



**FINAL REPORT**

DECEMBER 2011

# Strengthening Strathbogie in a Changing Climate: Risk Assessment and Adaptation Strategy

Report prepared for Strathbogie Shire Council



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Cover photos: Main, bushfire smoke near Strathbogie Ranges (J Washusen). Top left, creek bed Boho 2007 (J. Washusen). Top right, flood waters near Euroa, 2010 (unkown).

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# Executive summary

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## Introduction

- ES.1. Natural climate variability and associated natural disasters have long been a fact of life for communities in the Shire of Strathbogie. Prolonged drought throughout the Shire in the 1990s and 2000s, followed more recently by floods, could be viewed as just the latest examples of the fickleness of ‘mother nature’. Even so, the recent droughts and floods have come at significant cost – economic, social and environmental – to the Shire.
- ES.2. The importance of planning for climate change, in particular to reduced water availability and increased rainfall variability, is recognised by the Strathbogie Shire Council which has secured funding through the Australian Government’s *Strengthening Basin Communities* program to assist in community-wide planning for climate change through development of a climate change adaptation strategy.

## Context

- ES.3. The Shire of Strathbogie is likely to be warmer in the future, with rainfall becoming less reliable and more extreme. Increased rainfall variability, combined with higher average and extreme temperatures, points to an increase in drought severity and maybe drought frequency for Strathbogie Shire in the future. The length of the fire season is likely to increase as well.
- ES.4. The climate changes outlined above could result in a range of impacts – some positive, but many negative – to the Shire of Strathbogie’s natural and physical assets, as well as to major industries and infrastructure within the Shire. Impacts on these systems will, in turn, have indirect economic and social effects as well as implications for the delivery of local community services provided by Strathbogie Shire Council.
- ES.5. A commonly used framework for assessing the vulnerability of a community or region to climate change is to consider vulnerability as a function of potential climate change impacts and the *adaptive capacity* of the community. Compared to other regions in Victoria and Australia, the Strathbogie Shire appears to have fewer resources (e.g. financial, physical and human capital) available to adapt to climate change and other structural pressures. On the other hand, communities in Strathbogie Shire appear to have substantial resources of social capital – strong social relationships and bonds within the community.

## Risk assessment

- ES.6. The purpose of the risk assessment was to explore the full range of potential risks posed by climate change and climate variability and to prioritise those risks for Council, the broader community and partners organisations involved in the project.
- ES.7. The assessment followed the approach set out in the Australian Greenhouse Office / Department of Climate Change publication, *Climate Change Impacts and Risk*

*Management: A Guide for Business and Government* (the Guide), which is based on the Standard AS/NZS 4360 / ISO 31000 for Risk Management.

- ES.8. The assessment encompasses all of the roles and responsibilities of Council that may be affected by climate change, in particular increased rainfall variability and reduced water availability. Risks were considered under five major categories (or key elements) – ‘Infrastructure’, ‘Planning & Economic Development’, and ‘Emergency Management’ ‘Community’ and ‘Environment’.
- ES.9. Risks were examined and rated over current, medium (2030) and long term (2070) time horizons, using a qualitative risk evaluation framework (e.g. likelihood and consequence scales). The risk assessment commenced with a workshop involving councillors and council staff, and was completed via a series of follow-up consultations with community groups, agencies and other organisations.
- ES.10. Over 50 risks were identified, discussed and rated during or following the risk assessment workshop.
- ES.11. Eight risks (~ 16% of all risks) are rated as *Extreme*, with a further 26 (~51% of all risks) are rated as *High*, in the current period. Thus there is a predominance of *High* and *Extreme* rated risks in the current period. The number of *High* and *Extreme* rated risks increases marginally to 35 (~ 69% of all risks) in the medium and 36 (~ 71% of all risk) long term.
- ES.12. There is a similar proportion of *High* and *Extreme* rated risks across all five key elements and across the three time periods. However, the Infrastructure, Planning & Economic Development, and Emergency Management key elements have higher number of risks than the Community and Environment key elements.
- ES.13. Factors influencing *High* and *Extreme* risk ratings vary from risk to risk and can be quite complex, but in most cases a *High* or *Extreme* rating reflects a moderate to high sensitivity of Council to that risk and a view that existing controls will not be sufficient to mitigate the risk, if the impacts associated with climate change become more marked in the future.
- ES.14. Many of the risks that are *High* and/or *Extreme* in the short to medium terms relate to impacts that Council and/or the wider community already have experienced difficulties in coping with due to:
- increased frequency of intense rainfall events and flooding (e.g. risks 1.02, 1.03, 1.06, 2.01, 3.03a);
  - prolonged drought (e.g. risks 1.09, 1.10, 1.11, 2.02, 3.02); or
  - multiple climate and non-climate pressures (e.g. risk 2.03, 2.06, 2.07, 2.10, 3.01, 3.05, 3.07, 3.08, 4.04, 4.05, 4.06, 5.04, 5.05, 5.07).

## Adaptation strategy

- ES.15. Climate change adaptation can be defined as ‘actions taken in response to actual or anticipated climate change impacts that lead to a reduction in risks or realisation of benefits’. Adaptation can be viewed as a planned, proactive response to climate change and, as such, can be distinguished from reactive adjustments to climate change impacts after they have occurred.

- ES.16. Actions considered for the Adaptation Strategy are wide-ranging and include changes to revised strategies and plans, changes to statutory planning, improved decision making processes and procedures, on the ground works, education and training, monitoring and data collection, and research.
- ES.17. It is important that their adaptation actions are well considered and designed prior to implementation. The following generic principles underpin adaptation actions proposed in the Adaptation Strategy:
- focus on priority climate change issues;
  - use an adaptive management approach (i.e. flexible, incremental changes);
  - avoid adaptation constraining decisions or maladaptation;
  - achieve balance between climate and non-climate risks; and
  - prioritise actions.
- ES.18. Development of the Adaptation Strategy centred on workshops and consultations with Council staff and councillors, other agencies and authorities and community organisations. The adaptation planning process entailed five major steps:
- priority risk selection;
  - grouping of priority risks into subsets to enable risks that have significant similarities to be considered collectively in the adaptation planning process;
  - identifying and reviewing existing controls;
  - identifying new and revised actions; and
  - consolidation of inputs and further analysis.

## Recommended actions for priority risks

- ES.19. This section presents recommended actions to deal with priority climate change risks. Risks rated 'High' or 'Extreme'. Priority risks addressed by actions include risks relating to emergency management, social and community, environmental management, infrastructure & assets planning and economic development.
- ES.20. It is important to note that implementation of these actions by Council and other agencies and/or organisations will depend on available resources.
- ES.21. Table ES 1 to Table ES 6 following provide summaries of recommended actions, proposed implementing organisations and implementation timeframes.

**Table ES 1: Emergency Management – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations <sup>1</sup>	Implementation Timeframe <sup>2</sup>	
<b>Subset A – Isolation of communities</b>				
<ul style="list-style-type: none"> <li>– increasing pressures due to climate change have not yet been adequately addressed in the MEMP</li> <li>– need for better integration of all risk and hazard assessments and planning to ensure efficient prevention of and response to emergencies</li> <li>– sufficient and timely funding for transport route upgrades within the Shire is an ongoing issue; and</li> <li>– lack of neighbourhood Safer Places in the Strathbogie Ranges.</li> </ul>	A1.	Conduct a review of the emergency response framework, Municipal Emergency Management Plan (MEMP) and sub-plans, and relationships for the Shire to identify existing limitations with the MEMP and provide recommendations and tools to improve the capacity of the Council, and emergency service agencies to manage projected increases in extreme events from an emergency response perspective.	<b>Municipal Emergency Management Planning Committee (MEMPC)</b>	Short-term
	A2.	Develop a community awareness program to promote increased household preparedness for floods and bushfires.	<b>MEMPC</b>	Short-term
	A3.	Investigate potential additional Neighbourhood Safer Places, in particular near the Strathbogie Ranges, and inform the community about these places.	<b>MEMPC</b>	Short-term
<b>Subset B – Staff &amp; volunteer shortages</b>				
<ul style="list-style-type: none"> <li>– Disaster Recovery and Business Continuity Plan needs to be reviewed in light of potential increases in the frequency or severity of extreme weather events; and</li> </ul>	B1.	Review and extend Council’s Business Continuity Plan to ensure that it can cope with the impacts of climate change and extreme weather events on staff resources and service provision.	<b>Strathbogie Shire Council (SSC)</b> (risk management committee)	Short-term
	B2.	See Action A1 (Review of existing emergency response framework, MEMP, sub-plans and relationships).	<b>MEMPC</b>	Short-term

<sup>1</sup> Suggested lead organisation is indicated in bold, where that is clear. Order of organisations in list is not necessarily an indication of their relative importance to the action.

<sup>2</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations <sup>1</sup>	Implementation Timeframe <sup>2</sup>
<ul style="list-style-type: none"> <li>Improvement of community information and education on emergency response and importance of self-preparedness.</li> </ul>	<p>B3. Develop a recruitment and succession strategy to ensure all roles and responsibilities outlined in the MEMP are adequately resourced.</p>	<p><b>SSC</b> (human resources and emergency management team)</p>	<p>Medium-term</p>
	<p>B4. Develop an inter-agency recruitment and succession strategy with the aim of ensuring adequate resourcing for all organisations within the Shire that are dependent on volunteers.</p>	<p><b>MEMPC</b></p>	<p>Short-term</p>
<p><b>Subset c – Bushfire management &amp; response</b></p>			
<ul style="list-style-type: none"> <li>significant water shortages were evident through the extended drought of the 2000s (incl. in the vicinity of major towns), which could have had serious consequences for fire fighting and the protection of life and property had a major fire broken out in the Shire in that period; and</li> <li>need to translate some of these recommendations re resolving tensions between bushfire management and biodiversity protection objectives made by the 2009 Victorian Bushfire Royal Commission to the local level through better integration of relevant strategies and plans.</li> </ul>	<p>C1. Review fire management plans for the Shire and associated components of the Victorian Fire Risk Register, to ensure availability of suitable water supplies for fire suppression.  Identify existing or potential new water supply sources, which could be quarantined for bushfire fighting during the fire season.</p>	<p><b>MEMPC</b>, Goulburn Valley Water (GVW)</p>	<p>Long-term</p>
	<p>C2. Instigate a Shire wide process to remove uncertainties and inconsistencies between bushfire management and native vegetation management objectives in the Shire, including through:</p> <ul style="list-style-type: none"> <li>discussions with DSE and DPCD about changes to be implemented as a consequence of the Bushfire Royal Commission recommendations; and</li> <li>facilitation of discussions between the MEMPC and relevant environmental protection agencies and community organisations.</li> </ul>	<p>MEMPC, SSC Environmental Sustainability Committee, Department of Sustainability &amp; Environment (DSE), Department of Planning &amp; Community Development (DPCD), Goulburn Broken CMA (GBCMA)</p>	<p>Medium-term</p>

**Table ES 2: Social and Community – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>3</sup>
<b>Subset D – Public Health</b>			
<ul style="list-style-type: none"> <li>the Heatwave Plan’s effectiveness has yet to be tested in a major heatwave and it is important that the Plan and the measures it contains are fully communicated to the community;</li> </ul>	D1. Review existing heatwave refuges and investigate possible new refuges, ensuring accessibility to all community members and that suitable air conditioning and back-up power supplies (e.g. generators) are in place.	<b>SSC</b>	Short-term
<ul style="list-style-type: none"> <li>community information about the importance of taking extra food safety precautions (in the home) on extreme heat days; and</li> </ul>	D2. Investigate potential Commonwealth and state funding sources for increasing the uptake of photo-voltaic systems by Strathbogie residents.	<b>SSC</b>	Short-term
<ul style="list-style-type: none"> <li>unclear, wether cool places / heat refuges have emergency back-up power supplies, which is critical issue in the event of power black-outs or brown-outs.</li> </ul>	D3. Review tree and vegetation management and investigate ways to provide additional shading for buildings and roads through trees and other vegetation.	<b>SSC</b>	Short-term
	D4. Ensure that the Heat Wave Plan is fully integrated into the Municipal Emergency Management Plan (MEMPC).	<b>SSC, MEMPC</b>	Short-term
<b>Subset E – Community wellbeing</b>			
<ul style="list-style-type: none"> <li>scope to further empower local communities, to increase the level of civic engagement, networking and connectedness within local communities; and</li> </ul>	E1. Implement a local Community Neighbourhood program in each of the Shire’s major towns to build a sense of community and empower local communities by encouraging people to get to know their neighbours, supporting local networks and participating in local community activities and organisations.	SSC, township community action groups	Short-term
<ul style="list-style-type: none"> <li>need to improve and strengthen the relationship and communication between Council</li> </ul>	E2. Ensure that information on the full range of bill payment assistance subsidies and schemes provided by State Government, welfare agencies and utilities is compiled and widely disseminated to community members.	<b>SSC</b>	Short-term

<sup>3</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>3</sup>
and community groups.	<p>E3. Develop and disseminate an information package to the local community on climate change, the potential impacts of climate change in Strathbogie and how residents can respond at the household and business levels, including information on:</p> <ul style="list-style-type: none"> <li>– energy and water use efficiency, relevant programs by government agencies and utilities, and information resources;</li> <li>– the importance of self-sufficiency in preparing and responding to climate-related disruptions and emergencies; and</li> <li>– relevant voluntary organisations in the Shire and the benefits of participation in one or other of those organisations.</li> </ul>	SSC	Short-term
<b>Subset F – Recreation</b>			
<ul style="list-style-type: none"> <li>– recreational asset planning needs to be informed by an understanding of how the community utilises and values open spaces;</li> <li>– information gaps on water supplies available to Council and sustainable water use options;</li> <li>– aging existing recreation</li> </ul>	F1. Develop a recreation strategy that reflects community requirements for playing fields, swimming pools and open spaces.	SSC	Short- to medium-term
	F2. Develop a sustainable plan for the usage of bore water across the Shire for irrigation of playing fields, parks and gardens.	SSC, working with GVW and Goulburn-Murray Water (G-MW)	Short-term
	F3. Investigate medium to long term actions to ensure ongoing viability of priority parks, gardens and playing field, including alternative water sources and improved irrigation efficiency.	SSC, working with GVW	Medium- to long-term

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>3</sup>
<p>infrastructure (e.g. swimming pools) and an ongoing shortage of funds for retrofits and maintenance works;</p> <ul style="list-style-type: none"> <li>– decrease in volunteering with regard to the upkeep of open spaces; and</li> <li>– an increase in the intensity of the wet and dry cycle requires species that are drought tolerant <b>and</b> able to cope with periods of wet weather.</li> </ul>	<p>F4. Review the Asset Management Plan and incorporate findings of actions F1 and F2.</p>	<p>SSC</p>	<p>Short- to medium-term</p>

**Table ES 3: Environment – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>4</sup>
<b>Subset G – Biodiversity and wildlife habitats</b>			
<ul style="list-style-type: none"> <li>– decline in the extent and quality of vegetation, suggesting that existing programs are having mixed success in meeting their</li> </ul>	<p>G1. Implement relevant actions in the Draft Environmental Management Strategy including actions relating to native vegetation protection (5.3 to 5.6), invasive plants and animal control (5.7 to 5.9) and roadside management of native vegetation (6.1 to 6.3).</p>	<p>SSC (various departments)</p>	<p>Short-term</p>

<sup>4</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>4</sup>
<ul style="list-style-type: none"> <li>objectives, possibly due to</li> <li>– a lack of coordination between agencies and resourcing of initiatives.</li> <li>– insufficient financial incentives for the protection of native vegetation on private and public land.</li> <li>– difficulties in enforcing planning provisions relating to the protection of native vegetation on private land; and</li> <li>– information gaps on catchment health and the implications of climate change for catchment health in the context of other drivers and trends.</li> </ul>	<p>G2. Strengthen regional cooperation on environmental protection and catchment management through regional partnerships on environmental/ catchment protection. Potential programs include:</p> <ul style="list-style-type: none"> <li>– education and engagement programs with local landholders re the importance of wildlife corridors / ‘refugia’;</li> <li>– conservation incentive and conservation works programs targeting high conservation value locations; and</li> <li>– a co-ordinated program aimed at monitoring changes over time to high conservation value vegetation communities and ecosystems.</li> </ul>	<p><b>SSC Environmental Sustainability Committee, GBCMA, G-MW, GVW, DSE, Department of Primary Industries (DPI)</b></p>	<p>Short-term and ongoing</p>
	<p>G3. Strengthen enforcement of land clearing planning provisions and controls.</p>	<p><b>SSC, DSE</b></p>	<p>Short-term</p>
<b>Subset H – Waterways (incl. groundwater)</b>			
<ul style="list-style-type: none"> <li>– inconsistent approaches to managing stock and domestic water use in the Shire through planning and development controls;</li> <li>– information gaps relating to the number and location of bores for stock and domestic use and stock and domestic water demand from</li> </ul>	<p>H1. Implement relevant actions from the Draft Environmental Management Strategy including actions 5.1 and 5.2 relating to the development of creek/ waterways management plans.</p> <hr/> <p>H2. Ensure that water use conditions in development applications are coordinated and consistently applied, with particular attention being given to groundwater use for stock and domestic purposes and water use from unregulated systems.</p> <p>Examine the need for amendments to the Planning Scheme to include provisions relating to groundwater management.</p>	<p>SSC, <b>GBCMA</b></p> <hr/> <p><b>SSC, G-MW, GVW</b></p>	<p>Short-term</p> <hr/> <p>Short-term</p>

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>4</sup>
<p>unregulated surface water systems;</p> <ul style="list-style-type: none"> <li>– need to improve understanding of the links between shallow groundwater and surface water systems;</li> <li>– need to improve landholder and broader community understanding of the implications of climate change for waterways health in the conjunction with other pressures on waterways such as waste runoff from intensive agriculture</li> <li>– gap between agency and Council objectives for catchment and waterways protection on the one hand and private land holder responsibilities and objectives on the other</li> </ul>	<p>H3. See action F3 (Water use efficiency and alternative water supplies).</p>	<p>SSC, working with GVW</p>	<p>Medium- to long-term</p>

