Park. • The Wye River Caravan

[1] 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

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

[3] 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

[4] ibid

Regional change	Temperature	Rainfall	Bushfire	Sea level rise
	temperature increase. • High terrain areas in the south of the Shire (south of Colac) will experience the least temperature increase.	along the Great Ocean Road, will be the wettest areas. • The shire will have the wettest area in the south west region.	areas.	Park is also expected to be affected by inundation.

2.2 Extreme weather events in the Barwon South West Region

Extreme weather events are unpredictable and unexpected discrete weather events that tend to be dangerous to human health. These lie at the extremes of historical weather distribution for a defined area. Over future decades climate change is projected to increase both the intensity and frequency of these events.

The Barwon South West region has experienced extreme weather in the form of fire, flood and drought, which have had significant impacts on local communities. Recent events include the September 2016 flooding, 2016 Wye River bushfire, the millennial drought, and the flash flooding in Geelong in February 2016. The following case studies provide an overview of the impacts of extreme weather events in Colac Otway.

Wye River Christmas Day Fire
December, 2015

December 2015 was one of the warmest months on record for Australia. On 19 December 2015, lightning ignited a bushfire in the Otway Ranges National Park near Lorne, Victoria. Severe fire weather conditions developed overnight on 24 December, including a strong northerly wind change. This led to the fire jumping containment lines and impacting on the townships of Wye River and Separation Creek early on the morning of 25 December. Cooler conditions and overnight rainfall slowed the fire on the morning of 26 December, however the steep and heavily vegetated terrain continued to burn for several weeks.

No lives were lost as a result of this fire event, however the financial and emotional impact on the communities has been substantial. A total of 109 houses were lost in the Wye River and Separation Creek townships, which equates to approximately 80% of buildings. This included both permanent residents and holiday homes. The damaged bill for the houses loses alone is estimated to be at $38 million. It is therefore estimated that the total costs of this event would be between $60-70 with the inclusion of the costs to coordinate, plan and deliver the required infrastructure and services to rebuild this community.

It is also important to note that the impacts of this event will continue to be felt by this community well into the recovery period, as the actual physical works occur (e.g. government authorities reconstructing public assets such as retaining walls) and private landholders rebuilding their homes.

While this single event cannot be directly linked to climate change, it is an example of the types of scenarios which can be expected to occur more frequently into the future due to a changing climate. Increased annual temperate and decreased annual rainfall will mean that fire seasons will become longer and extreme weather events (such as heat waves) will mean that fire activity is more intense. Therefore, the more effort that Council can do to plan for these events,

the better prepared we will be to withstand and recover from such events.

Figure 2 Wye River Christmas Day Bushfire 2015

Colac Otway Flooding
September, 2016

In September 2016, South West Victoria received an extreme rainfall and flooding event. In the Colac Otway Shire district more than 45 millimetres of rain was received within a 24 hour period.

This event resulted in widespread flooding that affected a range of public and private assets, including roads, bridges and homes. The financial impacts of this event, which includes costs to coordinate the response and recovery, including cleaning blocked drains, waste disposal, landslip repair, footpath replacement, road works and bridge restoration, is estimated to be approximately $4 million dollars.

Colac Otway has experienced these types of flooding events in the past and therefore has an understanding of the resource impacts. However, with the effects of climate change, these events are predicted to become more intense and frequent into the future. Therefore, an opportunity exists to ensure that the infrastructure that we design and construct is resilient enough to withstand these events, which will minimise the recovery costs into the future.

Figure 3 (above) and Figure 4 (below) Colac Otway Flooding, 2016

As an example of the increased frequency of future events, the incidence of exceptional droughts, without action to avoid dangerous climate change, is likely to increase from one every twenty-five years to once every two[5].

[5] *Climate change and extreme weather events*, The Climate Institute

In relation to bushfire, in 2016/17 the potential for the Colac Otway region was projected to be above normal (Figure 5) and by 2050, with a potential global warming of 3°C, days with a 'very extreme' fire weather rating are projected to occur four to five times as often in South-eastern Australia[6].