**Table ES 4: Infrastructure & Assets – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>5</sup>
<b>Subset I – Stormwater and flooding</b>			
<ul style="list-style-type: none"> <li>– ongoing shortage of funds for infrastructure retrofits and maintenance works;</li> </ul>	<p>I1. Model changes to extreme rainfall intensities and duration under climate change scenarios, with modelled outputs being used to update flood mapping and flood studies for the Shire of Strathbogie.</p>	<p>SSC, <b>GBCMA</b>, DSE, other councils</p>	<p>Short- to medium-term</p>
<ul style="list-style-type: none"> <li>– the lack of a complete asset register</li> </ul>	<p>I2. Develop a guideline and standards for the design of new and upgraded drainage assets taking into account outcomes of I1 as well as local needs.</p>	<p><b>SSC</b></p>	<p>Medium-term</p>
<ul style="list-style-type: none"> <li>– need to upgrade design standards to take account of higher intensity rainfall events;</li> <li>– limited flood mitigation structures in the LGA; and</li> </ul>	<p>I3. Undertake an infrastructure audit regarding capacity and lifespan of assets to identify deficiencies and (drawing on outputs of I1 and I2) apply a risk management approach to prioritise management and upgrade of vulnerable stormwater assets within the Shire.</p>	<p><b>SSC</b>, working with VicRoads, VicRail and GBCMA</p>	<p>Medium-term</p>
<ul style="list-style-type: none"> <li>– need to improve advertising / communication of early warning system.</li> </ul>	<p>I4. Develop an infrastructure communications strategy and undertake a level of service information and education campaign, targeting community expectations on levels of service and Council’s ability to deliver with regards to maintenance of stormwater and flood management infrastructure.</p>	<p><b>SSC</b></p>	<p>Short- to medium-term</p>
<b>Subset J – Transport Infrastructure</b>			
<ul style="list-style-type: none"> <li>– significant backlog in road maintenance and upgrade schedule;</li> </ul>	<p>J1. Identify and review key traffic routes affected by flooding, bushfires or other extreme events.  Identify alternative options and provide information to the community on alternative transport and evacuation routes in the event of a flood or bushfire.</p>	<p>SSC, <b>MEMPC</b></p>	<p>Short-term</p>
<ul style="list-style-type: none"> <li>– ongoing shortage of funds for infrastructure retrofits and maintenance works;</li> <li>– need to manage community expectations regarding level and cost of services</li> </ul>	<p>J2. Undertake an infrastructure audit to identify deficiencies with roads and other transport infrastructure and (drawing on outputs of I1 and J1) apply a risk management approach to prioritising management and upgrade of vulnerable transport infrastructure in the Shire.</p>	<p><b>SSC</b></p>	<p>Short- to Medium-term</p>

<sup>5</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>5</sup>
	J3. See action I4. Extend campaign to include information aimed at managing community expectations relating to transport infrastructure costs and level of service.	SSC	Short- to medium-term

**Table ES 5: Planning – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>6</sup>
<b>Subset K –Flood Management</b>			
<ul style="list-style-type: none"> <li>– flood maps may not reflect current runoff, flows and inundation;</li> <li>– flood maps do not take account of potential increases in maximum rainfall intensity under climate change scenarios;</li> <li>– lack of funding to plan works and check Development Approvals (DAs); enforce conditions of consent; ground truth works against design specifications.</li> </ul>	K1. See action I1.	SSC, <b>GBCMA</b> , DSE, other councils	Short- to medium-term
	K2. Reflect outcomes from action I1 in changes to the Planning Scheme and Land Subject to Inundation Overlays.	SSC	Medium-term
	K3. Examine potential funding sources (e.g. levies) to improve resourcing of development approvals and audits of conditions of consent and works in flood and bushfire hazard areas.	SSC	Short-term
	K4. Incorporate information on flood modelling, management and planning processes in the proposed climate change community awareness and information package.	SSC	Short-term

<sup>6</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>6</sup>
<b>Subset L –Bushfire Management</b>			
<ul style="list-style-type: none"> <li>– mapping may not reflect current bushfire prone areas</li> <li>– buffer zones may need to be introduced to take account of likely increases in the frequency of extreme fire danger and code red days</li> <li>– inconsistencies in between planning and building regulations regarding siting and design controls for residential developments in Wildfire Management Overlay (WMO) areas</li> <li>– lack of funding to plan works and check Development Approvals (DAs); enforce conditions of consent; ground truth works against design specifications.</li> </ul>	<p>L1. Review Wildfire Management Overlays (WMOs) to ensure that they align with best available data for the Shire on relevant wildfire prone areas. Attention should be paid in the review to the need for buffer zones in areas adjacent to forests. Incorporate any changes to WMOs into the Planning Scheme.</p>	<p><b>SSC</b>, Country Fire Authority (CFA), DPCD</p>	<p>Medium-term</p>
	<p>L2. Approach DPCD and the Building Commission to ensure that there is consistency (at the state level) in objectives, approach and terminology between planning provisions and building regulations relating to fire protection and management.</p>	<p><b>SSC, Municipal Association of Victoria (MAV)</b>, advocating to DPCD and Building Commission</p>	<p>Short-term</p>
	<p>L3. See action K3 (Resourcing of development approvals and audits).</p>	<p><b>SSC</b></p>	<p>Short-term</p>

**Table ES 6: Economic Development – Issues, Gaps and Recommended Actions**

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>7</sup>
<b>Subset M – Agriculture</b>			
<ul style="list-style-type: none"> <li>– the need to improve change management in agriculture through succession planning, integrated education and training programs for landholders, and programs to attract rural businesses and promote agricultural development;</li> </ul>	<p>M1. Develop an agriculture succession plan to promote the long term sustainability and viability of the sector in the face of climate, demographic and other changes. The plan includes:</p> <ul style="list-style-type: none"> <li>– integrated education and training programs;</li> <li>– local forums and partnerships; and</li> <li>– a marketing campaign to promote Strathbogie as a state agricultural hub.</li> </ul>	<p><b>DPI, Victorian Farmers Federation (VFF), Victorian Employer Chamber of Commerce &amp; Industry (VECCI), SSC</b></p>	<p>Medium-term</p>
<ul style="list-style-type: none"> <li>– significant uncertainty about water security for the Shire’s intensive agriculture and dryland farms in drought periods; and</li> </ul>	<p>M2. Investigate the desirability and feasibility of a establishing a regional groundwater partnership that adds value to the State Observation Bore Network in terms of improved co-ordination of decision-making on groundwater at the regional level and enhanced local knowledge.</p>	<p><b>SSC, G-MW, GBCMA, DSE, other councils</b></p>	<p>Short-term</p>
<ul style="list-style-type: none"> <li>– gap in understanding of roles and responsibilities for pests and weeds management.</li> </ul>	<p>M3. See action G1 (implement actions from the Draft Environmental Management Strategy relating to pests and weeds control).</p>	<p><b>SSC</b></p>	<p>Short-term</p>
<b>Subset N – Tourism</b>			
<ul style="list-style-type: none"> <li>– lacks of trained staff and other resources dedicated to the development and promotion of tourism in the Shire;</li> <li>– major gaps in understanding of the impacts of climate variability</li> </ul>	<p>N1. Explore the feasibility of resourcing a program or programs (possibly shared with another council in the region) dedicated to tourism development and promotion across the Shire.</p> <p>Develop a strategy and programs that highlight and promote the Shire’s diverse but positive environments and attractions, and diverse range of tourism opportunities.</p>	<p><b>SSC, Goulburn River Valley Tourism (GRVT)</b></p>	<p>Short-term</p>

<sup>7</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Issues and Gaps Addressed	Recommended Actions	Implementing Organisations	Implementation Timeframe <sup>7</sup>
<p>and climate extremes on the viability of tourism in the region</p> <ul style="list-style-type: none"> <li>– lack of processes to plan for the impacts of climate change and extreme weather events; and</li> <li>– need to improve visitor management during climate related emergencies</li> </ul>	<p>N2. Develop a communications and exit plan for visitors aimed at educating and providing timely information to visitors about the risks of extreme weather events, how to act and where to go when these events occur.</p> <hr/> <p>N3. Develop a training and capacity building program on business continuity planning for tourism businesses in the Shire to educate businesses on how to produce business continuity plans and to consider and address disruptions to business associated with the direct impacts of climate change and variability.</p>	<p>SSC, <b>MEMPC</b>, GRVT and Bureau of Meteorology (BoM)</p> <hr/> <p>SSC, local business associations, <b>VECCI</b></p>	<p>Medium-term</p> <hr/> <p>Medium-term</p>

## Discussion and next steps

- ES.22. This strategy sets out more than 40 recommended actions for addressing the priority risks. The actions are directed at Strathbogie Shire Council or Council working cooperatively with other organisations. When implemented together, the actions will provide the Shire of Strathbogie with a sound basis for responding to the challenges of reduced water availability and increase rainfall variability.
- ES.23. Table ES.7 provides an overview of the different types of actions proposed in the adaptation plan, noting that there is overlap between the types of action, with some of the actions in the strategy having multiple components. Information in the table reveals the wide spectrum of action types.

**Table ES.7 – Types of Adaptation Actions Proposed in the Strategy**

Category of action	Actions	
	Council	Council & other
New or amended strategies and plans	B1, B3, F1, F2, F4	A1, B4, M1
Land-use and statutory planning	K2	G3, H2, L1, L2
Improved decision-making processes and procedures	D4, I3	-
Research and data collection	-	I1, K1
Information, education and training	E2, E3, I4, J3, K4	A2, I2, J1, N2
‘On the ground’ programs or works	D1, D2, D3, J2	A3, C1, E1, F3, J1, N3
Resourcing	K3, N1	-
Regional cooperation	-	C2, G2, M2
<b>Number of actions</b>	19	22

- ES.24. Ongoing resource and administrative constraints and other Council priorities mean that it will not be feasible to implement all actions in the strategy concurrently. It will therefore be necessary to prioritise the actions.
- ES.25. Council should consider establishing a reference group to oversee prioritisation, implementation and evaluation of the priority actions. The strategy should also be reviewed on a regular basis.

# 1. Introduction

Natural climate variability and associated natural disasters have long been a fact of life for communities in the Shire of Strathbogie. Prolonged drought throughout the Shire in the 1990s and 2000s, followed more recently by floods, could be viewed as just the latest examples of the fickleness of ‘mother nature’. Even so, the recent droughts and floods have come at great cost – economic, social and environmental – to the Shire. Thus the potential for greater climate variability in the future linked to global climate change, with more frequent and / or severe droughts, more severe fire weather conditions, interspersed by periods of intense rainfall, poses significant challenges to the Shire of Strathbogie and to the communities who live and work here.

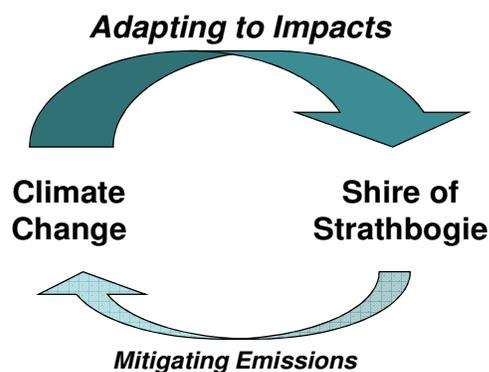
The importance of planning for climate change, in particular to reduced water availability and increased rainfall variability, is recognised by the Strathbogie Shire Council which has secured funding through the Australian Government’s *Strengthening Basin Communities* program to assist in community-wide planning for climate change through development of a climate change adaptation strategy.

## 1.1 Scope of the adaptation strategy

Climate change response can occur at two levels (Figure 1):

1. The first involves mitigating greenhouse gas emissions that scientific analysis suggest are contributing to global warming.
2. The second involves adapting to the local and regional impacts that could stem from that warming and associated climate changes.

Figure 1: Project Focus – Adapting to the Impacts of Climate Change



While these two activities are complementary, the focus of this climate change strategy is on the second element – **adapting to the impacts of climate change**<sup>8</sup>. More specifically, the focus of

<sup>8</sup> The main reasons for this focus are: 1) in contrast to the question of greenhouse gas mitigation, which is largely being driven at the international and national responses, adaptation to the impacts of climate change is best undertaken locally and regionally, since local conditions will significantly determine the extent of the risks

the strategy is on adapting to **reduced water availability** and **increased rainfall variability** and increasing the capacity of the Council and local community to respond to these changes (Box 1).

#### Box 1: Climate Change Adaptation – Some Important Concepts

##### ***Climate change adaptation***

Climate change adaptation refers to actions taken in response to actual or anticipated climate change impacts that lead to a reduction in risks or realisation of benefits. Adaptation can involve ***direct actions*** aimed at reducing the magnitude or likelihood of an impact occurring (e.g. through improved infrastructure or services) or ***indirect actions*** aimed at increasing the capacity of vulnerable communities and systems to respond to an impact should it occur (see below).

##### ***Adaptive capacity***

Adaptive capacity refers to the ability of a community or organisation to cope with actual or anticipated impacts of climate change. Enhancing the adaptive capacity of the community, for example through improving knowledge or strengthening and diversifying the economy, is one aspect of adaptation.

Development of the climate change adaptation strategy has entailed two main steps.

The first step involved undertaking a climate change risk assessment, assimilating information about the ways in which climate change could impact on the Shire of Strathbogie and presenting that information in the form of an assessment of risks to:

- Council infrastructure and associated services;
- economic development & planning issues;
- emergency management;
- social issues and related social services such as community health; and
- the natural environment of Strathbogie.

The second step involved developing adaptation actions in response to identified high priority risks.

Both steps had substantial input from the community of Strathbogie, achieved through consultations with Shire of Strathbogie councillors, council staff, the Shire's Environmental Management Committee, State government departments and regional authorities and industry and community representatives.

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posed by climate change, as well as the most appropriate adaptation responses; and 2) Strathbogie Shire Council has already developed a greenhouse gas mitigation plan.

## 1.2 This report

This report contains the following information:

- Section 2 outlines climate change projections for the Shire, potential impacts of those changes and discusses the vulnerability of the Shire to climate change.
- Section 3 presents results the climate change risk assessment that was undertaken with Council and the community.
- Section 4 discusses the concept and principles of climate change adaptation, and the process that was used to identify new actions.
- Section 5 provides a detailed review of current policies, programs and measures relevant to identified 'priority risks' and sets out recommendations for new adaptation actions.
- Finally, section 6 provides an assessment of the proposed actions and provides recommendations on next steps.

## 2. Context

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### 2.1 Climate change projections

#### 2.1.1 Global climate change

Since the late nineteenth century, average air temperatures at the earth's surface have increased by approximately 0.8°C. The warming has been detected in three independent temperature records over land, over sea and in ocean surface water. The Intergovernmental Panel on Climate Change (IPCC) concluded in its most recent assessment (IPCC 2007) that:

- it is very likely that greenhouse gas emissions generated by human activities caused most of the observed increase in globally averaged temperatures since the mid-20th century;
- temperature increases have also influenced the global hydrological cycle - precipitation in some regions of the world has increased significantly while more intense and longer droughts have been observed since the 1970s in other regions;
- an average global warming of 1.1 to 6.4 °C by 2090-99 relative to 1980-1999 temperatures can be expected;
- warming will be accompanied by increases in the amount of precipitation in high-latitude areas (very likely), while decreases are likely in most subtropical and warm temperate land regions;
- warming will also be accompanied by an increase in the frequency of extreme climate events – hot extremes, heat waves and heavy rainfall.

While there are uncertainties about global climate projections, including the magnitude of changes and regional and local impacts, it is important to note that the IPCC's conclusions are supported by the world's major science academies including the American Academy of Sciences, the Royal Society (UK) and the Australian Academy of Science.

#### 2.1.2 Climate change projections for Strathbogie

The Shire of Strathbogie is likely to be warmer in the future, with rainfall becoming less reliable and more extreme. Table 1 summarises indicative changes to a range of climate variables for the Strathbogie region, drawing on projections from the CSIRO and the South East Australia Climate Initiative (SEACI) and assuming a high global emissions scenario<sup>9</sup>. The years provided (i.e. 2030 and 2070) should be viewed as reference periods for the changes, rather than as specific points in time. The indicative changes are relative to averages for 1960 to 1990.

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<sup>9</sup> Global greenhouse gas emissions are currently tracking at the high end of emissions scenarios used in generating global and regional temperature change projections.

**Table 1. Indicative changes to Strathbogie’s climate**

Climate variable	Current <sup>10</sup>	Indicative changes <sup>11</sup>		Comments
<b>Average rainfall</b>		2030	2070	Average annual rainfall could decrease by up to 25% by 2070 in the worst case.  In the decade to 2007, the region’s average rainfall was 12% below the 1961 to 1990 average.
Annual	774 mm	- 3 %	- 10 %	
Spring	200 mm	- 7 %	- 20 %	
Summer	135 mm	-1 %	-4 %	
Autumn	188 mm	-2 %	-5 %	
Winter	251 mm	- 4 %	- 12 %	
<b>Runoff</b>		2030	2070	Reductions in runoff are linked to a number of variables including reduced rainfall, higher evaporation and lower soil moisture.
Annual		- 12% to - 35%	> 50 %	
<b>Rainfall intensity</b>		2030	2070	Rainfall in the region is projected to become more variable, with fewer rainy days but rain falling in more intense bursts.
24 hour rainfall intensity		0% to + 10 %	+10 to + 50 %	
Probable maximum flood levels		+	+	
Flood return intervals		+	+	
Number of rainy days	130	- 5 %	- 16 %	
<b>Fire weather</b>		2020	2050	The length of the fire season is projected to increase also.
Number of high and extreme forest fire danger days	18	+ 4	+ 12	
<b>Other</b>		2030	2070	Average annual temperature could increase by up to 3 °C by 2070.  Average annual temperatures in the last decade have warmed by 0.5 °C, reflecting increases in both daily maximum and minimum temperatures.
Average annual temperature	13.9	+ 1 °C	+ 3 °C	
Potential evaporation		+ 3%	+ 8%	
Solar radiation		+ 0.8 %	+ 2.5 %	

Sources: CSIRO 2008; SEACI 2010

<sup>10</sup> Average 1961-1990, ‘typical’ location

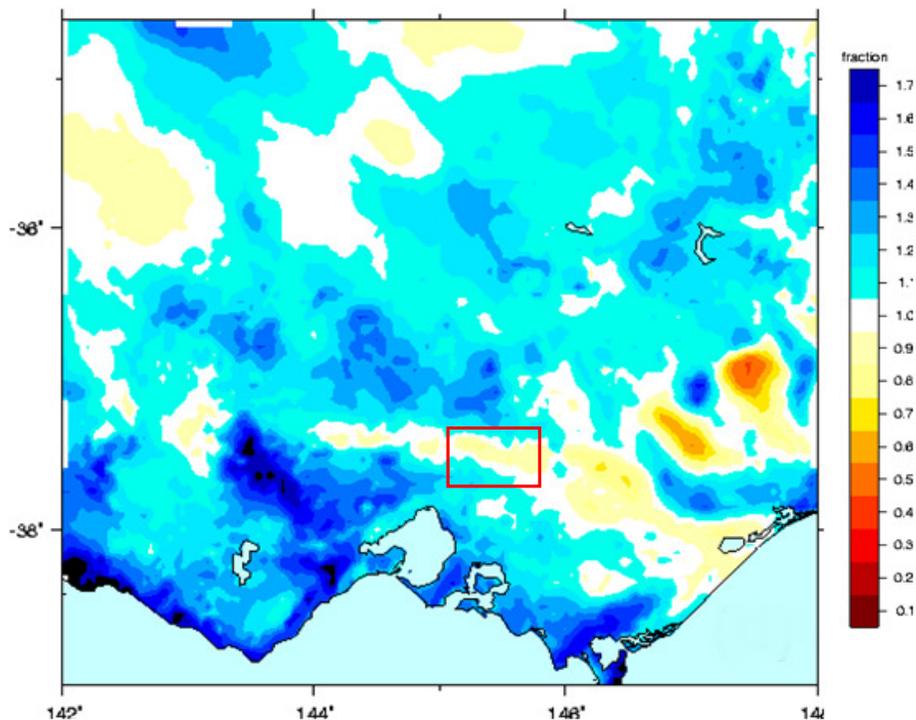
<sup>11</sup> Given high emissions scenario

Average rainfall projections indicate that the most likely change to 2030 will be a small decline (about 3 percent) in annual rainfall compared with the historic average, with most of the decline coming in winter and spring (reductions of 4 percent and 7 percent respectively). This trend is likely to intensify by 2070, with average annual rainfall decreasing by up to 10 percent by 2070. Although these projections of changes to average rainfall seem relatively modest, it needs to be noted that relatively small reductions in rainfall can lead to much larger reductions in runoff and water availability – most rainfall-runoff modelling for south eastern Australia showing ratios of 2/1 - 3/1 in reductions in runoff relative to rainfall. Research undertaken by both CSIRO and South Eastern Australian Climate Initiative (SEACI) suggest that runoff could decrease between 12 percent and 35 percent by 2030 and over 50 percent by 2070.

Moreover, climate change projections for south eastern Australia indicates that there will be increased rainfall variability (both season to season and year on year). These projections, combined with higher average and extreme temperatures, point to an increase in drought severity and maybe drought frequency for Strathbogie Shire in the future. Specific projections relating to seasonality of runoff and frequency and duration of extreme dry and wet periods are not available however.

Projections also indicate that rain will fall in less frequent but more intense bursts. Figure 2 shows some projections for changes to the maximum intensity of 24 hour rainfall events for 2070 in Victoria, with downscaled data for Goulburn region indicating the potential for an increase in maximum intensity of between 10 and 50 percent for most parts of the Shire.

**Figure 2: Modelled changes to maximum 24 hour rainfall intensity, Victoria (2070)**



Source: Abbs and Rafter 2008

## 2.2 Potential impacts of climate change

The climate changes outlined above could result in a range of impacts – some positive, but many negative – to the Shire of Strathbogie’s natural and physical assets, as well as to major industries and infrastructure within the Shire. Impacts on these systems will, in turn, have indirect economic and social effects as well as implications for the delivery of local community services provided by Strathbogie Shire Council (either as the key service provider or, more often, in partnership with other agencies and organisations).

Table 2 provides an overview of the possible impacts of climate change in the Shire. Some of these impacts will be felt quite uniformly throughout the Shire. Others however, will vary greatly from locality to locality depending on local physical and social characteristics.

**Table 2. Potential impacts of climate change in the Shire of Strathbogie – direct and indirect**

Assets/service area	Possible impacts	Comments
<b>Infrastructure &amp; built assets</b>		
Roads/pavements/bridges	<ul style="list-style-type: none"> <li>Increases rates of deterioration of roads and pavements (e.g. more intense rainfall, higher temperatures and/or increased solar radiation)</li> <li>Increased destruction of roads and bridges due to inundation (floods)</li> <li>Increased disruption to traffic (local, business or tourist) (floods or bushfires)</li> </ul>	Council is responsible for managing 2,182 km of roads and 136 bridges with a replacement cost of \$156 m. A recent audit of sealed roads for the Council found that many are already in very poor condition.
Stormwater, drainage & flood management	<ul style="list-style-type: none"> <li>Exceedance of drainage capacity causing flash flooding</li> <li>Exceedance of existing flood defences causing flooding of protected towns</li> <li>Increased flooding of areas not protected by flood defences</li> </ul>	Most drains in the Shire are designed to cope with 5 year or less rainfall events. Euroa (Seven Creeks & Castle Creek) and Violet Town (Honeysuckle Creek) experienced major flooding in 1993. The Castle Creek Levy played a major role in mitigating the impacts of the 2010 floods in Euroa.
Buildings	<ul style="list-style-type: none"> <li>Increased risk of damage to community buildings (e.g. floods, bushfires or storms)</li> <li>Increased damage to community buildings due to shifting foundations (increased rainfall variability)</li> </ul>	Several public buildings were flooded in Euroa in 2010. Shifting foundations already impact on the Council Building in Euroa and caused damage to Council’s swimming pools.
Recreational facilities	<ul style="list-style-type: none"> <li>Reduced availability of water for sports fields and other public open space, resulting in their degradation or closure</li> <li>Limited water for swimming pools</li> </ul>	Playing fields, parks and gardens in the Shire were adversely affected by the recent drought. Council has now ‘drought proofed’ some playing fields
Water & wastewater	<ul style="list-style-type: none"> <li>Changes to mean and peak stream flows impacting on security of water supply for towns and industries</li> <li>Increased potential contamination of water supplies associated with extreme rainfall events (nutrient and sediment runoff)</li> <li>Flooding of waste water facilities impacting on service delivery</li> </ul>	Goulburn Valley Water provides urban water and wastewater services to towns in Strathbogie. Towns were subject to tight water restrictions during the last drought.

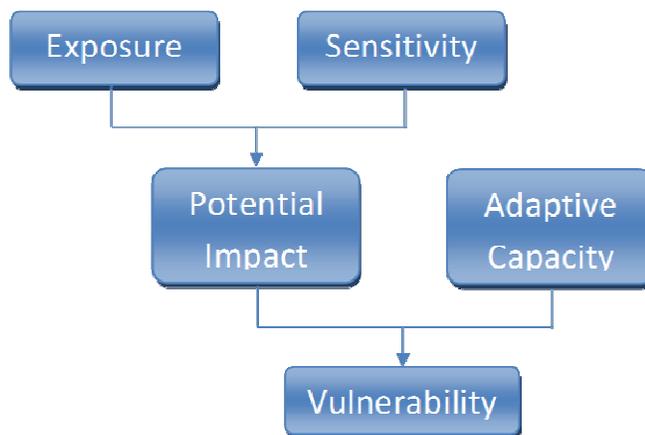
Assets/service area	Possible impacts	Comments
<b>Planning &amp; development approvals</b>		
Planning policy	<ul style="list-style-type: none"> <li>Inappropriate location of urban expansion areas and other developments (especially in land subject to flooding)</li> <li>Loss of private property and community assets</li> <li>Increase in insurance costs</li> <li>Early retirement of capital infrastructure</li> </ul>	Historic 1:100 flood mapping is used for the Strathbogie Planning Scheme. The maps do not incorporate the potential for increased maximum flood levels in the future.
<b>Emergency services</b>		
	<ul style="list-style-type: none"> <li>Increased need for emergency response and recovery operations (bushfires, floods)</li> <li>Risks to public safety (floods, bushfires)</li> <li>Isolation of vulnerable communities (floods, bushfires)</li> </ul>	Emergency management in the Shire is overseen by a Municipal Emergency Management Committees, coordinated by the Council and including the CFA, SES and Victoria Police.
<b>Economic development</b>		
Agriculture	<ul style="list-style-type: none"> <li>Decline in viability of established intensive and broad acre agricultural industries due to increased severity or frequency of droughts, reduced yields and carrying capacity or increased production costs</li> </ul>	Agricultural industries are critical to the Shire's economy (Table 1). There has been a long term trend towards intensive agriculture away from grazing and broad acre cropping in the Shire. This intensified during the last drought.
Tourism	<ul style="list-style-type: none"> <li>Decline in viability of tourism industries linked to increased severity or frequency of droughts and extreme weather events (floods, bushfires)</li> <li>Risks to tourist safety (floods, bushfires)</li> </ul>	Tourism is also important to the Shire's economy, although less significant than agriculture.
Townships	<ul style="list-style-type: none"> <li>Threats to viability of towns linked to decline in viability or shift in structure of agricultural industries</li> <li>Threat to viability of towns linked to limitations to future water supply</li> </ul>	
<b>Community services</b>		
Community and workplace health	<ul style="list-style-type: none"> <li>High temperatures increasing incidence of food and water-borne diseases</li> </ul>	Strathbogie already has a relatively low

Assets/service area	Possible impacts	Comments
and safety	<ul style="list-style-type: none"> <li>Health impacts due to exposure of vulnerable groups (e.g. elderly and infants) to extreme weather (especially heatwaves)</li> <li>Extreme rainfall events transporting contaminants into waterways and drinking water supplies (intense rainfall).</li> <li>An increase in injuries due to increased intensity of extreme events (e.g. storms, droughts, bushfires)</li> </ul>	level of socio-economic advantage relative to other parts of Victoria and Australia (see section 2.3) and has experienced detrimental impacts on community wellbeing during the last drought (including mental health issues and suicides).
<b>Environmental protection</b>		
Biodiversity	<ul style="list-style-type: none"> <li>Increased pressures on aquatic and amphibious species due to decreased water reliability in waterways, wetlands and standing water bodies</li> <li>Loss or change in composition and distribution of native vegetation</li> </ul>	
Land management	<ul style="list-style-type: none"> <li>Changes in distribution of invasive species due to changes in climate and bushfire intensity</li> </ul>	Some pests (rabbits and foxes) and weeds (blackberries) are already an issue in the region.

## 2.3 Vulnerability of Strathbogie to climate change

A commonly used framework for assessing the vulnerability of a community or region to climate change is to consider vulnerability as a function of potential (climate change) impacts and the *adaptive capacity* of the community (see Box 1). Potential impacts are determined in turn by the exposure of the community to different climate variables and changes and sensitivity of the community to those changes where *exposure* is the magnitude and nature of the climate change or related event and *sensitivity* is the responsiveness of a community or system to an exposure/change event (Figure 3). The greater the potential impact and the lower the adaptive capacity, the greater the vulnerability of a community will be.

**Figure 3: Components of vulnerability**



Source: adapted from Schröter, 2004

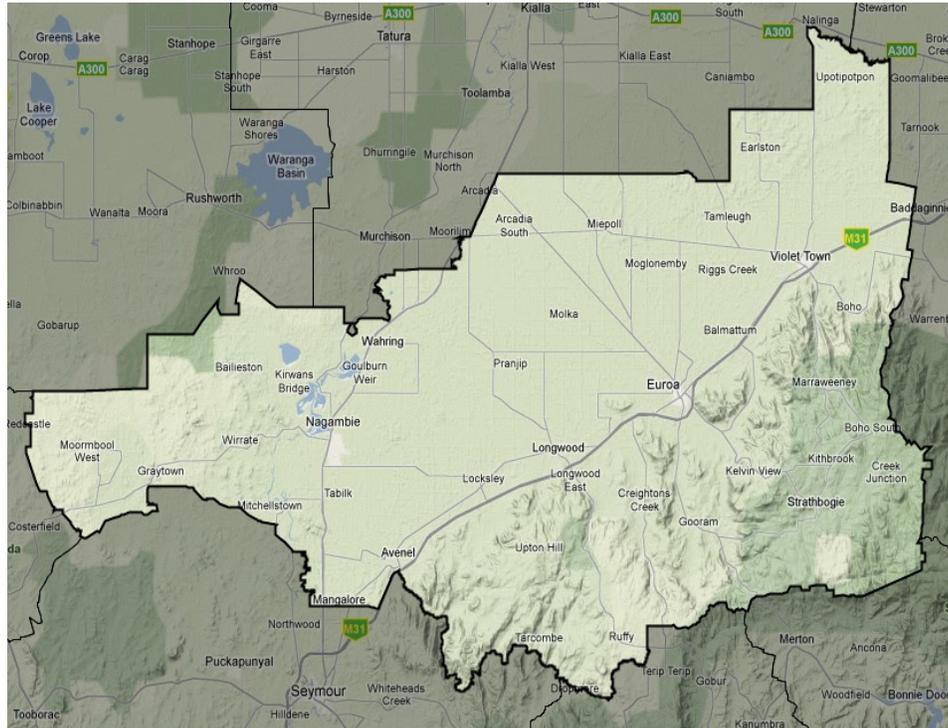
An outline of the physical and the socio-economic characteristics of the Shire of Strathbogie, in sections 2.2.1 and 2.2.2 below, provides an understanding of the exposure and sensitivity of the Shire and its community to climate change. Section 2.2.3 considers the adaptive capacity of the community of Strathbogie to those changes.

### 2.3.1 Physical characteristics of the Shire - exposure

The Shire of Strathbogie is located in north east Victoria between Melbourne and Albury-Wodonga. The 3300 square kilometre municipality encompasses part of the Strathbogie Ranges and the plains of the Goulburn River (Figure 4).

The Shire of Strathbogie is part of the Goulburn River Basin. Most streams in the Shire are eastern tributaries to the Goulburn River downstream of the Goulburn Weir. The Goulburn Broken Catchment Management Authority (GBCMA) has classified the health of streams and water ways in the region as ‘Low’ to ‘Moderate’.

Figure 4: Shire of Strathbogie



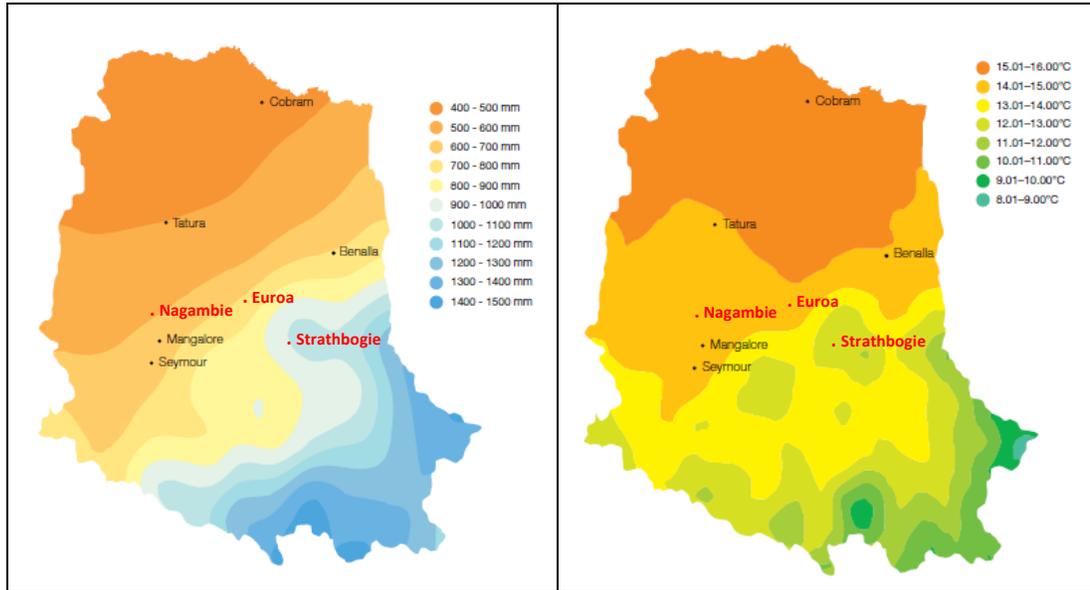
Source: Remplan Mapbuilder, based on Google Maps

The climate of the Shire is temperate, with average annual daily temperatures ranging from about 12° C to 15° C. Due to its geographic location on the northern edge of the Great Dividing Range, the Shire experiences significant variations in rainfall, with Nagambie and other areas in the west and north of the Shire receiving, on average, less than 600 mm of rainfall annually and Strathbogie in the south east receiving almost 1000 mm. (Figure 5)

Given the north west – south east gradation in rainfall, it is likely that the north western areas of the Shire (north of the Hume Highway) will be more exposed to reduced water availability in the future than the higher rainfall south east. Paradoxically, because the areas to the north west of the Shire tend to be low lying and subject to inundation, they are more exposed to intense rainfall events and associated flooding than south eastern areas of the Shire around the Strathbogie Ranges.