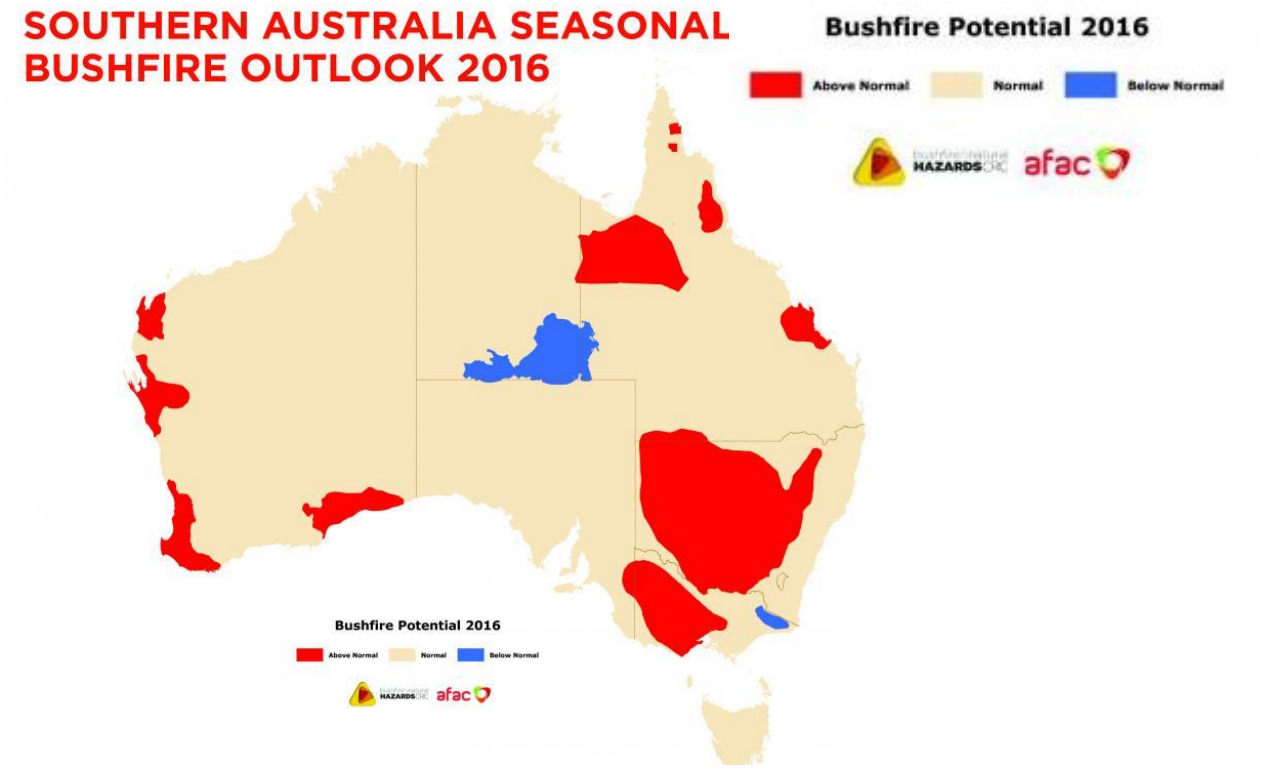

Figure 5 Bushfire Potential 2016[7]

[6] With global warming of 3°C, http://www.climateinstitute.org.au/verve/_resources/BushfireMythsAndFacts1.jpg
[7] https://www.climatecouncil.org.au/bushfire-outlook-2016

3 Vulnerability of the Council to climate change

Vulnerability refers to the degree to which a Council is susceptible to changes in the climate and its potential impacts (Figure 6).

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, as well as the **capacity** to do something about the exposure or susceptibility.

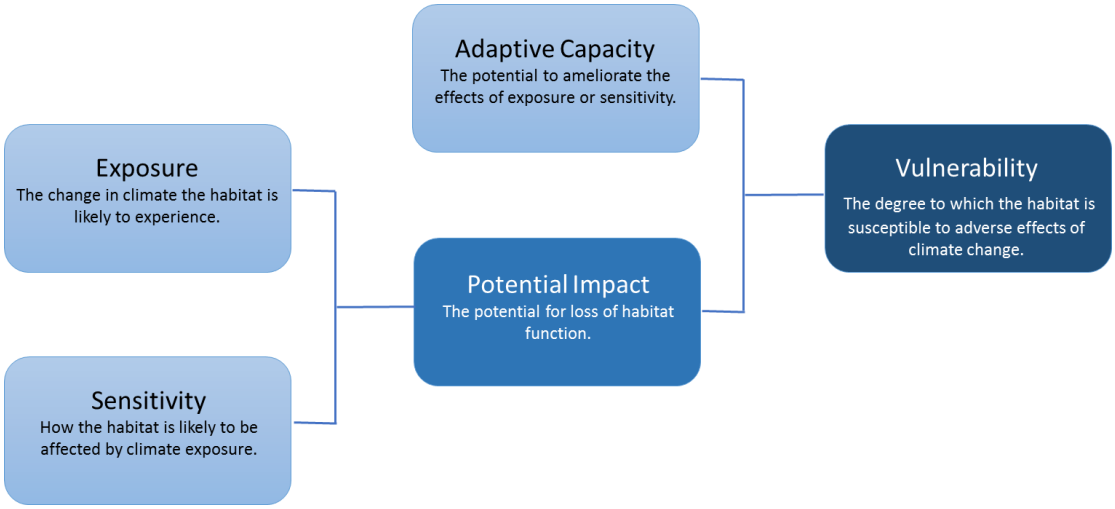

Figure 6 Concept of vulnerability

A vulnerability assessment was undertaken across social, economic and environmental indicators to help identify high priority risks and response actions. Listed below are the data sources that were used to help inform this analysis. Please refer to the Climate Resilient Communities of the Barwon South West Phase One report for further information. It is important to understand this process was undertaken to identify local trends in terms of higher and lower vulnerability. However, the response actions developed are broad and will address risks beyond the local trends.

Social indicators

- Age (above 65 and living alone and full dependant – 4 years and under)
- Household ownership
- Median house income
- Non-English speaking backgrounds
- Population density

Economic indicators

- Areas of economic activity for agriculture
- Soil productivity
- Soil degradation
- Land managed within capability

- Land use
- Areas of economic activity for tourism
- Tourist destination locations
- Water storage levels
- Network peak demand
- Infrastructure type, condition and location

Environmental indicators

- Surface water quality and flows
- Wetland extent and condition
- Native vegetation extent (cover)
- Native vegetation condition
- Landscape connectivity
- Coastal erosion prone areas
- Bushfire prone areas
- Flood prone areas

4 Risk assessment

4.1 Approach

A risk assessment approach was followed to inform the development of this CCAP, to focus the work of the Colac Otway Shire on those most highly rated 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 risks over the immediate (0-5 years) and longer (5-60 years) term. Following the risk identification and assessment process, an interdependency analysis was completed to investigate potential cumulative effects and/or additional consequences that arose between the risks.

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

4.2 Prioritised risks

The highest priority risk is the threat posed by bushfire, with residential homes, council assets and services, and native vegetation all being vulnerable to damage.

The risks associated with a rise in sea level and increased flooding represents another significant risk, where non-council coastal assets, such as ports, and

roads, and council assets, such as marinas and boat ramps may experience some damage. Low lying assets and biodiversity will potentially be impacted as well.