As a rule of thumb, the Hume Highway can be seen as a boundary between the Strathbogie Plains and the Strathbogie Ranges (Figure 4), and thereby also provides a separation between the flood prone areas to the north-west and the bushfire prone areas to the south-east. This is evident in the Strathbogie Planning Scheme, with the majority areas covered by *Wildfire Management Overlays* being in the area south of the Hume Highway and the majority areas covered by *Land Subject To Inundation Overlays* being to the north of the Hume Highway.

Figure 5: Average annual rainfall and daily temperatures, Goulburn Broken Catchment



Source: DSE 2008

### 2.3.2 Socio-economic characteristics of the Shire – sensitivity

The Shire of Strathbogrie is heavily dependent on Agriculture and Manufacturing for employment and wealth creation, with well over 40% of the Shire’s workforce being employed in those two sectors.

Table 3 illustrates an outflow of workers to other LGAs and possibly regional centres. While approximately 4,000 residents of the Shire are employed, only about 3,000 people work in the Shire. This net outflow of people to work outside the Shire indicates limited employment opportunities within the region. However, recent data suggests that the unemployment rate in the LGA is relatively low (3.4 percent in 2009) (ABS, 2010) compared with the wider region and the State.

**Table 3: Strathbogie, employment by industry (2006)**

Industry	Place of usual residence		Place of work	
	# of workers	% of workers	# of workers	% of workers
Agriculture, forestry & fishing	880	22%	852	28%
Manufacturing	491	12%	439	14%
Health care & social assistance	366	9%	275	9%
Retail trade	324	8%	243	8%
Education & training	268	7%	191	6%
Accommodation & food services	210	5%	171	6%
Public administration & safety	230	6%	164	5%
Construction	285	7%	144	5%
Transport, postal & warehousing	234	6%	132	4%
Wholesale trade	121	3%	75	2%
Arts & recreation services	48	1%	48	2%
Mining	12	0%	9	0%
Other Industries	462	11%	262	9%
Inadequately described/Not stated	138	3%	51	2%
<b>Total</b>	<b>4,069</b>	<b>100%</b>	<b>3,056</b>	<b>100%</b>

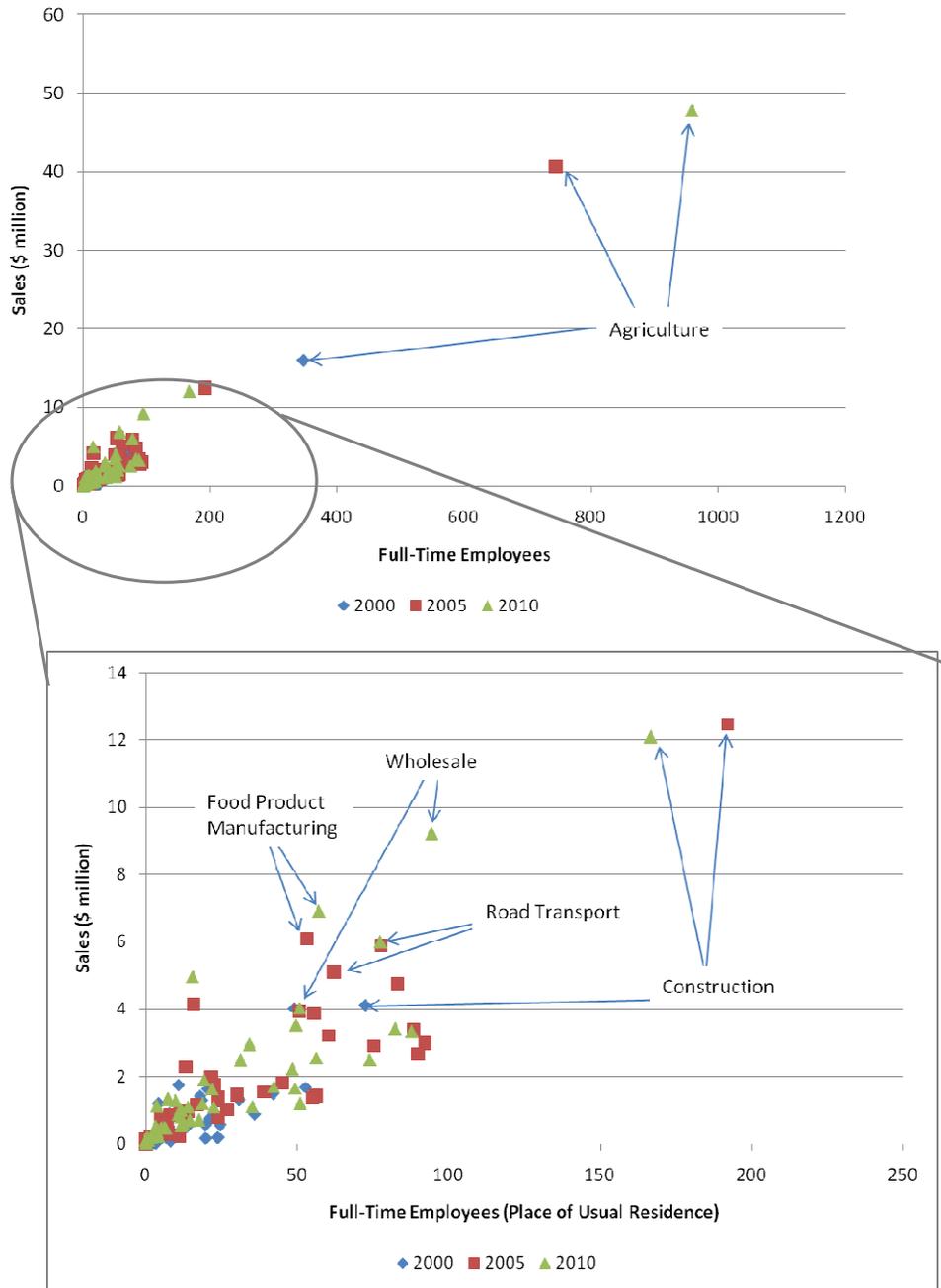
Source: ABS Census 2006

### A Shire coupled to regional agricultural production

According to international and Australian classifications (USBER, 2011, Houghton, 1997), Strathbogie's economy is agriculturally dependent, since more than 15 percent of residents work in farm related occupations. It is also responsible for substantial share of the Shire's economic outputs. In 2006, the total gross value of agricultural production amounted to \$79.7 million (Table 4), with approximately 75% of that value coming from livestock and the remainder from cropping. On a per capita basis, the value of agricultural production in the Shire is substantially greater than for the state as a whole, although comparable to neighbouring regions.

Figure 6 highlights the primacy of agriculture to the Shire's economy, in terms of both output and employment. To a significant extent, other businesses in the Shire are dependent on agriculture, being integrated within the agricultural value chain by providing inputs and using outputs of agricultural activities.

Figure 6: Estimated business turnover and employment by industry, Strathbogie Shire



Source: National Institute for Economic and Industry Research, 2011

**Table 4 : Regional agricultural production statistics, Strathbogie Shire, South Goulburn and Victoria, 2006**

Measure	Strathbogie		South Goulburn	Goulburn	Victoria
<b>Gross value of agricultural production</b>	(\$m)	(\$'000 per capita)	(\$'000 per capita)	(\$'000 per capita)	(\$'000 per capita)
Crops	20	2.1	1.5	3.3	0.8
Livestock	46.2	4.8	3.2	1.8	0.5
Livestock slaughtering	13.5	1.4	0.9	3.1	0.5
<b>Total</b>	<b>79.7</b>	<b>8.3</b>	<b>5.7</b>	<b>8.3</b>	<b>1.8</b>
<b>Area under production</b>	(ha)	(ha per capita)	(ha per capita)	(ha per capita)	(ha per capita)
Cereals for grain (ha)	17,305	1.80	1.09	0.89	0.48
Vegetables for human consumption (ha)	5	0.00	0.00	0.02	0.01
Orchard trees (including nuts) (ha)	189	0.02	0.01	0.07	0.01
All fruit (excluding grapes) (ha)	193	0.02	0.01	0.07	0.01
Non-cereal broadacre crops (ha)	1,722	0.18	0.32	0.17	0.11
<b>Total (ha)</b>	<b>231,491</b>	<b>24.0</b>	<b>14.5</b>	<b>7.7</b>	<b>2.4</b>
<b>Livestock</b>	(no)	(no per capita)	(no per capita)	(no per capita)	(no per capita)
Sheep and lambs (no)	528,333	54.87	30.54	9.97	3.49
Milk cattle (excluding house cows)	625	0.06	0.18	2.24	0.34
Meat cattle	62,964	6.54	5.38	2.14	0.52
<b>Water use</b>	(ML)	(ML per capita)	(ML per capita)	(ML per capita)	(ML per capita)
Irrigation volume applied (ML)	7,686	0.80	0.65	5.65	0.48
Total water use (ML)	10,688	1.11	0.86	5.83	0.52
Area irrigated as proportion of agricultural land	1.7%		1.8%	18.0%	5.3%

Source: ABS 2010, National Regional Profile, 2005-2006 for Strathbogie, South Goulburn, Goulburn and Victoria

Note:

South Goulburn includes Benalla, Mansfield, Strathbogie and Mt Buller and Mt Stirling Alpine Resorts

Goulburn includes Benalla, Campaspe, Greater Shepparton, Mansfield, Mitchell, Moira, Murrindindi, Strathbogie as well as Mt Buller, Mt Stirling and Lake Mountain Alpine Resorts

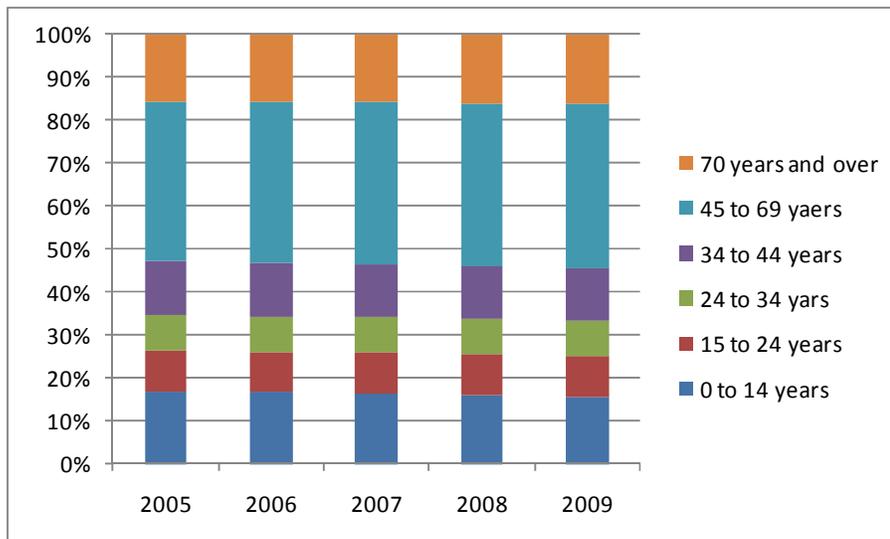
### A small, growing but ageing population

In 2009, about 10,000 people called the Shire of Strathbogie home, the Shire having experienced population growth over the previous five years. The Shire's residents are not concentrated in one large rural centre but rather spread across several townships, including Euroa, Nagambie, Violet Town, Avenel, Longwood, Ruffy and Strathbogie. Interest from the Melbourne and Shepparton property markets is increasing, particularly in the Strathbogie Ranges, Avenel and Nagambie.

Since 2004, population growth in the Shire was slower than the State average, at 1.1 percent per annum. Comparatively, the population of Victoria grew by almost 2 percent per year over the same period. Consistent with this trend, building approvals for private sector houses, have been decreasing over the last five years from 78 in 2005 to 49 in 2009.

The age distribution of the Shire stayed largely constant over the last five years. It should be noted, however, that a large proportion (55 percent) of the Shire's population is older than 45 years. This is significantly higher than the Victorian average (38 percent). Conversely, the Shire's percentage of children (15 percent), adolescents (10 percent) and adults aged 25 to 44 years (20 percent) is lower than the Victorian average (18 percent, 14 percent and 29 percent, respectively).

**Figure 7: Age distribution Strathbogie Shire**



Source: Australian Bureau of Statistics, 2010, National Regional Profile, Strathbogie (S), 2005-2009

### Significance of the Shire's socio-economic characteristics

As outlined above, the Shire of Strathbogie can be characterised as having a strong dependency on agriculture and having a small and ageing population.

The primacy of agriculture to the Shire's economy is significant because:

- the agricultural sector is, prima facie, more sensitive to the direct effects of climate change than are most other sectors; agriculture is especially dependent on amount and timing of rainfall, as well as being impacted by changes in temperatures, soil moisture conditions, and the frequency and severity of extreme weather events such as floods, storms and bushfires.

- regions with a diversified economy are generally less sensitive to major structural changes.

On the other hand, the agricultural sector in Strathbogie is highly diversified, including wool, grain and cattle production, horse studs, vineyards and a wide range of intensive cool climate horticultural enterprises (Table 4). This diversity, combined with its low dependence on irrigated agriculture, should improve the Shire's capacity to adapt to a future with lower water availability and increased rainfall variability than might otherwise have been the case. This point is discussed further in section 2.3.

The small and ageing population of Strathbogie is significant because international and national research suggests that younger and larger communities (>15,000) are often less sensitive and are more resilient to structural pressures, such as might be expected from climate change (USERB, 2011; Houghton, 1997).

### 2.3.3 Adaptive capacity of the Shire

As previously noted, adaptive capacity refers to the ability of a community or organisation to cope with actual or anticipated impacts of climate change. One means of assessing adaptive capacity is to consider the stocks of assets, tangible and intangible, that are available to a community in times of change (Figure 8). This 'five capitals' approach has been used in recent studies examining the vulnerability of rural communities to climate change (Nelson et al. 2010). Households and communities with greater diversity and stocks of the five capitals are likely to have greater adaptive capacity to deal with events, such as drought or future climate change. These communities have more resources to draw down on, and greater flexibility to substitute between different livelihood strategies in times of stress. Balance between the five capitals is also important, as minimum levels of one capital may be necessary to effectively make use of others.

**Figure 8: The five capitals**



Compared to other regions and towns in Victoria and Australia, the Strathbogie Shire appears to have fewer resources available to adapt to climate change and other structural pressures:

- Strathbogie Shire has a relatively low level of socio-economic advantage relative to other parts of Victoria and Australia. The Index of Relative Socio-economic Advantage and Disadvantage<sup>12</sup> ranks Strathbogie Shire in the bottom 41st percentile in Australia and the bottom 19th percentile in Victoria with a score of 930. Towns within Strathbogie generally have a lower level of socio-economic advantage relative to the Australian average (1000) (Table 5).
- Relative to Victoria, Strathbogie Shire has slightly lower general levels of education and occupation-related skills than other LGAs, ranking it in the bottom 46<sup>st</sup> percentile of Victorian LGAs with a score of 965. The Shire ranks above the Australian average on this measure however.

**Table 5: Socio-economic indices for towns in Strathbogie**

Town	Population	Index of Relative Socio-economic Advantage and Disadvantage	Index of Economic Resources	Index of Education and Occupation
Avenel	813	959	1009	958
Boho South	199	944	962	1103
Euroa	3,222	905	940	936
Longwood	157	910	944	972
Nagambie	1,923	925	969	931
Ruffy	281	1002	1051	1077
Strathbogie	255	926	970	1013
Violet Town	954	935	975	991

Source: Australian Bureau of Statistics, 2008

Other indicators also suggest the Shire has fewer resources available to adapt to immediate structural pressures:

- wage and salaries growth has been lower (about 6 percent) than in other parts of Victoria and Australia (both 8 percent); and
- post high school education levels are comparable with other smaller regions of the Basin, but lag behind the Victorian and national levels.

On the other hand, communities in Strathbogie Shire, appear to have substantial resources of social capital – strong social relationships and bonds within the community.

Overall however, a picture emerges of the importance of building adaptive capacity as one approach to climate change adaptation in the Shire of Strathbogie.

12 Socio-Economic Indexes for Areas (SEIFA) have been constructed by the Australian Bureau of Statistics from the 2006 Census of Population and Housing data. These indexes allow comparison of the social and economic conditions across Australia. Lower values indicate lower socioeconomic status. A score below 900 indicates significant socioeconomic disadvantage and low advantage. Four SEIFA indexes were constructed to focus on different aspects of socioeconomic status (Adhikari, 2006).

### 2.3.4 Strathbogie's vulnerability to climate change

As noted at earlier, the vulnerability of a community to major change is based on its exposure and sensitivity to change and adaptive capacity in the face of that change. ABARES/BRS recently undertook a study of community vulnerability to reduced water availability in the context of the Basin Plan examining all municipalities in the Murray Darling Basin (ABARE/BRS 2010). In the study, vulnerability is assessed on sensitivity and adaptive capacity, with sensitivity being determined as dependence on agriculture and water and adaptive capacity being based on human and social capital. Exposure is not assessed.

The ABARE/BRS research suggests that the Shire of Strathbogie has, on average, a 'moderate' vulnerability to reduced water availability, with moderate vulnerability having an index value of 0.4 to 0.6 on a scale of 0 (very low vulnerability) to 1 (very high vulnerability) (Table 6).

The study analysed vulnerability on a Census Collection District (CCD)<sup>13</sup> level, a very fine geographic scale, as local conditions can strongly influence the vulnerability of communities. About 83 percent of the population in Strathbogie was assessed as having a moderate vulnerability to reduced water availability, with the remaining 17 percent of residents having a low vulnerability, in other words are quite resilient to reduced water availability.