The remaining priority risks include a decrease in potable water supply and an increase in heat stress and solar exposure to the community. These risks have the potential to exacerbate existing social vulnerability factors, which would result in an increased demand on council, emergency and health services. A decline in potable water availability will also likely increase costs, which may impact on community health and wellbeing.

The priority risks for Colac Otway are outlined in Table 2 below.

Table 2 Priority Risks

Priority risk	Asset	Rating 0-5 years	Rating 6-50 years	Council control
Bushfire				
Damage to council (non -building) assets from bushfires	Infra	Medium	Extreme	H
Damage to council buildings from bushfires leading to disruption / loss of services and increased asset renewal costs	Buildings	Medium	High	H
Increased bushfire risk to community homes, which will require more resources for recovery.	Community Wellbeing	High	Extreme	M
Increased intensity and severity of bushfires impacting on native vegetation potentially resulting in fragmentation of habitat and refugia, as well as increased weed infestations.	Natural	Medium	High	L
Flooding and Coastal Inundation				
Increase in localised flooding and incidence of council infrastructure assets being flooded, which will require more resources for recovery.	Infra	Medium	High	H
Disruption to coastal infrastructure e.g. roads reducing access and egress along the coast	Infra	Medium	High	H

Priority risk	Asset	Rating 0-5 years	Rating 6-50 years	Council control
Increased runoff and localised flood events leading to increased incidence of private and community assets being flooded	Community Wellbeing	Medium	High	H
Increase in flood damage to council coastal assets (including marinas and boat ramps) causing restricted access to key council assets in low lying areas	Infra	Medium	High	M
Disruption / erosion of non-council (other govt assets such as surf clubs, Ports) coastal assets and heritage items	Infra	Medium	High	L
Increase in localised flooding damaging low lying natural assets and biodiversity	Natural	Low	High	L
Increased erosion of shore-zones resulting in damage to coastal ecosystems	Natural	Negligible	High	L
Heatwave and water supply				
Increase in heat stress and solar exposure to the community leading to increased heat-related illness	Community Wellbeing	High	Extreme	M
Decreased potable water supply causing increased water restrictions	Community Wellbeing	Medium	High	L
Increased pressure on water supplies resulting in competition for scarce water supply between residents and business	Infra	Medium	High	L

5 Adaptation actions

5.1 Adaptation action occurring already

Council is already responding to the more immediate risks of climate change – those associated with emergency management, impacts on the community and the environment.

Bushfire management

The Otway District Strategic Fire Management Plan was a partnership between the Department of Environment, Land, Water and Planning (DELWP), Parks Victoria, Country Fire Authority (CFA), local government and saw the development of a strategic approach to protecting the vulnerable coastal communities in the Otways.

Community consultation helped to identify locally important social, economic and environmental values, with the planning stage setting objectives that considered these values. Simulations of bushfire growth under set conditions using 'Phoenix RapidFire' – a computer-based tool, helped to show partners and the community likely scenarios in a bushfire event, as well as the benefits that arise when treatments like planned burning takes place. This type of exercise has allowed for more informed and transparent decisions to be made.

Risk Assessments were undertaken of roads within the Colac Otway Shire by VicRoads and Council with respect to vegetation that may pose high risks in the event of bushfire. Roads identified in high risk environments, or as being of high strategic value, have been surveyed by a mixture of Council, VicRoads, DELWP and CFA, and suitable treatments have been prioritised and works plans prepared.

Council has a regularly updated database of individuals who have been identified as vulnerable and to whom Health and Community Care (HACC) services are provided. This database is made available to response agencies in the event of a possible major incident occurring. External health and community agencies who provide direct services to vulnerable individuals within the municipality have also been identified by Council. Each of these agencies maintain lists of clients receiving various services, and a register of these agencies and their contact details can be located in the Municipal Emergency Management Plan. Emergency services may use this information to contact vulnerable individuals in the case of bushfire to assist and ensure safety, in a more targeted manner.

The Colac Otway Shire Fire Management Plan also contains an Implementation of Integrated Fire Management Plan Engagement Process, of which the aim is for communities and organisations to participate together in the collaborative development, delivery and monitoring of local Fire Management Plans.

The Colac Otway Shire Environment Unit has implemented fire management regimes that enhance environmental values. For example, ecological burns have been carried out in partnership with the CFA on high value areas on Council managed land. Burning reduces the available fuel load for fires, therefore reducing the risk of an uncontrolled fire occurring.

In term of infrastructure, non-combustible retaining walls are being installed at Wye River and Separation Creek post bushfire to provide more resilience to future events.

Heatwaves

The Colac Otway Shire Heatwave Plan 2010 has been prepared and implemented. This plan contains information on the health risks posed by heatwaves and treatment advice, power failure advice, relief centres, communications, and HACC.

Actions from this plan include an implemented heat alert system, from the Bureau of Meteorology for the Colac Otway Shire. This threshold is set to 30ºC and is measured by taking the average of the maximum day time and maximum night time temperatures.

Water availability

Water conservation measures such as retrofitting of public toilets and water management actions plans for major users of Council water (i.e. Blue Water Fitness Centre, Sale Yards, Botanic Gardens, Central reserve) have been implemented. Whilst Council have delivered a range water conservation measures at Bluewater and Central Reserve, further opportunities exist given they are both significant water users.

Through the Climate Resilient Communities of the Barwon South West Project, Council is delivering a program that will help assist communities that are not serviced by potable water. Tools being developed include a water calculator, which will help property owners to calculate the amount of catchment and storage they require into the future.