**Table 6: ABARE/BRS indexes description**

Description	Index
Very low	0.0 – 0.2
Low	0.2 – 0.4
Moderate	0.4 – 0.6
High	0.6 – 0.8
Very high	0.8 – 1.0

For a number of reasons results of the ABARE/BRS analysis need to be treated with considerable caution in the context of assessing the Shire of Strathbogie's vulnerability to climate change:

- First, the indices do not account for population and factor mobility - this means that a region indexed with low to moderate vulnerability may be more vulnerable if people travel away from the region to work for the day (as is the case with Strathbogie).
- Second, the indices are based on 2006 ABS Census data, which may have changed since they were reported.
- Third, potential impacts on communities are based only on their sensitivity to change, whereas exposure (e.g. the magnitude of water reduction due to changes in policy or climate change) is not included in the calculations of the vulnerability indexes - with larger reductions in water availability the vulnerability index would be expected to be higher.

<sup>13</sup> CCDs are the smallest geographic area, designed for use in the Census of Population and Housing as the smallest unit for collection, processing and output of data. CCDs are usually defined as spatial units containing about 150 to 200 dwellings.

- Fourth, the small proportion of irrigated agriculture in the Shire - less than 15 percent of agricultural businesses in the Shire are irrigation businesses – has probably skewed the results of the analysis since sensitivity to reduced water has been assessed on dependence on access to irrigation water. It is notable that the ABARE/BRS analysis found a significantly higher variance in the Shire’s adaptive capacity index, which varies between 0.13 and 0.75 and identifies about 54 percent of the Shire’s population as having low or very low adaptive capacity.

On the other hand, it is noteworthy that employment and output from agriculture in the Shire increased markedly in the 2000s (see Figure 6) despite the major drought during that period. This indicates a high resilience and adaptive capacity to reduced water availability – possibly linked to a shift from broad acre to more intensive agriculture within the Shire.

Importantly, the ABARE/BRS study tells us little about the vulnerability of the Shire to other climate changes, notably increased rainfall variability (intense rainfall, flooding), fire weather and heat waves or to reduced water availability in combination with these other changes. Available information suggests that the vulnerability of the community to these climate changes is likely to be very variable within the Shire but that some sections of the community will be highly vulnerable to climate changes due either to high exposure to the changes (e.g. flood or bushfire prone areas) or to high sensitivity (e.g. elderly) in combination with low adaptive capacity.

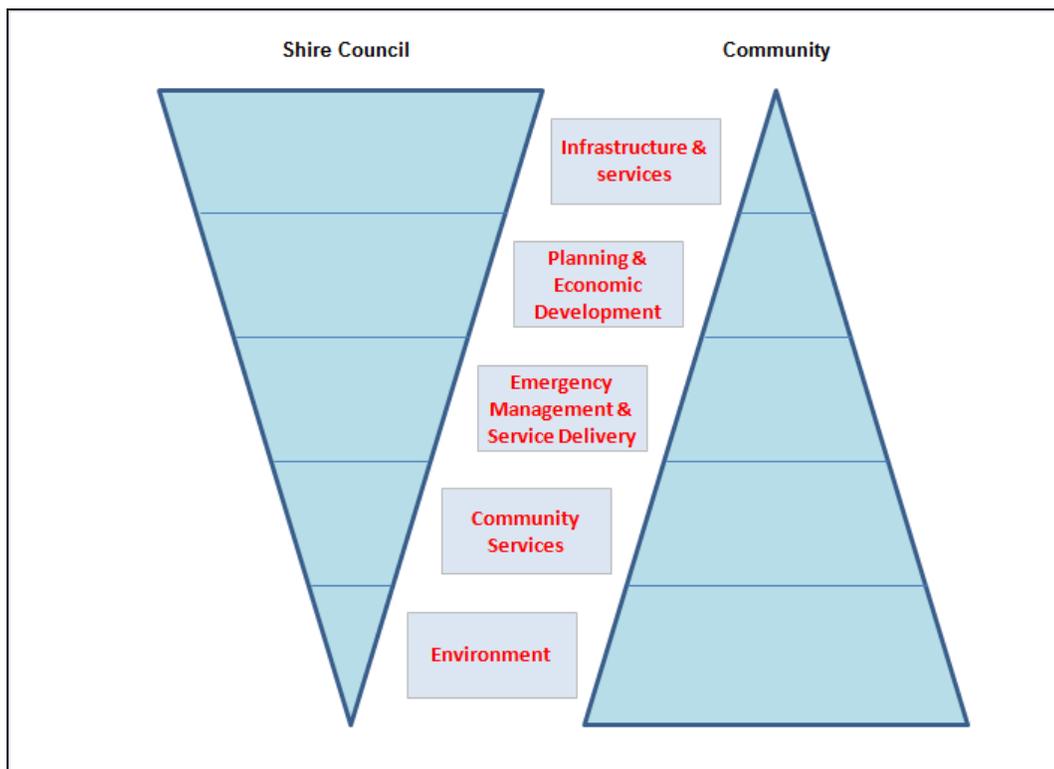
## 3. Risk Assessment

### 3.1 Overview

A climate change risk assessment has been undertaken for the Shire of Strathbogie encompassing issues directly relevant to the Strathbogie Shire Council's operations and services, as well as issues of concern to the broader community of Strathbogie.

Figure 9 below sets out a hierarchy of those issues, indicating the relative importance of the major categories of issue (key elements) to the council and community, respectively. Thus infrastructure and planning issues are largely the domain of the Council. Environment protection issues, on the other hand, are largely managed by other agencies and (community) organisations. Responsibilities for economic development, emergency management and community services are shared between Council and a range of other agencies.

**Figure 9: Strathbogie risk assessment hierarchy of risk categories**



### 3.2 Risk assessment process

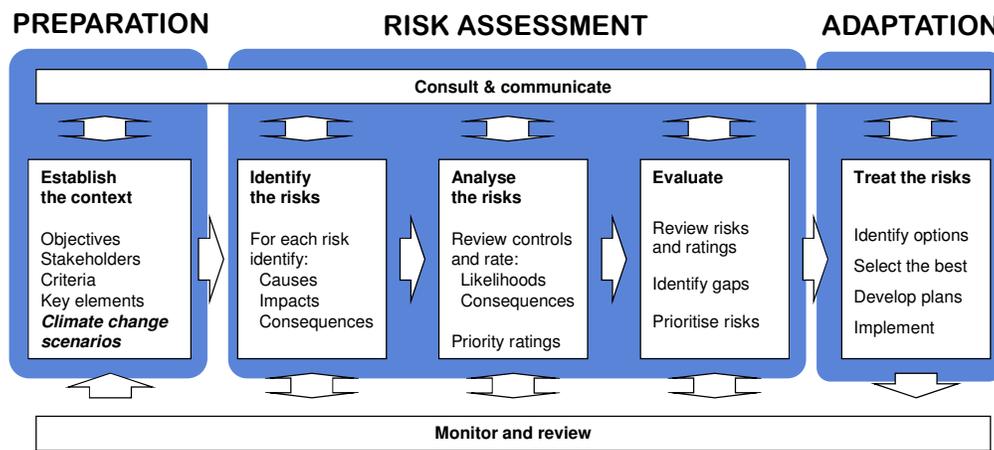
The risk assessment followed the approach set out in the Australian Greenhouse Office / Department of Climate Change publication, *Climate Change Impacts and Risk Management: A Guide for Business and Government* (the Guide), which is based on the Standard AS/NZS4360 and International Standard ISO 31000 for Risk Management. The process can be summarised very briefly as follows:

- Establishing the context. This involves preparation to understand:

- what is at risk;
  - how risks are to be defined; and
  - how they are to be evaluated (e.g. the scales that will be used to estimate consequences, likelihood and risks).
- Risk assessment - identifying, analysing and evaluating the risks.
  - Adaptation - developing and implementing treatments to deal with the risks (to be undertaken later in the project).

These steps are being implemented in three stages (preparation, risk assessment and adaptation) prior to an iterative monitoring and review cycle. Figure 10 illustrates the stages and steps.

**Figure 10: Risk Assessment Process Stages**



### 3.2.1 Risk assessment scope

This risk assessment encompasses all of the roles and responsibilities of council that may be affected by climate change, in particular increased rainfall variability and reduced water availability. It covers the geographic area within the boundaries of the Strathbogie LGA.

Council works closely with a range of external stakeholder groups and individuals, including representatives of community and business organisations (e.g. community action groups), special interest groups, and Victoria and Commonwealth Government departments and agencies (e.g. SES, CFA, Goulburn Valley Water).

This notwithstanding, the climate change risk assessment workshop relied solely on internal stakeholders, i.e. Council staff and councillors. However, extensive consultation with agencies and community members were undertaken following the risk assessment workshop. Through those consultations, amendments and additions were made to the risk register and revisions were made to risk ratings. Through this process two risk registers were produced, reflecting risks to council and the wider community.

### 3.2.2 Risk assessment framework

#### Rating scales

The framework used to analyse and evaluate risks consists of three components:

- A scale to describe the level of consequence of a risk, if it should happen;
- A scale to describe the likelihood of experiencing that level of consequence; and
- A scale to assign a priority rating to each risk, given its consequences and likelihood.

The scales used for this risk assessment are presented in Appendix 1.

The priority ratings used for this risk assessment are based on the risk framework used by the Shire of Strathbogie.

### Risk rating periods

The risk assessment was carried out at three points in time:

- **current**, and extending through the life of existing plans of Strathbogie Shire Council and other planning agencies;
- beyond this to **2030**, when we have an initial projection of the changes that might arise; and
- beyond 2030, using the **2070** projection as an indication of long term prospects.

### Key elements and risk categories

Key elements and risk categories are a list of topics used to work through risks to Council's assets, services and responsibilities and the wider community in a systematic manner. The elements and categories used for this assessment are shown in Table 7.

**Table 7: Key Elements**

Key Element	Risk Categories
<b>1 Infrastructure &amp; Services</b>	Stormwater and Drainage
	Flood Mitigation
	Transport
	Buildings and Facilities
	Recreation
<b>2 Planning &amp; Economic Development</b>	Planning
	Townships and Industry
	Agriculture
	Tourism
	Water Security and Reliability
<b>3 Emergency Management &amp; Services</b>	Emergency Management
	Service Delivery
<b>4 Community Services</b>	Public Health
	Community Wellbeing
<b>5 Environment</b>	Wildlife habitats and biodiversity
	Land management
	Waterways & aquifers

### 3.3 Risk assessment results

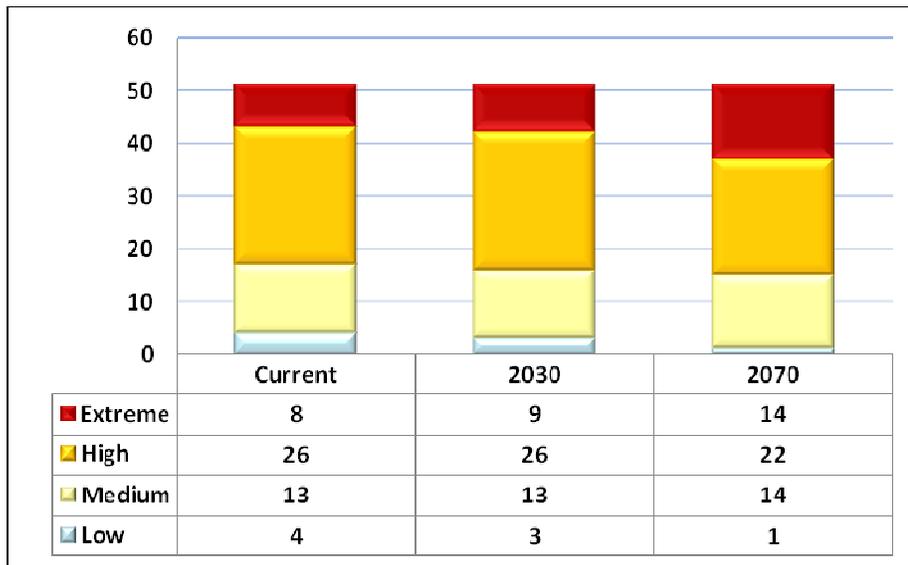
Over 50 risks were identified, discussed and rated during or following the risk assessment workshop, taking into account expert advice from councillors and council staff, agencies and the wider community.

As previously noted, the risks have been rated at both council and community level. The following discussion focuses on council wide ratings and trends for the key elements Infrastructure, Planning and Emergency Management and Service Delivery. Community ratings are discussed for key elements Economic Development, Community Services and Environment. Differences in ratings between council and the wider community or agencies are noted, focussing in particular on risk rated High and Extreme.

A summary of the risk ratings across all major categories (key elements) is given in Figure 11 for the current period, the medium term (2030) and the longer term (2070).

Full details of risks can be found in a register that accompanies this report.

**Figure 11: Summary of climate change risks for the Shire of Strathbogie**



The summary distribution shows that eight risks (~ 16% of all risks) are rated as *Extreme* in the current period, with a further 26 (~51% of all risks) are rated as *High*. Thus there is a predominance of *High* and *Extreme* rated risks in the current period. The number of *High* and *Extreme* rated risks increases marginally to 35 (~ 69% of all risks) in the medium and 36 (~ 71% of all risk) long term.

The number of *High* and *Extreme* risks appears quite significant for a strategic risk assessment of this nature, especially in the short term, and suggests that Council and the community are already struggling with climate change stressors. Given Strathbogie’s location in one of the most bushfire prone areas of Australia and the world, it is not surprising that a ten of the 36 *High* or *Extreme* risks have bushfire, extreme temperature and/or drought as the major driver / stressor. A further eight of the 36 risks rated *High* or *Extreme* in the long term have intense rainfall and/or flooding as the key driver/stressor (see Table 8). The remaining risks are driven by a combination of stressors, such as droughts, bushfires, flooding and other non-climatic drivers, reflecting the sensitivity of the Shire to

the impacts of extreme weather events associated with natural climate variability and climate change, and the limited resources available to Council for ongoing control.

**Table 8: Drivers of High and Extreme Risks**

Climate Drivers / Stressors	Number of Risks
Intense rainfall / flooding	8
Rainfall variability / drought	7
Bushfires	3
Multiple drivers	18

In all cases, it is important to note that all risks were rated based on residual levels of risk. This suggests that *High* or *Extreme* rated risks are either *untreated* or that existing controls are inadequate and hence there is a need for additional, focussed adaptation planning requiring to ensure that they are effectively addressed. Conversely, risks rated *Low* and *Medium* over all time periods suggest either a low level of inherent risk or a high degree of confidence that existing controls are sound and will be able to keep pace with increases to climate stressors.

In general terms, climate change-related risks can be grouped into four broad categories:

- risks associated with the direct, physical impacts of climate change on natural systems;
- risks associated with the direct, physical impacts of climate change on infrastructure;
- indirect, derived risks associated with the economic and social 'flow on' effects (or consequences) of the physical risks; and
- indirect risks associated with policy responses linked to climate change.

It is useful to consider climate change risks in these terms because adaptation planning for direct, natural systems risks will tend to be quite different in nature to adaptation planning for risks to infrastructure, which in turn will be different to adaptation planning for indirect risks.

Give that, it is interesting to note that the 36 risks rated *High* or *Extreme* in the medium term (Table 9) are split fairly evenly between direct and indirect risks, which in turn are split fairly evenly between derived and policy related risks.

**Table 9. Categories of High and Extreme Rated Risks (medium term)**

Category of risk	Risks	Number
Direct, natural systems	2.11, 2.12, 5.01, 5.02, 5.04, 5.05, 5.07,	7
Direct, built infrastructure & services	1.01, 1.02, 1.03, 1.04, 1.05, 1.09, 1.10, 1.11, 3.07	9
Indirect, derived	2.06a, 2.06b, 2.07, 2.10, 3.01, 3.02, 3.03a, 3.03b, 4.04, 4.05	10
Indirect, policy and community response	2.01, 2.02, 2.03, 2.08, 3.04, 3.05, 3.08, 3.09, 3.12, 4.06	10

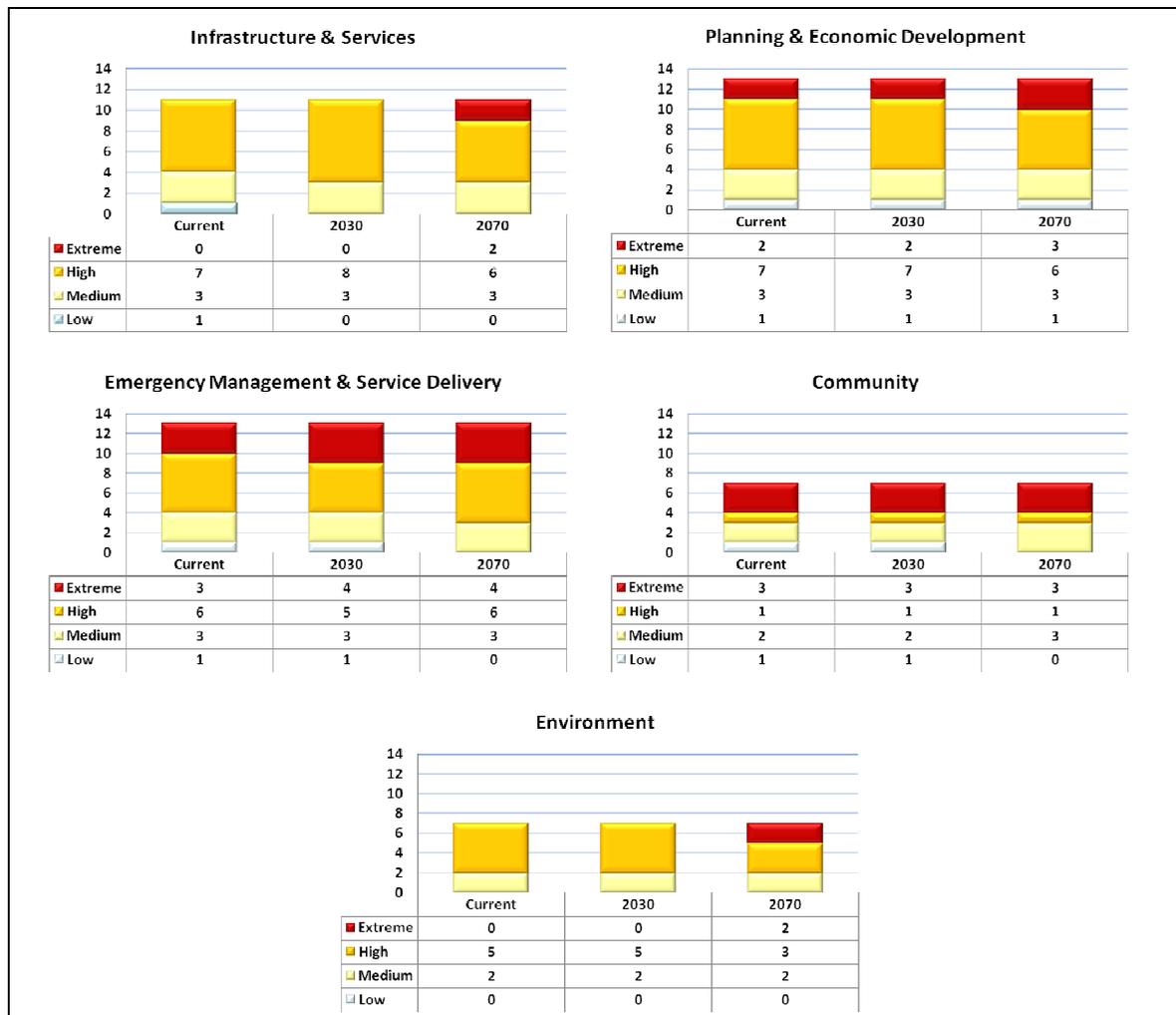
### 3.3.1 Ratings by key element

A breakdown of risk ratings by key element is provided in Figure 12, indicating a similar proportion of *High* and *Extreme* rated risks across the five key elements and across the three time periods. However, the Infrastructure, Planning and Economic Development, and Emergency Management key elements have higher number of risks than the Community and Environment key elements.

There is no clear explanation for these outcomes, although the following factors provide possible explanations to the relatively high number of risks given to the infrastructure and emergency management risks:

- impacts of direct risks, such as infrastructure and emergency management risks can be experienced more immediately (e.g. during or shortly after an extreme event) and are easier recognised and measured; whereas
- impacts resulting from indirect risks (such as risks to the environment and community wellbeing) take longer time to evolve and lag behind the occurrence of a direct risks, which means these indirect risks are less obvious and not readily measureable and therefore not as detailed as direct risks.

**Figure 12: Risks by key element**



### 3.3.2 Risks rated *High* and *Extreme*

Factors influencing *High* and *Extreme* risk ratings vary from risk to risk and can be quite complex. In most cases a *High* or *Extreme* rating reflects:

- a moderate to high sensitivity of Council and/or the community to that risk;
- an increase over time in likelihood of the risk as climate change becomes more marked; and/or
- a view that existing controls, while possibly adequate at present, will not be sufficient to mitigate the risk if the impacts associated with climate change become more marked in the future.

Many of the risks that are *High* and/or *Extreme* in the short to medium terms relate to impacts that Council and/or the wider community already have experienced difficulties in coping with due to:

- increased frequency of intense rainfall events and flooding (e.g. risks 1.02, 1.03, 1.06, 2.01, 3.03a);
- prolonged drought (e.g. risks 1.09, 1.10, 1.11, 2.02, 3.02); or
- multiple climate and non-climate pressures (e.g. risk 2.03, 2.06, 2.07, 2.10, 3.01, 3.05, 3.07, 3.08, 4.04, 4.05, 4.06, 5.04, 5.05, 5.07).

Any increase in the frequency and/or magnitude of impacts due to climate change in the future will only exacerbate these risks. Particular attention will need to be given to these risks in the adaptation planning process.

There are a number of other risks, rated *Medium* or *High* in the short term, which have the potential become *Extreme* in the longer term. As with those discussed above, Council, agencies and the broader community have already been grappling with these risks. Council, working with agencies, has been able to mitigate these risks in the short to medium terms though, as a consequence of controls they have successfully introduced. There is a very possibility however, that impacts will become more striking with climate change and related stressors in the longer term, making it substantially more difficult for Council and agencies to manage the risk without a specific adaptation plan in place (encompassing new or additional measures). Examples of these risks include 1.01, 1.04, 1.05, 2.11, 3.04, 3.09, 5.01 and 5.02.

Seven risks rated *High* or *Extreme* over all three time periods are worth drawing attention to as the consequences of these risks have been rated as *Catastrophic* for both the broader community and Council:

- Risks 3.02 (Reduced availability of water for emergency services), 3.03b (Isolation of communities due to bushfires), 3.12 (misaligned objectives for vegetation management) and 4.04 (Increased community anxiety and stress) are rated as *Catastrophic* because the potentially disastrous consequences to community safety possibly resulting in loss of life.
- Risks 2.01 and 2.02 (inadequate flood modelling, planning scheme and bushfire controls), 2.03 (lack of compliance with bushfire / flooding protection conditions) and 3.07 (property damage or personal injury caused by trees managed by Council) are rated as *Catastrophic* because of Council's liability and the significant financial loss, should one of these risks occur.

Although significant effort has already been made to mitigate these risks, Council and relevant agencies and community members need to review existing controls and implement further adaptation actions to ensure that these risks do not eventuate.



**Table 10: Council and community risks rated *High* and *Extreme***

Risk descriptions				Risk ratings			Other information	
Risk ID & Category	Causes / Stressors	Risk / Impact	Consequences	Priority Current	Priority 2030	Priority 2070	Controls	Notes
1.01 Stormwater & drainage	Increased frequency and severity of intense rainfall events Increased rainfall variability	<b>Stormwater &amp; drainage systems increasingly overwhelmed or damaged (short-term impacts)</b>	Increased maintenance and capital costs Increased flooding disruption to businesses damage to community property	Medium	High	High	systems designed for 5 year and less (frequency of events), limited retrofits (driven by developments)	Council's system designed for 1 to 5 year events, and is at or over capacity already; CMA flood mapping is underway, but not completely yet; stormwater outlets are blocked when creeks are full of water; this pushes stormwater back into towns and the system shuts down; Retrofits of stormwater systems are driven by new developments; Consequences based on financial impact to Council
1.02 Flood mitigation	Increased frequency and severity of intense rainfall events	<b>Flooding of low-lying areas without (or limited) flood mitigation structures in place</b>	Increased maintenance and capital costs Increased flooding	High	High	High	Municipal Emergency Management Plan (MEMP), warning systems, SES response, BoM, CFA, Police,	Council experienced a major flood event in September 2010 due to riverine flooding; Consequences based on financial and service delivery impact to Council
1.03 Flood mitigation	Increased frequency and severity of intense rainfall events Increased rainfall variability	<b>Damage to or failure of flood mitigation structures (e.g. levees)</b>	Increased maintenance and capital costs Increased flooding	High	High	High	flood mitigation structures (levee) maintenance regimes, as above	Levee banks in Euroa were installed on one side of the creek; nearly overtopped during September 2010 flood; responsibility for and governance of creeks, waterways and levees is unclear; state government agencies involved include DSE and DPI; funding of maintenance is uncertain;
1.04 Transport	Increased frequency and severity of intense rainfall events Increased rainfall variability	<b>Increased damage to local transport infrastructure (roads, bridges, culverts,</b>	Increased maintenance and capital costs Increased flooding	High	High	Extreme	maintenance regime, design code (e.g. elevation of roads), asset management system	Council is experiencing a higher deterioration of roads due to extreme weather events and more pronounced wet/dry cycle; budget shortfalls cause a backlog of maintenance despite disaster recovery funding (September 2010 event causes \$2.8 million damage, which were reimbursed through NDRF)

Risk descriptions			Risk ratings			Other information	
		footpaths)					Consequences based on financial impacts to Council after NDRF
1.05 Transport	Increased frequency and severity of droughts and extended dry periods Lack of suitable water supplies Increased frequency and severity of intense rainfall events	<b>Increased difficulty of maintaining gravel roads</b>	Increased maintenance and capital costs Increased flooding	High	High	Extreme	maintenance regime, design code (e.g. elevation of roads), asset management system  Council has a good understanding (documentation / information) of the current status of gravel roads; budget shortfalls cause backlog of maintenance (as above)
1.09 Recreation	Increased rainfall variability Reduced water availability rising water table Flooding	<b>Degradation of playing fields and sport fields</b>	Loss of community access to playing fields Reduced community wellbeing and health Community complaints Increased maintenance costs	High	High	High	drought-proofing of playing fields drought tolerant grass species access to bore water, volunteer groups support maintenance of fields  Playing / sport fields are the 'life blood' of the community, which is also evident in the number of grants available for the upgrade of playing / sport fields Council received grants to upgraded some playing / sport fields; Council has access to bores in Euroa, Avenel and Longwood; however, no water is available for football / cricket field in Longwood
1.10 Recreation	Increased frequency and severity of droughts Increased rainfall variability Reduced water availability	<b>Degradation of parks, gardens and streetscapes, footpaths and walking trails</b>	Loss of community access to gardens Reduced community wellbeing and health Community complaints	High	High	High	drought tolerant species, mulching, deep watering, irrigation systems  Parks, gardens and streetscapes are of high amenity value for the community; Council has less staff / resources to maintain gardens, parks and streetscapes compared with playing / sport fields, additionally, sport fields are maintained by volunteer groups as well Consequences are the same as with risk 4.01; footpaths and walking trails along creeks were damaged by drought and flooding
1.11 Recreation	Increased frequency and severity of droughts Increased rainfall variability	<b>Increased damage to council swimming pools due to ground movement and shifting</b>	Increased maintenance and capital costs Increased flooding	High	High	High	asset management, inspection and maintenance program,  Council faces a lack of funding for maintenance and repair of swimming pools; costs are significantly higher than revenue from ticket sales; in particular ground movement causes major damages; Patronage of Euroa and Violet Town swimming pools is good, but low for other two

Risk descriptions				Risk ratings			Other information	
		foundations						swimming pools (contributing to low revenue); lawns couldn't be watered during drought, resulting in a loss of amenity, which has also contributed to lower patronage
2.01 Planning	Increased frequency and severity of flooding	<b>Flood modelling and planning scheme fails to reflect the extent of inundation under climate change scenarios</b>	Inappropriate development Council liability for developments threatened by flooding	Extreme	Extreme	Extreme	planning scheme maps, overlay controls (based on 1993 modelling); referral to CMA (for larger subdivisions)	historic 1-in-100 year flood mapping is used in planning scheme; Updated flood modelling for Violet shows significant difference to flood modelling used in planning scheme; levee banks in Euroa alters the mapping and has downstream impacts, these are not capture in planning scheme; planning scheme does not include extreme rainfall intensity modelling; Council does not have flood modelling for Nagambie, relies on local knowledge and building surveyors; development applications for large subdivisions are referred to CMA
2.02 Planning	Increased frequency and severity of bushfires Increase frequency and severity of droughts, dry periods	<b>Planning scheme places inadequate controls on developments in high bushfire risk areas</b>	Inappropriate development Council liability for developments destroyed by bushfires	High	High	High	wildfire management overlays, referral to CFA (for larger subdivisions)	State might change wildfire management overlays; current controls based on best available information and seen as adequate;
2.03 Planning	Increased frequency and severity of bushfires Increase frequency and severity of droughts, dry periods Increased frequency and severity of flooding	<b>lack of compliance with bushfire / flooding protection conditions applied to new developments</b>	Council liability	Extreme	Extreme	Extreme	audit program (limited),	Council has an obligation to actively audit (random audits) and enforce conditions applied to new developments, but faces a lack of resources to do so; Council could possibly face legal consequences, in case of accidents due to non-compliance; This risk was not rated, as further investigations (e.g. advice from MAV) are required to better understand the consequences to council.
2.06a Agriculture	Reduced water availability Increased frequency and	<b>Decline in viability of</b>	Regional economic decline	High	High	High	Council negotiates with GVW on behalf of	The region has seen a shift from non-intensive to intensive plant agriculture (e.g. viticulture);

Risk descriptions			Risk ratings			Other information	
	severity of droughts Increased frequency of extreme climate events	<b>intensive plant industry linked to climate changes</b>	Reduced employment Reduced rate base				developers  Viticulture is under threat with farm dam supplies for irrigation:  Intensive agriculture is less exposed to climate change risks than non-intensive agriculture. Many businesses have permanent water supply or trying to connect to the reticulated system. However, GVW limits supply to rural industries;
2.06b Agriculture	Reduced water availability Increased frequency and severity of droughts Increased frequency of extreme climate events	<b>Decline in viability of intensive animal industry linked to climate changes</b>	Regional economic decline Reduced employment Reduced rate base	<b>High</b>	<b>High</b>	<b>High</b>	Council negotiates with GVW on behalf of developers  The region has seen a shift from non-intensive to intensive animal agriculture (e.g. pigs, eggs for vaccine production, etc. );  Intensive agriculture is less exposed to climate change risks than non-intensive agriculture, however, water availability is an issue; many businesses are connected or trying to connect to the reticulated system. However, GVW limits supply to rural industries;
2.07 Agriculture	Increased frequency and severity of droughts Increased frequency of extreme climate events	<b>Decline in viability of non-intensive agriculture linked to climate changes</b>	Regional economic decline Reduced employment Reduced rate base	<b>High</b>	<b>High</b>	<b>High</b>	
2.08 Agriculture	Increased input costs (energy, fertilisers) Increased costs associated with mitigating GHG emissions State, national and international greenhouse gas mitigation	<b>Decline in viability of regional agricultural sector linked to increased operating costs</b>	Regional economic decline Reduced employment Reduced rate base	<b>High</b>	<b>High</b>	<b>High</b>	This presents both an <u>opportunity</u> and a <u>risk</u> ; many grass-root producer, cutting-edge farmers and other innovative industries are located in the region; the agriculture support industry is coping well;
2.10 Tourism	Changes in regional climate More extreme climate events Reduced water availability Increased frequency and severity of droughts	<b>Decline in viability of regional tourism sector linked to changed climate</b>	Regional economic decline Reduced employment Reduced rate base	<b>High</b>	<b>High</b>	<b>High</b>	regional partnerships to support industry, strategic plan to grow tourism (GVRTB)  Tourism is not a major industry for the region, but seen as underdeveloped; locations such as sporting fields, parks and waterways (e.g. Lake Nagambie) are important for tourism and recreation; Tourism and recreation could decline due to extreme events (storms, flooding, wildfires) or

Risk descriptions				Risk ratings			Other information	
								other events driven by climate change, such as blue green algae
2.11 Other	Reduced average rainfall and increased rainfall variability Increased surface or groundwater extractions Reduced reliability of surface water Reduced groundwater recharge	<b>Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)</b>	decline in tourism industry decline in agriculture	High	High	Extreme	Waterways strategy	All river in the region, except Goulburn river, are unregulated; In addition to their importance for biodiversity, all waterways are imperative for the tourism industry and unregulated rivers are also an important water source for farmers; Decreased water reliability in unregulated rivers will have direct impacts on the environment as well as indirect impacts on the region's economy, in particular tourism and agriculture
3.01 Emergency Mgmt	Increase of frequency and intensity of rainfall / flooding Increase of frequency and intensity of heatwaves	<b>Council unable to meet demand for recovery services</b>	Strain on council services (e.g. unable to provide adequate clean-up and infrastructure repairs) Increase in operating costs wellbeing of staff impacted, OHS	High	High	High	cooperation with other councils (sharing of resources), staff training (work in relief centres),	It is highly likely that some of Council's personnel are affected by the event themselves and are therefore unable to provide recovery services;  Consequences are based on service delivery and reputational impacts to Council
3.02 Emergency Mgmt	Increased rainfall variability Increased frequency and severity of droughts	<b>Reduced availability of water for emergency services (esp. bushfire fighting)</b>	Loss of life Loss or damage to property Increased insurance costs	Extreme	Extreme	Extreme	CFA tanks, CFA bought add. water license, water replacement policy, register of water sources and information provided to community;	CFA installed bigger tanks, bought additional water licenses and implemented a 'water replacement policy', which ensure that private dams will be filled after water was used for fire-fighting, providing easier "access" to private dams/ tanks; Dry periods / drought caused major water shortages, which could have fatal consequences during the fire season; Euroa ran out of water in 2006, Violet Town ran out of water twice during the 12 year drought
3.03a Emergency Mgmt	Increased frequency and intensity of rainfall / flooding Increased frequency or	<b>Isolation of vulnerable communities due to flooding</b>	disruption to travel emergency access and access for recovery service	High	High	High		Council currently does not have safe places / shelters in the hill area and is actively looking for safe neighbourhood places