Heavy rainfall/ flooding

Stormwater management has been improved in the Colac Otway Shire (e.g. installation of Gross Pollutant Traps in Colac and Apollo Bay, and construction of the Kennett River Wetland) and revegetation projects along waterways such as Lake Colac and Barongarook Creek have been undertaken to improve water quality.

The Colac Council Plan 2013-2017 identifies the need to ensure the impacts of human settlement on the environment are minimised and that significant landscapes and natural assets need to be protected – including the natural functions of the region's waterways, wetlands, riparian areas and floodplains.

The impacts of climate change on Apollo Bay have also been modelled and costed, based on expected sea level rise and higher intensity of rainfall.

5.2 Prioritised adaptation actions

Council has prioritised adaptation actions to respond to the identified high climate risks. As part of the plan's development, workshops were held with staff responsible for the management of each of the priority risks. These workshops identified and prioritised actions to manage each prioritised risk.

Research, policy and design, structural and behavioural types of actions were identified and then prioritised.

Outlined below are the prioritised adaptation actions for Council that cut across three key areas of action.

A. Bushfire

A.1. Build community awareness through community based fire planning for bushfire management by:

A.1.1. Integrating bushfire risk management approaches into fire resilient landscaping booklet.

A.1.2. Creating information pack to provide community and Council staff with clear steps to mitigate bushfire risk to the home and Council assets. Include information about retrofitting homes to meet relevant standards.

A.1.3. Working with tourism operators and holiday rental owners to raise awareness and build capacity of the sector to understand bushfire risk.

A.2. Build new/replace old retaining walls on Council managed land in highest fire risk towns, using non-combustible materials.

A.3. Undertake fire resilience asset (building and non-building) vulnerability assessment, using criticality as a prioritisation process.

A.4. Embed fire proofing adaptation into asset development and maintenance processes.

A.5. Incorporate climate change considerations and projections in the review of Fire Management Plan and Fire Inspection Program to target the highest risk areas.

A.6. Work in partnership with other agencies to monitor and develop a greater understanding of the impacts of more frequent and intense fire activity on vegetation communities and strategically improve habitat linkages and vectors of movement of fauna.

A.7. Identify appropriate tree species for selection in bushfire interface zones, and educate the community on this.

B. Flooding and coastal inundation

B.1. Incorporate climate change projections into future flood studies and integrate into our flood management and inundation management, responses and policies.

B.2. Complete the Local Coastal Hazard Assessment and explore opportunities to embed results into planning scheme.

B.3. Expand the scope of the LCHA to allow funding to be accessed through the Victorian Floodplain Management Strategy for overland flooding.

B.4. Screen relevant specifications and models to incorporate climate change projections, and ensure agility for future projections.

B.5. Consider including climate change projections for new development.

C. Heatwaves and water supply

C.1 Develop standard stormwater policy, which incorporates opportunities to harvest and reuse stormwater from council buildings, reserves and other facilities.

C.2. Review heatwave strategy and existing strategies relating to people/ community services, and urban planning and streetscapes, for climate change considerations and incorporate where gaps exist.

C.3. Investigate expanding bushfire events cancellation and postpone policy to include heatwaves.

C.4. Identify triggers that will restrict council services during heatwaves and develop a contingency plan for times when council outdoor services will be unavailable.

C.5. Improve and maximise shade in both public and private sphere:

C.5.1.1. In public spaces, in particular play spaces, align with Council's Open Space Strategy, Playspace Strategy and Play Australia standards and ensure adequate consideration of climate change.

C.5.1.2 Consider incentives to support businesses to extend verandas to provide shade in summer, protection in winter as a mechanism to activate the Colac CBD.

C.6. Implement Colac Urban Forest Strategy, Integrated Water Catchment Management Plan, Lake Colac Master Plan and CBD and Entrance Strategy.

C.6.1. Extend Urban Forest Strategy to include Apollo Bay.

C.7. Participate in the state and regional resilience planning projects.

C.8. Develop a water use and monitoring project at Council reserves – install soil moisture sensors in specific Council reserves and open spaces to determine effective watering regimes.

C.9. Install automated irrigation systems to better control water use at recreation reserves.

C.10. Implement a water supply resilience project for non-reticulated communities.

6 Implementation plan

The following table outlines the implementation plan for the adaptation actions in Section 5.2. As actions are completed, new ones will be generated to address priority risks.

Table 3 Climate change action implementation plan

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
Action theme: A. Bushfire					
A.1. Build community awareness through community based fire planning on bushfire management by: A.1.1. Integrating bushfire risk management approaches into fire resilient landscaping booklet. A.1.2. Creating information pack to provide community and Council staff with clear steps to mitigate bushfire risk to the home and Council assets. Include information about retrofitting homes to meet relevant standards.	A.1.1 • Review existing bushfire risk management information. • Determine bushfire risk management actions relevant to vegetation recovery • Incorporate into fire resilient landscaping booklet • Distribute to community • Embed within Council processes. • Consider opportunities to develop further iterations of the booklet for broader landscapes (coastal, inland) A.1.2 • Research steps to	• Increased bushfire risk to community homes, which will require more resources for recovery. • Increased intensity and severity of bushfires impacting on native vegetation potentially resulting in fragmentation of habitat and refugia, as well as increased weed infestations.	**Action owner:** Environment Community Safety Manager **Partnerships** Country Fire Authority (CFA) Emergency Management Victoria (EMV) Department of Environment Land Water and Planning (DELWP)	1. Landscape booklets launched with integrated bushfire risk management approaches. 2. Information pack distributed to target high risk towns and Council staff. 3. 20 holiday rentals have emergency procedures in place.	December 2020

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
A.1.3. Working with tourism operators and holiday rental owners to raise awareness and build capacity of the sector to understand bushfire risk.	mitigate bushfire risk to homes and review Wye River/Separation Creek guidelines (EMV guidelines) • Prepare information packs • Distribute to and engage with community and Council staff • Request community and Council staff feedback to monitor usefulness of information. A.1.3 • Develop materials for tourism operators to ensure the sector and tourists are aware of what to do in an emergency (especially bush fires) • Distribute material to holiday rental properties.				
A.2. Build new/replace old retaining walls on Council managed land in highest fire risk towns, using non-combustible materials.	• Highest fire risk town identified in Municipal Fire Management Plan • Embed non-combustible retaining wall replacement approach into asset maintenance	• Damage to council (non -building) assets from bushfires • Damage to council buildings from bushfires leading to disruption / loss of services and increased	**Action owner:** Assets & Property Services Planning, Building and Health Manager	1. All new Council retaining walls in high risk towns are made from non-combustible materials. 2. Planning permits approved with non-combustible materials	December 2020

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
	processes. • Apply requirements through planning permits around non-combustible materials.	asset renewal costs		for retaining walls in close proximity to private homes.	
A.3. Undertake fire resilience asset (building and non-building) vulnerability assessment, using criticality as a prioritisation process.	• Undertake climate change asset vulnerability assessment • Prioritise assessment using criticality • Develop implementation plan, including the identification of actions and project set up.	• Damage to council (non -building) assets from bushfires • Damage to council buildings from bushfires leading to disruption / loss of services and increased asset renewal costs	**Action owner:** Assets & Property Services Manager **Internal partnerships:** Services & Operations Manager Environment and Sustainability	1. Fire resilience asset vulnerability assessment complete. 2. Actions incorporated into asset renewal process.	December 2021
A.4. Embed fire proofing adaptation into asset development and maintenance processes.	• Develop guidelines to assess new assets • Review asset development and maintenance tools to identify areas for embedding climate change adaptation. • Cross reference with other local governments and best practice approaches • Integrate climate change adaptation within existing tools to track and identify	• Damage to council (non -building) assets from bushfires • Damage to council buildings from bushfires leading to disruption / loss of services and increased asset renewal costs • All flooding and coastal inundation risks	**Action owner:** Assets & Property Services Manager **Internal partnerships:** Services & Operations Manager Environment and Sustainability	1. New assets are constructed with fire proofing measures.	December 2021

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
	assets requiring upgrades, maintenance and renewals				
A.5. Incorporate climate change considerations and projections in the review of Fire Management Plan and Fire Inspection Program to target the highest risk areas.	• Screen Fire Management Plan and Fire Inspection Program for climate change. • Research climate change projections and incorporate within the Fire Inspection Program. • Update Fire Management Plan or other relevant documentation for climate projections • Roll out fire inspections program • Regularly update climate change risks and latest projections.	• Increased bushfire risk to community homes, which will require more resources for recovery.	**Action owner:** Environment and Community Safety Manager	1. Climate change forecasts incorporated into Fire Management Plan.	December 2018
A.6. Work in partnership with other agencies to monitor and develop a greater understanding of more frequent and intense fire activity on vegetation communities and strategically improve	• Identify key agencies for partnership development • Develop methodology for understanding climate change impacts on vegetation communities.	• Increased intensity and severity of bushfires impacting on native vegetation potentially resulting in fragmentation of habitat and refugia, as well as increased weed infestations.	**Action owner:** Environment and Community Safety Manager **Partnership** Operations services	1. Partnership agreements made with identified agencies. 2. Impacts of climate change on vegetation identified and assessed	December 2022

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
habitat linkages and vectors of movement of fauna.					
A.7. Identify appropriate tree species for selection in bushfire interface zones, and educate the community on this.	• Research appropriate tree species for bushfire (balance with the objectives of the urban forests strategy) • Engage and educate community on findings	• Increased intensity and severity of bushfires impacting on native vegetation potentially resulting in fragmentation of habitat and refugia, as well as increased weed infestations.	**Action owner:** Environment and Community Safety Manager **Partnership** Operations services	1. Inform the community about the outcomes and the most appropriate species to plant.	December 2020
Action theme: B. Flooding and coastal inundation					
B.1. Incorporate climate change projections into future flood studies and integrate into our flood management and inundation management, responses and policies.	• Screen our drainage studies across the Shire for projected climate change. • Integrate updated projection within flood management and inundation management, responses and policies. • Include in new development requirements	All flooding and coastal inundation risks with the **exception** of increased erosion of shore-zones resulting in damage to coastal ecosystems.	**Action owner:** Assets and Property Planning, Building and Health Manager	1. Drainage studies incorporate projected climate change. 2. Climate projections are integrated into flood and inundation management, responses and policies. 3. Updated flood mapping included within Planning Scheme.	December 2020
B.2. Complete the Local Coastal Hazard Assessment (LCHA) and explore opportunities to embed	• Design scope of local coastal hazard assessment project to focus on key risk areas.	• Disruption to coastal infrastructure e.g. roads reducing access and egress along the coast.	**Action owner:** Environment Community Safety Manager.	1. Local Coastal Hazard Assessment completed.	December 2021

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
results into planning scheme..	• Undertake a local coastal hazard assessment Explore opportunities to embed results into planning scheme in partnership with DELWP.	• Increase in flood damage to council coastal assets (including marinas and boat ramps) causing restricted access to key council assets in low lying areas. • Disruption / erosion of non-council (other government assets such as surf clubs, Ports) coastal assets and heritage items. • Increase in localised flooding damaging low lying natural assets and biodiversity. • Increased erosion of shore-zones resulting in damage to coastal ecosystems.			
B.3. Expand the scope of the LCHA to allow funding to be accessed through the Victorian Floodplain Management Strategy for overland flooding.	• Prepare and submit grant application	• Increase in localised flooding and incidence of council infrastructure assets being flooded. • Disruption to coastal infrastructure e.g. roads reducing access and egress along the coast • Increased runoff and	**Action owner:** Environment Community Safety Manager	1. Grant funding application submitted to complete full LCHA.	December 2018