Risk descriptions				Risk ratings			Other information	
	severity of storms		blocked					
3.03b Emergency Mgmt	Increased frequency and severity of bushfires	<b>Isolation of vulnerable communities due to bushfires</b>	disruption to travel emergency access and access for recovery service blocked Loss of life	<b>Extreme</b>	<b>Extreme</b>	<b>Extreme</b>		
3.04 Emergency Mgmt	Increased frequency of other severe fire weather conditions/ code red days Increased frequency/severity of intense rainfall and flooding Increased severity of storms	<b>Increase in frequency and severity of extreme weather strains capacity of emergency response agencies</b>	Increased disruptions to services and community (voluntary evacuations) Lack of human resources/ strain on council services (e.g. unable to provide adequate emergency accommodation for people or stock)	<b>High</b>	<b>Extreme</b>	<b>Extreme</b>	business continuity plan (limited control), MEMP, MEROs, regional cooperation with other Shires, support agencies and emergency response agencies heat wave alert, system for dealing with vulnerable members of the community on code red days	Human resource constraints are a major issue, Council and agencies do not have enough staff / MEROs to deal with extreme events / code red days (18 code red days during 2009/10); Council expects a shortages of staff for emergency management centre during code red days and other extreme climate events; most council staff live in the region and are impacted by code red days / extreme events themselves; Code red days also impact on Council's regular service delivery as staff is not permitted to work outdoors; Council also does not have enough safe places for community members;
3.05 Service Delivery	Increased frequency and severity of floods, bushfires, storms, heatwaves	<b>Inability of council to deliver regular services due to staff responding to weather-related emergencies</b>	Disruption to council services	<b>High</b>	<b>High</b>	<b>High</b>	business continuity plan, community information with regard to service delivery,	Flood repairs (after September 2010 flood) required Council to defer other services / regular maintenance; without state / federal funding, resources would need to be re-allocated to recovery services, resulting in less (or worst case, no) regularly service delivery;
3.07 Other	Increased rainfall variability Increased frequency of drought Extreme weather events	<b>Increased property damage or personal injury as a result of falling limbs and other damage caused by trees managed by</b>	Legal liability Financial loss amenity of events compromised	<b>High</b>	<b>High</b>	<b>High</b>	insurance, condition assessment, urban tree management plan, management of events, closure of areas at risk, risk management for	trees in parks are relatively old, drought had a long-term impact on health of trees, which now shed limbs; Council had to move or cancel events due to a high risk of falling limbs; so far no major injuries or death have been recorded, but there is the a high risk of injuries especially during bigger events

Risk descriptions				Risk ratings			Other information	
		Council					events	
3.08 Emergency Mgmt	Ageing population leading to a reduced volunteer resource. Increased demand for response and recovery services	<b>reduced volunteer base available to respond to the increasing numbers of emergency events</b>	failure to meet expectations of community support. Unsustainable demands placed on volunteers	High	High	High	existing recruitment programs. Variety of volunteer services. Leadership development programs. Agency and community.	concerns about recruitment into volunteer services. Need for appropriate skills in volunteers. Technology improvements may occur
3.09 Emergency Mgmt		<b>Increasing frequency of code red days</b>	Increased disruption to services, school closures, public facility closures, voluntary relocation, economic and tourism impacts, impacts on volunteer demand	Medium	Medium	High		
3.12 Emergency Mgmt		<b>misaligned objectives for vegetation management between agencies and landholders</b>	community safety measures restricted or compromised	Extreme	Extreme	Extreme		
4.02 Public health	Increase in average and extreme temperatures loss of power	<b>Increase in disease outbreaks associated with food borne bacteria</b> (home and commercial premises)	Morbidity and mortality Increased demand / load on public health system Public outcry	Extreme	Extreme	Extreme	inspection regime, regulations	Only individual / minor incidents so far, e.g. people / businesses trying to safe power by having a 'warmer' fridge; The elderly more susceptible to poor food quality issues from their own refrigerators and freezers; less power outages as SP Ausnet has improved capacity of distribution network over the last years
4.03	More hot days and runs of	<b>Increased incidence of heat</b>	Stress on community and	Extreme	Extreme	Extreme	Heatwave Plan	Council's Heatwave Plan was implemented in

Risk descriptions		Risk ratings			Other information		
Public health	hot days	<b>related morbidity and mortality</b>	health services Negative effects on mental and physical health Increased energy demand and associated cost Impact on power infrastructure				2009, addressing this risk.
4.04 Public health	Increased frequency and severity droughts Increased frequency and severity of flooding Increased frequency and intensity of bushfires	<b>Increased community anxiety and stress associated with droughts and extreme climate events</b>	Decline in wellbeing / mental health of farmers Family breakdowns Decline in community wellbeing Suicides financial distress	<b>Extreme</b>	<b>Extreme</b>	<b>Extreme</b>	information on service providers, referrals to counselling services (drought), community gatherings and forums, beyond blue and similar organisations,  Over the last decade the number of suicides, in particular amongst younger persons, have increased drastically; The catastrophic consequences are based on the high number of suicides;  A demographic change is expected over the coming decades, possibly increasing the resilience of the community
4.06 Community wellbeing	Increase water prices linked to reduced water availability Increased energy costs increased costs for waste management	<b>Financial stress on (low income) households</b>	Reduced community wellbeing Community complaints Impact on economic development	<b>High</b>	<b>High</b>	<b>High</b>	Rebates / vouchers (free hard waste collection, free tickets for swimming pool), community events, community initiatives for social interaction  ABS statistics indicate a high proportion of vulnerable communities within the Shire; increased utility costs will lead to residents cancelling other service (provided by Council) because they cannot afford these anymore;
5.01 Wildlife habitats and biodiversity	Reduced average rainfall Increased rainfall variability Persistently raised temperatures Changed evapo-transpiration Increased frequency or severity of bushfires	<b>Loss or change in composition of native vegetation (including instream vegetation)</b>	Reduced catchment health Loss of communities or biodiversity	<b>High</b>	<b>High</b>	<b>Extreme</b>	Planning controls re removal of native vegetation, environmental overlays Environmental Committee  Council controls illegal dumping, pollution, septic systems and has development controls in place, but no direct responsibility for environmental management Predicting changes is very difficult due to many unknowns and interrelationships isolated and/or pockets of habitat will be particularly impacted
5.02 Wildlife habitats and	Reduced average rainfall Increased rainfall variability Increase frequency of	<b>Increase in invasive weed and pest species</b>	Reduced catchment health Loss of	<b>High</b>	<b>High</b>	<b>Extreme</b>	Environmental Committee; Draft Environmental  Pests (rabbits, foxes) and weeds (blackberries) can be a major issue; in particular flats (west of Hume Highway) are covered in black berries without any

Risk descriptions				Risk ratings			Other information	
biodiversity	droughts increase in wildfires		communities and biodiversity Agricultural impacts Increased costs of weed control				Management Strategy	weed control A weeds/ pest committee <u>was</u> in place and Council took a lead role in land pest and weed control; however, pest and weed control is no longer Council's responsibility, although DPI / DSE provide grants to councils for weed management and might require councils to take on more responsibility in the future
5.04 Waterways & aquifers	Reduced average rainfall Increased rainfall variability Increased surface or groundwater extractions Reduced reliability of surface water Reduced groundwater recharge increases in water temperature change in hydrology due to move from winter/spring flooding events to more intense summer storm events	<b>Reduction in shallow groundwater recharge</b>	Increased pressure on aquatic or amphibious species and communities Decreased breeding opportunities for birds, impacts on wetlands, groundwater dependent ecosystems poor water quality impacts on ecosystems alterations to breeding cues	High	High	High	Waterways strategy planning conditions on subdivisions and residential development to restrict bores	A planning response to groundwater is required
5.05 Waterways & aquifers	Reduced average rainfall Increased rainfall variability Increased surface or groundwater extractions Reduced reliability of surface water Reduced groundwater recharge	<b>Decreased water reliability in <u>unregulated</u> systems (standing waterbodies, wetlands and waterways)</b>	Increased pressure on aquatic and amphibious species and communities Impaired ecosystem function	High	High	High	Waterways strategy	Decreased water reliability is likely to impact on social amenity of waterways as well, e.g. less attractive for swimming, fishing, walking and picnicking Increased likelihood of exotic weeds species invading
5.07 Waterways & aquifers	Persistently raised temperatures Reduced steamflows	<b>Increased frequency of poor water quality</b>	Increased pressure on aquatic or amphibious	High	High	High	controls for septic systems,	In addition to the detrimental impacts on biodiversity, poor water quality will have negative flow on effects on tourism, recreation, agriculture

Risk descriptions		Risk ratings			Other information	
	More frequent and severe droughts, intense rainfall events, flooding Increased frequency and severity of bushfires		species and communities Flow on effects for recreation, tourism and aquaculture			and aquaculture

## 4. Approach to developing adaptation actions

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### 4.1 Climate change adaptation

Notwithstanding an increasing level of national and international research aimed at building awareness and understanding of climate change adaptation (e.g. Brooks 2003, Smit & Wandel 2006, Preston & Stafford\_Smith 2009), there is still no universally agreed definition of climate change adaptation. As outlined in Box 1 though, for the purpose of this strategy climate change adaptation is defined as ‘actions taken in response to actual or anticipated climate change impacts that lead to a reduction in risks or realisation of benefits’<sup>14</sup>.

Actions in the strategy include policies, program or measures that will work to reduce the financial, social or environmental costs stemming from climate change impacts, either:

- **directly**, by reducing the magnitude or likelihood of an impact occurring - i.e. by reducing the risk; or
- **indirectly**, by increasing the capacity of vulnerable communities and systems to respond to an impact should it occur - i.e. by enhancing their adaptive capacity.

As outlined in Table 11, actions considered for the Adaptation Strategy are wide-ranging and include changes to legislation, standards and statutory planning, revised strategies and plans, on the ground works, improved decision making processes and procedures, education and training, monitoring and data collection and research. At first glance, actions falling into the latter three categories might not be regarded as ‘actions’, but improved data collection, research and education and training can be crucial to increasing the capacity of communities to respond to climate change.

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<sup>14</sup> This is an abridged version of a definition provided by the IPCC (Parry et al. 2007).

**Table 11. Types of adaptation actions considered for the strategy**

Adaptation types	Description and examples
<b>Regulations / standards / statutory plans</b>	Regulations, standards and planning frameworks: <ul style="list-style-type: none"> <li>– Local planning schemes</li> <li>– Building design standards</li> <li>– Planning provisions that prevent new infrastructure from being built in high risk areas</li> <li>– Council by-laws</li> </ul>
<b>Strategies and plans</b>	Local strategies and plans: <ul style="list-style-type: none"> <li>– Strategic plans</li> <li>– Management plans</li> </ul> (Note, plans are likely to be made up of items listed below)
<b>Infrastructure, 'on-ground' works or design</b>	Engineering solutions and practices: <ul style="list-style-type: none"> <li>– Infrastructure protection measures</li> <li>– Inherent design of infrastructure to maximise resilience</li> <li>– Environmental protection or remediation works</li> <li>– Energy / water efficiency measures</li> </ul>
<b>Internal procedures</b>	Practices and procedures at an organisational level: <ul style="list-style-type: none"> <li>– Environmental management systems</li> <li>– Emergency management planning</li> <li>– HR management practices</li> <li>– OH&amp;S practices</li> </ul>
<b>Data collection / information / research</b>	Information / data collection or research that improves understanding of relationship between climate change and risk: <ul style="list-style-type: none"> <li>– Research on relationship between past and potential future variations in climate and performance of economic, social and environmental systems</li> <li>– Research on relationship between changes to frequency and magnitude of extreme events and critical thresholds</li> <li>– Assessment of adaptation options</li> </ul>
<b>Education, behavioural</b>	Educate and inform community about climate change risks and adaptation measures Educate community about approaches to and benefits of changing behaviour
<b>Spread or displace risk</b>	Insurance and diversification strategies: <ul style="list-style-type: none"> <li>– Use of insurance products to off-lay the risk</li> <li>– Risks shared between different agencies / entities</li> <li>– Geographical diversification (e.g. of raw materials)</li> </ul>
<b>Coordinated, regional approach</b>	Coordinated, regional approaches to managing an issue: <ul style="list-style-type: none"> <li>– Regional institution or organisation</li> <li>– Regional alliance or network</li> <li>– Shared regional framework or approach</li> </ul>

## 4.2 Principles underpinning adaptation actions

To the extent feasible, every effort has been made to ensure that actions in this plan are consistent with generic principles of good practice climate change adaptation, which have been developed in the climate change adaptation literature over recent years. Principles include:

- **Focus on priority climate change issues:** The climate change risk assessment has provided Strathbogie Shire with a process for identifying and prioritising climate change issues. As discussed further in 4.3, this strategy focuses on a defined list of priority risks, ensuring that it is targeted at the issues most important to the Shire of Strathbogie.
- **Use an adaptive management approach:** Adaptive management is an important strategy for dealing with climate change uncertainties. It is the process of putting into place, flexible, incremental changes based on regular monitoring and revision of plans as new information arises. This strategy seeks to build on existing plans and strategies, recognising that most of the climate change risks in the region are not 'new' risks but add to or compound established risks.
- **Avoid adaptation constraining decisions or mal-adaptation:** Actions in this strategy should not lead to perverse outcomes, such as constraining the ability of the Council and local communities to adapt to climate change in the future.
- **Achieve balance between climate and non-climate risks:** Implementing a climate change adaptation plan is not itself risk free. Council and local communities need to take a balanced approach to managing climate and non-climate risks. This is best achieved by the Shire of Strathbogie integrating its climate change risk assessment with its broader risk management processes. An important criterion for assessing priority actions (see below) is that they are 'no-regrets' actions, i.e. they will have net benefits to Council and local communities beyond climate change.
- **Prioritise actions:** It is important that the Shire of Strathbogie has a clear understanding of the pros and cons, and costs and benefits of adaptation actions. Criteria for selecting priority actions are identified later in this report. More detailed assessment (e.g. financial costs) of some of the actions may be required to complete the process.

## 4.3 Process used to develop actions

The process used to develop actions in this strategy centred on workshops held with Council staff, councillors and representatives of relevant stakeholder organisations at Euroa in October 2011. In all, the process entailed five main steps, with steps 1 and 2 being undertaken prior to the workshops, steps 3 and 4 being completed at the workshops, and step 5 following the workshops:

1. **Priority risk selection:** The principal basis for selecting priority risks was their overall risk rating. Generally, a risk has been classified as a priority risk if it has been rated 'High' or 'Extreme' by Council and Community (averaged over the three time periods). Using this approach, a total of 37 priority risks were selected to be addressed in the strategy (see Table 12).
2. **Priority risk categories and subsets:** Priority risks were then grouped into categories and subsets (see Table 12, section 5.1). The purpose of the grouping was to enable risks that have significant similarities (and are therefore likely to require common adaptation responses) to be considered collectively in the adaptation planning process.
3. **Review existing controls:** Existing controls (policies, programs and measures) relevant to each priority risk subset were identified and then reviewed against a range of criteria, such as effectiveness and

resourcing, with the purpose of establishing where there are significant gaps or deficiencies with current controls.

4. **Potential new and revised actions:** For each priority risk subset, potential actions for overcoming gaps or deficiencies were identified. Noting the adaptation principles discussed in section 4.2, an initial assessment of the actions was undertaken against a range of criteria such as timeframe for implementation, budgetary implications, Council's role vis-à-vis other agencies and barriers to implementation.
5. **Consolidation of inputs and further analysis.** Outputs from workshops were consolidated and scrutinised to ensure consistency. Further analysis of actions was then undertaken considering current strategies, plans and policies. All outputs were then refined and consolidated into climate change adaptation actions, which are presented in the following section.

## 5. Adaptation actions

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### 5.1 Scope and presentation of actions

This section presents the priority risks to the Shire of Strathbogie and the wider community, a review of existing controls and recommended actions to deal with these priority climate change risks. Actions have been developed for risks rated *High* or *Extreme* by the Shire of Strathbogie and the wider community including actions on the following:

- emergency management;
- social and community;
- environmental management;
- infrastructure and assets;
- planning; and
- economic development.

Recommended adaptation actions relating to the priority risk subsets are detailed in sections 6.2 to 6.7. Within each subset, actions are accompanied by discussion of the underlying issue(s), existing controls and gaps and deficiencies with those controls. Actions having relevance to more than one risk subset are cross-referenced.

More than 40 recommendations have been made for actions to address risks to the Shire of Strathbogie associated with reduced water availability and increased rainfall variability. This strategy has been developed primarily for Strathbogie Shire Council. Thus many of the actions are directed at Council. Nevertheless, an effective adaptation strategy for the Shire of Strathbogie cannot be implemented by the Council alone. For that reason, numerous actions will require Council to work collaboratively with other organisations (government and non-government).

It is important to note that implementation of actions will be dependent on available resources.

Timeframes for implementation are provided with each action. Indicative timeframes are as follows: short term: 1-2 years; medium term: 2-5 years; and long term: more than 5 years.

Table 12 details all of the priority risks. As discussed in section 4.3, in order to undertake efficient adaptation planning for the priority risks the risks have been grouped into subsets. The purpose of this approach is to enable risks with similar themes, which are likely to require common adaptation responses, to be considered together when developing adaptation actions.