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
		localised flood events leading to increased incidence of private and community assets being flooded • Increase in flood damage to council coastal assets (including marinas and boat ramps) causing restricted access to key council assets in low lying areas • Increase in localised flooding damaging low lying natural assets and biodiversity			
B.4. Screen relevant specifications and models to incorporate climate change projections and ensure agility for future projections.	• Screen relevant specifications and models • Integrate climate change projections • Schedule periodic review to ensure agility for future projections updates.	• All flooding and coastal inundation risks	**Action owner:** Information Services Manager	1. Relevant specifications and models have been screened and climate change has been incorporated.	December 2018
B.5. Consider including climate change projections for new development	• Identify opportunities to include climate change projections in the design phase of new developments. • Undertake stakeholder engagement to seek feedback.	• Increased runoff and localised flood events leading to increased incidence of private and community assets being flooded • Increase in localised flooding and incidence	**Action owner:** Planning Manager	1. Opportunities identified for considering climate. change projections in new developments.	December 2020

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
	• Refine and explore avenues for implementation	of council infrastructure assets being flooded. • Disruption to coastal infrastructure e.g. roads reducing access and egress along the coast.			
Action Theme: C. Heatwaves and Water Supply					
C.1. Develop standard stormwater policy, which incorporates opportunities to harvest and reuse stormwater and water from council buildings, reserves and other facilities.	• Review the Sustainable Water Use Plan • Research stormwater policy requirements, specifications and definitions • Develop policy link to broader water use guidelines • Identify areas where water can be used Embed policy within Council processes and procedures.	• Increase in localised flooding and incidence of council infrastructure assets being flooded. • Disruption to coastal infrastructure e.g. roads reducing access and egress along the coast • Increased runoff and localised flood events leading to increased incidence of private and community assets being flooded. • Increase in localised flooding damaging low lying natural assets and biodiversity. • Increased erosion of shore-zones resulting in damage to coastal ecosystems	**Action owner:** Infrastructure & leisure Services General Manager **Partner** Environment and Sustainability	1. Stormwater policy developed.	December 2022

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
C.2. Review heatwave strategy and existing strategies relating to people/ community services, and urban planning and streetscapes, for climate change considerations and incorporate where gaps exist.	• Screen existing strategies for climate change • Update strategies where gaps exist.	All heatwave and water supply risks (Table 2)	**Action owner:** Development and Community Services General Manager	1. Climate change considerations are integrated into heatwave strategy.	December 2018
C.3. Investigate expanding bushfire events cancellation and postpone policy to include heatwaves.	• Specify criteria for heatwaves and incorporate within the policy	• Increase in heat stress and solar exposure to the community leading to increased heat-related illness	**Action owner:** Community Services Manager	1. Policy includes provision for heatwaves.	December 2018
C.4. Identify triggers that will restrict council services during heatwaves and develop a contingency plan for times when council outdoor services will be unavailable.	• Research and develop heatwave triggers • Develop contingency plan when thresholds are reached • Design and deliver training to educate staff and enforce plan	• Increase in heat stress and solar exposure to the community leading to increased heat-related illness	**Action owner:** Community Services Manager	1. Triggers have been identified. 2. Contingency plan has been developed and implemented.	December 2018
C.5. Improve and maximise shade in both public and private sphere: C.5.1. In public spaces, in particular play spaces, align with Council's Open Space Strategy,	C.5.1. • Map areas to maximise shade in public spaces across the Shire. • Prioritise locations for investment in shading assets including tree planting.	• Increase in heat stress and solar exposure to the community leading to increased heat-related illness.	**Action owner:** Infrastructure & Leisure Services.	1. Plant 50 shade trees in public open spaces.	December 2020

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
Playspace Strategy and Play Australia standards and ensure adequate consideration for climate change. C.5.2. In private sphere, provide grants to support businesses to extend verandas to provide shade in summer, protection in winter as a mechanism to activate the Colac CBD.	• Invest and install shade assets C.5.2. • Define business case for shade grants for private sector • Define criteria for grant support, including alignment with relevant strategies (Urban Forest, CBD & Entrance Strategies) • Allocate funding for grant scheme • Implement • Monitor outcomes of scheme.				
C.6. Implement Colac Urban Forest Strategy, Integrated Water Catchment Management Plan, Lake Colac Master Plan and CBD and Entrance Strategy. C.6.1 Extend Urban Forest Strategy to include Apollo Bay.	• Expand Urban Forest Strategy to include Apollo Bay. • Implement Urban Forest Strategy. • Implement CBD and Entrance Strategy	• Increase in heat stress and solar exposure to the community leading to increased heat-related illness. • Decreased potable water supply causing increased water restrictions	**Action owner:** Capital & major projects Manager.	1. Tangible actions from each of the plans either commenced or completed. 2. Promotion of these outcomes to the community.	Ongoing
C.7. Participate in the state and regional resilience	• Engage with project team	All heatwave and water supply risks.	**Action owner:** Development &	1. Engagement and participation in DHHS	Ongoing

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
planning projects.	• Co-design planning program • Implement program		Community Services	resilience planning program. 2. Implementation of resilience planning.	
C.8. Develop a water use and monitoring project at Council reserves – install soil moisture sensors in specific Council reserves and open spaces to determine effective watering regimes.	• Determine which reserves and open spaces to target • Research optimal areas to place soil moisture sensors. • Use information to determine and develop a water monitoring regime. • Implement water monitoring regime and adjust watering practices based on project learnings Connect with outcomes of Stormwater Policy	• Decreased potable water supply causing increased water restrictions • Increased pressure on water supplies resulting in competition for scarce water supply between residents and business	**Action owner:** Services & Operations Manager.	1. Soil moisture sensors installed and capture data. 2. Watering regime determined for Colac reserves. 3. Colac reserves are adequately watered.	December 2022
C.9. Install automated irrigation systems to better control water use at recreation reserves	• Determine which reserves and open spaces to target • Engage professional consultant to provide advice and design the required system. • Ensure that a management/monitoring program is in place.	• Decreased potable water supply causing increased water restrictions • Increased pressure on water supplies resulting in competition for scarce water supply between residents and business.	**Action owner:** Services & Operations Manager.	1. Automatic watering system installed. 2. Regular monitoring of use being undertaken.	December 2022

Action	Action activities	Relevant risks	Action owner and partnerships	KPIs	Timelines
C.10. Implement a water supply resilience project for non-reticulated communities.	• Research and develop area specific water resilience project for non-reticulated properties. • Implement project, incorporating community engagement.	• Decreased potable water supply causing increased water restrictions • Increased pressure on water supplies resulting in competition for scarce water supply between residents and business	**Action owner:** Environment Community Safety Manager	1. Water supply resilience project delivered.	December 2017

Appendix A Risk Assessment Procedure

Overview

The risk management process followed for Climate Resilient Communities of the Barwon South West (BSW), Phase 2, was in accordance with the AS5334:2013 *Climate change adaptation for settlements and infrastructure — A risk based approach*. The publication of this standard 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 7).

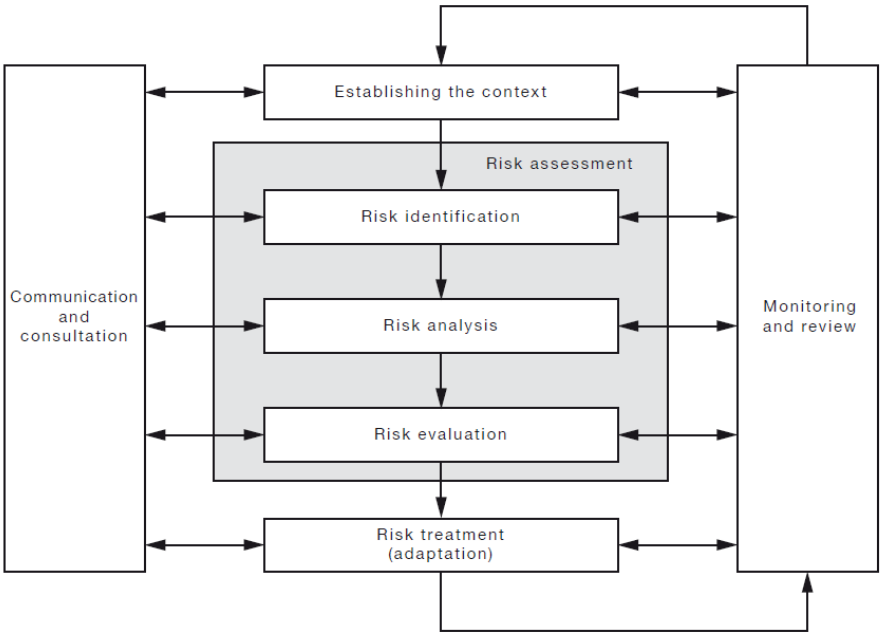

Figure 7 Risk Assessment approach (adapted from AS/NZS ISO 31000).

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 8 below).

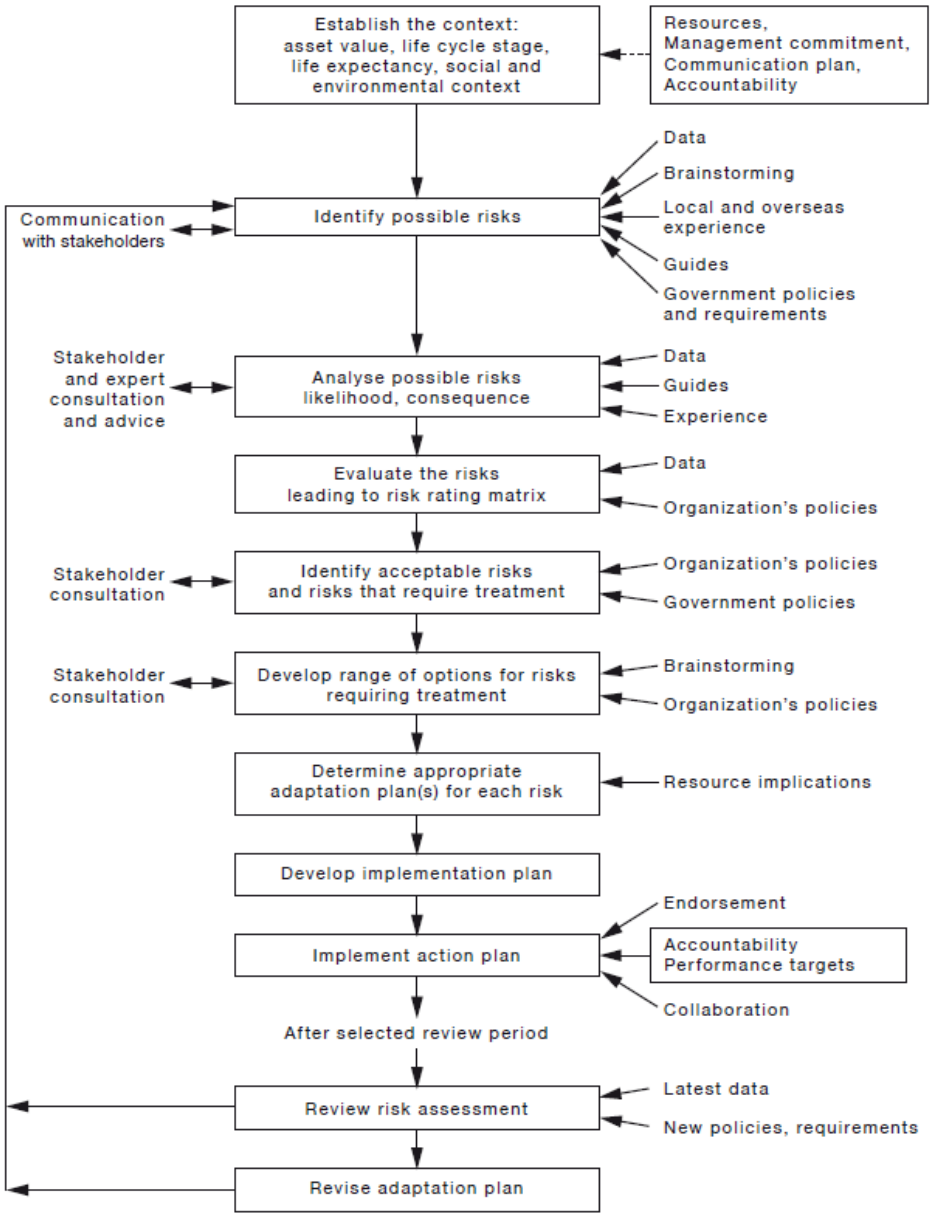

Figure 8 Risk Assessment Process (AS 5334-2013)

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.

Likelihood

All Council's within BSW utilised the likelihood rating system shown below when analysing risks.

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

Table 4 Likelihood Table

Consequence

As with likelihood for risk assessments to be effective a structured approach is required across the organisation to assessing consequence. **Error! Reference source not found.**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.

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

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

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)
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

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)
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

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)
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

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 BSW. 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 BSW 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 5 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.

		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	

Table 5 Likelihood x Consequence risk matrix.

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 (Figure 9), 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.

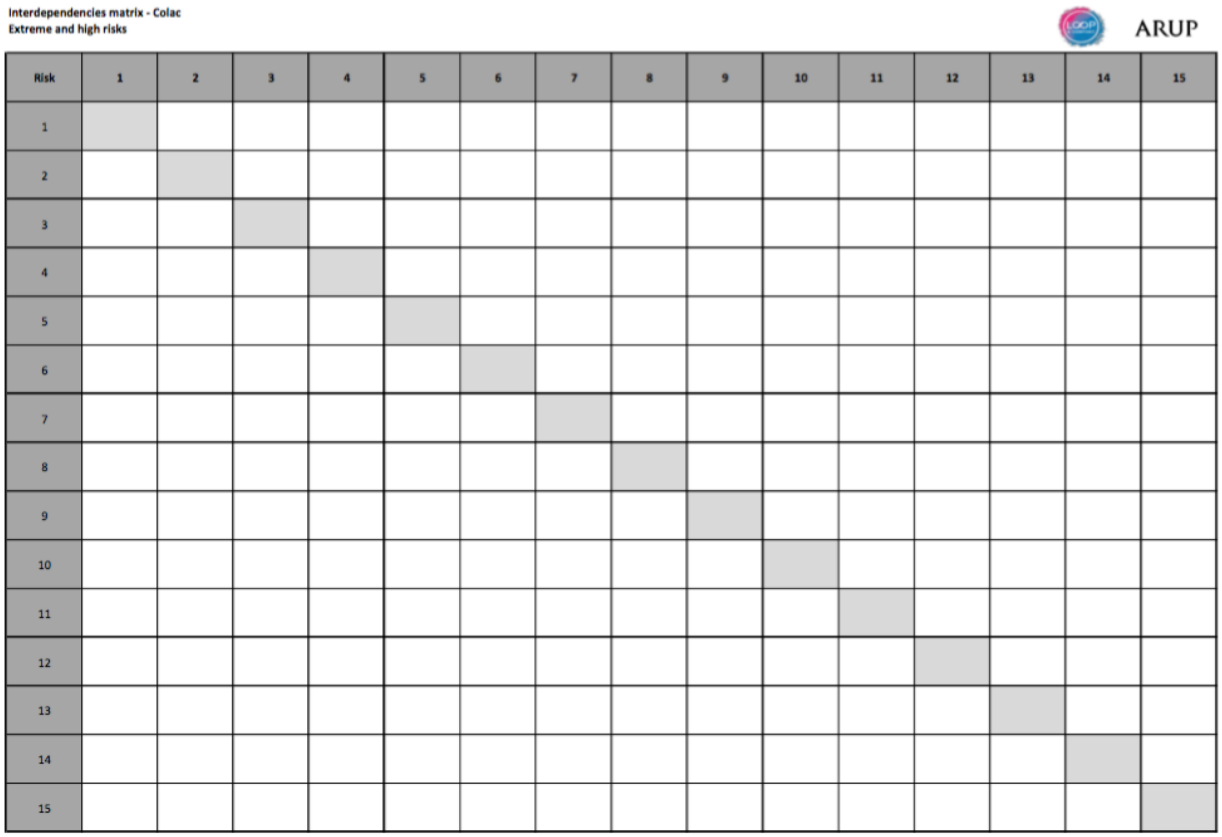

Figure 9: Interdependency matrix used in interdependency discussions - each risk included holds an opportunity to interact with the other risks