Table 12: Priority Risks and Subsets

Risk category / subset	Risk ID	Risk
<b>Emergency Management</b>		
<b>Subset A</b> Isolation of communities	3.03a	Isolation of vulnerable communities due to flooding
	3.03b	Isolation of vulnerable communities due to bushfires
<b>Subset B</b> Staff & volunteer shortages	3.04	Increase in frequency and severity of extreme weather strains capacity of emergency response agencies
	3.01	Council unable to meet demand for recovery services
	3.08	Reduced volunteer base available to respond to the increasing numbers of emergency events
	3.05	Inability of council to deliver regular services due to staff responding to weather-related emergencies
<b>Subset C</b> Bushfire management & response	3.02	Reduced availability of water for emergency services (esp. bushfire fighting)
	3.12	Misaligned objectives for vegetation management between agencies and landholders
<b>Social &amp; Community</b>		
<b>Subset D</b> Public health	4.02	Increase in disease outbreaks associated with food borne bacteria
	4.03	Increased incidence of heat related morbidity and mortality
<b>Subset E</b> Community wellbeing	4.04	Increased community anxiety and stress associated with droughts and extreme climate events
	4.06	Financial stress on households
<b>Subset F</b> Recreation	1.09	Degradation of playing fields and sport fields
	1.10	Degradation of parks, gardens and streetscapes, footpaths and walking trails
	1.11	Increased damage to council swimming pools due to ground movement and shifting foundations
<b>Environment</b>		
<b>Subset G</b> Biodiversity and wildlife habitats	2.01	Loss or change in composition of native vegetation (including instream vegetation)
	2.02	Increase in invasive weed and pest species
<b>Subset H</b> Waterways (incl. groundwater)	5.05	Decreased water reliability in unregulated systems (standing waterbodies, wetlands and waterways)
	5.07	Increased frequency of poor water quality
	5.04	Reduction in shallow groundwater recharge

Risk category / subset	Risk ID	Risk
<b>Infrastructure</b>		
<b>Subset I</b> Stormwater & flooding	1.01	Stormwater & drainage systems increasingly overwhelmed or damaged (short-term impacts)
	1.02	Flooding of low-lying areas without (or with limited) flood mitigation structures in place
	1.03	Damage to or failure of flood mitigation structures (e.g. levees)
<b>Subset J</b> Transport infrastructure	1.04	Increased damage to local transport infrastructure (roads, bridges, culverts, footpaths)
	1.05	Increased difficulty of maintaining gravel roads
<b>Planning</b>		
<b>Subset K</b> Planning – flood management	2.01	Flood modelling and planning scheme fails to reflect the extent of inundation under climate change scenarios
	2.03	Lack of compliance with bushfire / flooding protection conditions applied to new developments
<b>Subset L</b> Planning – bushfire management	2.02	Planning scheme places inadequate controls on developments in high bushfire risk areas
	2.03	Lack of compliance with bushfire / flooding protection conditions applied to new developments
	3.12	Misaligned objectives for vegetation management between agencies and landholders
<b>Economic Development</b>		
<b>Subset M</b> Agriculture	2.06a	Decline in viability of intensive plant industry (e.g. horticulture, viticulture) linked to climate changes
	2.07	Decline in viability of non-intensive agriculture linked to climate changes
	2.08	Decline in viability of regional agricultural sector linked to increased operating costs
<b>Subset N</b> Tourism	2.11	Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)
	2.10	Decline in viability of regional tourism sector linked to changed climate
	2.11	Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)
	2.12	Decreased water reliability in regulated systems (Goulburn River)

## 5.2 Emergency management

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to emergency management. Priority risk subsets addressed in this section include:

- Subset A: Isolation of communities
- Subset B: Staff & volunteer shortages
- Subset C: Bushfire management & response

### 5.2.1 Subset A: Isolation of communities

#### Priority Risks Addressed

3.03a: Isolation of vulnerable communities due to flooding

3.03b: Isolation of vulnerable communities due to bushfires

#### Focus and Context

**The focus of this section is on vulnerable sections of the community or individuals who could be isolated, either physically or due to lack of access to networks, by flooding or bushfires.**

Flooding of roads in the region in the past has isolated significant sections of the community for extended periods and prevented access by emergency management vehicles, as well as service providers. Similarly, bushfires can obstruct escape routes of communities and prevent access by emergency management vehicles service providers. Isolation is a particular problem for vulnerable sections of the community such as the elderly or infirm. In some cases isolation in emergency situations can also result from a lack of access to information and a support network (e.g. friends or neighbours).

Projections for an increase in the frequency and/or magnitude of extreme rainfall events and associated flooding as well as the increase in the number of extreme fire danger days indicate that the impacts of flooding and bushfires on traffic movement and access could become more severe in the future, possibly isolating communities for more prolonged periods or larger sections of the community.

#### Existing Controls

##### **Municipal Emergency Management Planning Committee (MEMPC) and Municipal Emergency Management Plan (MEMP)**

The MEMPC is coordinated by Council and includes the CFA, SES and Victoria Police representatives. It oversees the preparation of the MEMP, which covers the management, prevention, response, recovery and support arrangement for emergencies in each municipality.

The MEMPC also monitors the effects of and coordinates appropriate actions during emergencies, such as disseminating warnings and other related information to the community.

The *Municipal Emergency Management Plan* (MEMP) contains information on vulnerable communities.

##### **Municipal Fire Prevention Committee (MFPC)**

The MEMPC has established a MFPC, whose role includes

- developing and implementing the Municipal Fire Prevention Plan and township protection plans.
- designating Council Neighbourhood Safer Places (also known as Places of Last Resort);
- developing protocols for notification of code red days; and
- co-ordinating provision of water for fire fighting.

##### **Neighbourhood Safer Places (NSP)**

NSPs are places of last resort and can provide some protection from direct flame and radiant heat during a

## Existing Controls

fire.

### Road Management Plan

Council's Road Management Plan details how roads within the municipality are managed, including:

- emergency works, which are undertaken within a short timeframe, outside of the routine works programs, to ensure the safety of road users as a result of emergency incidents; and
- maintenance of fire access roads.

### Victorian Fire Risk Register

The Victorian Fire Risk Register (VFRR) prioritises localities and assets for protection during wildfires in the region. It supports bushfire management planning and provides evidence-based data to assess the level of risk to properties and provides a range of treatments to reduce those risks.

### Community information and education programs

Community information and education programs are provided in Shire, principally in the form of written materials. These include advice on emergency planning, relocation and insurance requirements in the case of floods or bushfires. Examples include:

- SES FloodSafe Guide;
- CFA Home Bushfire Advice Visit;
- CFA Education Programs;
- CFA Fire Ready Kit; and
- DHS Fire Ready Guide.

## Gaps and Deficiencies

### MEMP and sub-plans

The MEMP, implemented through the MEMPC, provides a sound platform for emergency response in the Shire, including in relation to emergency access. However, increasing pressures due to climate change (e.g. increased frequency and severity of rainfall) have not yet been adequately addressed in the MEMP and relevant sub-plans (e.g. flood plans, Municipal Fire Prevention Plan). Regular reviews and updates addressing climate change impacts and resulting extreme weather events are needed.

There is also a need for better integration of all risk and hazard assessments and planning to ensure efficient prevention of and response to emergencies.

Changes to the MEMP and other plans need to be communicated widely to all relevant stakeholders and the community and incorporated in other strategies and plans, where required.

### Resourcing

As discussed in relation to Subset J, sufficient and timely funding for transport route upgrades within the Shire is an ongoing issue, likely to be exacerbated under a future climate regime.

### Communication and information

It is likely that the broader community may not be fully aware of and effectively informed and engaged in local and regional emergency response efforts particularly in relation to:

- alternative transport routes in the event of a flood (or other emergency such as a bushfire);
- household preparedness in the event of being cut off from day to day services for prolonged periods due to road closures; and
- insurance requirements.

### Neighbourhood Safer Places (NSP) / Places of last resort

Council currently does not have NSPs and shelters in the Strathbogie Ranges – the most vulnerable area in the Shire - although it is actively looking for suitable places.

Existing places of last resort do not provide sufficient capacity for all community members.

Recommended Actions		Implementing Organisation(s) <sup>15</sup>	Implementation Timeframe <sup>16</sup>
#	Description		
A1.	<p><b>Review of existing emergency response framework, MEMP, sub-plans and relationships</b></p> <p>Council, working with regional emergency service agencies, should conduct a review of the emergency response framework, MEMP and sub-plans, and relationships for the Shire. The review should seek to identify existing limitations with the MEMP and provide recommendations and tools to improve the capacity of the Council, and emergency service agencies to manage projected increases in extreme events from an emergency response perspective, particularly projected increases in the coincident occurrence of extreme events, such as floods and bushfires.</p> <p>The review should also focus on the ability of key service providers to continue to deliver community services during and after extreme events.</p> <p>In addition, the review should seek to integrate all hazard and risk planning not currently part of the MEMP (e.g. heatwave planning – see D4)</p>	<b>MEMPC</b>	Short-term
A2.	<p><b>Community awareness program</b></p> <p>Council, working with regional emergency services agencies, should develop a community awareness program to promote increased household preparedness for floods and bushfires. The program would aim to improve household and community ownership / responsibility for emergency response and build capacity (including, for example, decentralisation of power and water supplies) to reduce their short term dependence on mainstream services and the need for evacuation.</p>	<b>MEMPC</b>	Short-term
A3.	<p><b>Neighbourhood Safer Places / Places of last resort</b></p> <p>In accordance with Council's Neighbourhood Safer Places Plan, Council should investigate potential additional neighbourhood safer places, in particular near the Strathbogie Ranges, and inform the community about these places – their location and the circumstances in which they are sought.</p>	<b>MEMPC</b>	Short-term

<sup>15</sup> Suggested lead organisation is indicated in bold, where that is clear. Order of organisations in list is not necessarily an indication of their relative importance to the action.

<sup>16</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

## 5.2.2 Subset B: Staff & volunteer shortages

### Priority Risks Addressed

- 3.01: Council unable to meet demand for recovery services
- 3.04: Increase in frequency and severity of extreme weather strains capacity of emergency response agencies
- 3.08: Reduced volunteer base available to respond to the increasing numbers of emergency events
- 3.05: Inability of council to deliver regular services due to staff responding to weather-related emergencies

### Focus and Context

**The focus of this section is on the capacity of Council and emergency response agencies to provide emergency response, recovery and other services, particularly in circumstances involving concurrent extreme weather events.**

An increase in the frequency and/or severity of climate related emergencies over time could increase demand on emergency response, recovery and other services provided by the Shire of Strathbogie and emergency service organisations agencies.

Many of Council's staff and volunteers live in the region and can themselves be impacted by extreme weather events, such as code red days, floods or bushfires, themselves. This can affect the availability of staff and volunteers for response and recovery services. This human resource constraint is already a major issue for Council and can have implications for the timely delivery of response and recovery services. Additionally, most day to day council operations and services require ongoing and consistent involvement of staff and contractors if they are to be effectively delivered. When a major natural disaster occurs, delivery of key council services can be directly affected. Many council staff and resources are needed to respond to the disaster and to undertake recovery works. Greater frequency and severity of extreme weather-related events (floods, storms, bushfires) has the potential to increase service disruptions.

Volunteer shortage is already a major issue for emergency service organisations such as the CFA and SES which are critically dependent on volunteers for service delivery. Greater frequency and severity of extreme weather-related events has the potential to exacerbate this situation.

### Existing Controls

#### **Disaster Recovery and Business Continuity Plan**

Council's *Disaster Recovery and Business Continuity Plan* sets out strategies, processes, policies and procedures to cater for loss of service and absent personnel and enable an efficient and quick recovery or continuation of services and operations following disasters (e.g. floods, storms, fires).

#### **Municipal Emergency Management Planning Committee (MEMPC) and Municipal Emergency Management Plan (MEMP)**

As described in A1, the MEMPC is coordinated by Council and includes the CFA, SES and Victoria Police representatives. It oversees the preparation of the MEMP. The appointed Municipal Emergency Resources Officer (MERO) coordinates the provision of Council resources in emergencies.

#### **Regional partnerships and cooperation with other councils / agencies**

Through their MEMPC, Council is able to coordinate and share emergency response actions with other councils and agencies and, potentially, reduce the emergency response workload on staff.

Some partnerships already exist with other Councils in the region. Thus there is already experience of coordinated regional emergency responses and 'buy in' to programs that enhance a regional approach.

#### **Internal council procedures**

In addition to the Disaster Recover and Business Continuity Plan, Council has a number of relevant internal emergency management procedures in place, including:

- maintaining work schedules within different departments to ensure works and services are prioritised;
- the use of contractors can also help to undertake works in a shorter timeframe and/or to diminish

### Existing Controls

- work load on council staff;
- ensuring that appropriate resources are available for use in emergencies and are supported by operational and financial systems;
- designating trained response & recovery staff; and
- internal procedures for preparation and response to Code Red days.

### Community Information

The Disaster Recovery and Business Continuity Plan requires Council to provide timely information to the wider community with regard to service delivery in times of an emergency.

### Volunteer recruitment and leadership development programs

Both CFA and SES have active recruitment, training, and leadership development programs to ensure adequate staffing and enhanced capacity of volunteers

### Gaps and Deficiencies

#### Disaster Recovery and Business Continuity Plan review

The Disaster Recovery and Business Continuity Plan provides a sound basis for Council business continuity given an assumption that natural disasters relating to extreme weather will continue at their historical levels. The Plan needs to be reviewed however in light of potential increases in the frequency or severity of these events.

#### Community information and education

As discussed under subset A, community information and education on emergency response can be improved. On the one hand the community expectations are high as to the role of Council and other agencies in responding to emergency situations. On the other hand, there needs to be improved community awareness and understanding of the importance of self preparedness, self responsibility and the ramifications of personal decisions (e.g. private land management).

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>17</sup>
#	Description		
B1.	<b>Review Disaster Recovery and Business Continuity Plan</b> Council should review and extend its Business Continuity Plan to ensure that it can cope with the impacts of climate change and extreme weather events (e.g. bushfires, storms, floods, code red days and heatwaves) on staff resources and service provision.	SSC (risk management committee)	Short-term
B2.	<b>See Action A1</b> (Review of existing emergency response framework, MEMP, sub-plans and relationships). The review could be extended to include the potential for enhancing regional resource sharing.	MEMPC	Short-term
B3.	<b>Develop recruitment / succession strategy</b> Council should develop a recruitment and succession strategy to ensure all roles and responsibilities outlined in the MEMP are adequately resourced, including deputies.	SSC (human resources and emergency management team)	Medium-term

<sup>17</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>17</sup>
#	Description		
B4.	<p><b>Inter-agency strategy for succession planning for volunteers</b></p> <p>MEMPC members should consider developing an inter-agency recruitment and succession strategy with the aim of ensuring adequate resourcing for all organisations within the Shire that are dependent on volunteers. The strategy would seek to educate the community about the critical role performed by emergency service organisations, the benefits of participating in those organisations and the range of different roles available. It would seek to foster volunteerism, with programs targeting schools, sporting clubs and the broader community.</p>	MEMPC	Short-term

### 5.2.3 Subset C: Bushfire management & response

#### Priority Risks Addressed

- 3.02: Reduced availability of water for emergency services (esp. bushfire fighting)  
 3.12: Misaligned objectives for vegetation management between agencies and landholders

#### Focus and Context

**The focus of this section is on the impacts of reduced water availability and increased rainfall variability on bushfire planning and response.**

Climate change projections for the region suggest that there will be an increase in the frequency of extreme fire weather over the coming decades in Strathbogie due to an increase in the frequency of extreme temperatures, combined with reduced soil moisture. These projections point to the importance of ensuring that emergency management and water management plans provide for adequate water resources for bushfire fighting in the long term.

An increase in the frequency of extreme fire weather conditions could also heighten uncertainties around misaligned objectives for the management of native vegetation (i.e. control burning and other bushfire management practices versus biodiversity protection), especially along roadside verges, an issue that was highlighted at the 2009 Victorian Bushfires Royal Commission.

#### Existing Controls

##### **Municipal Fire Prevention Committee (MFPC) and Municipal Fire Prevention Plan**

The MFPC is responsible for:

- developing and implementing the Municipal Fire Prevention Plan (MFPP) and township protection plans.
- designating Council Neighbourhood Safer Places (also known as Places of Last Resort);
- developing protocols for notification of code red days; and
- coordinate provision of water for fire fighting.

##### **Additional tanks and water license(s)**

During the recent drought, the CFA installed larger tanks, bought additional water licenses and implemented a 'water replacement policy'. This policy ensures that private dams are filled after water was used for fire-fighting and reduces community opposition against accessing private dams and tanks for fire fighting.

##### **Road Management Plan**

**Existing Controls**

Council’s *Road Management Plan* details how roads within the municipality are managed, including fire access roads. These are maintained to a standard appropriate for the passage of a CFA fire truck in dry weather.

**Register of water sources and information**

A register of water resources that can be accessed during emergencies is currently maintained as part of the MFPP.

**Gaps and Deficiencies**

Notwithstanding the installation of larger tanks in the Shire and the purchase of additional water licences, significant water shortages were still evident through the extended drought of the 2000s, including in the vicinity of major towns - Euroa ran out of water in 2006 and Violet Town ran out of water twice during the 12 year drought. These shortages could have had serious consequences for fire fighting and the protection of life and property had a major fire broken out in the Shire in that period.

Recommendations 58 to 62 of the 2009 Victorian Bushfire Royal Commission are aimed resolving tensions between bushfire management and biodiversity protection objectives at a statewide level. Nevertheless, there is need to translate some of these recommendations to the local level through better integration of relevant strategies and plans (e.g. bushfire prevention and environmental management) in Strathbogie.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>18</sup>
#	Description		
C1.	<p><b>Emergency water supplies for bushfire fighting</b></p> <p>The Municipal Fire Prevention Committee (MFPC) should review fire management plans for the LGA and associated components of the Victorian Fire Risk Register, to ensure availability of suitable water supplies for fire suppression, particularly in periods of low water availability.</p> <p>The MFPC, working with GVW, should then identify existing or potential new water supply sources that could be quarantined for bushfire fighting during the fire season, where gaps have been identified</p> <p>The MFPC should also seek funding through the FARSS<sup>19</sup> for construction of new supplies identified.</p>	MEMPC, GVW	Long-term
C2.	<p><b>Resolving uncertainties and inconsistencies between bushfire management and native vegetation management objectives</b></p> <p>SSC should instigate a Shire wide process to remove uncertainties and inconsistencies between bushfire management and native vegetation management objectives in the Shire. This will involve:</p> <ul style="list-style-type: none"> <li>– undertaking discussions with DSE and DPCD about changes to be implemented as a consequence of the</li> </ul>	MEMPC, SSC Environmental Sustainability Committee, DSE, DPCD, GBCMA	Medium-term

<sup>18</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

<sup>19</sup> The Fire Access Road Subsidy Scheme (FARSS) is administered by CFA and is a State Government funded subsidy scheme. Subsidies are available for Municipalities for the construction and maintenance of fire access roads or construction of static water supplies.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>18</sup>
#	Description		
	<p>Bushfire Royal Commission recommendations, including for example, amendments to Victorian Planning Provisions (recommendation 60); and</p> <ul style="list-style-type: none"> <li>– facilitating discussions between the MEMPC and relevant environmental protection agencies and community organisations to ensure that changes implemented within the Shire as a consequence of the Royal Commission recommendations are done in a way that minimise environmental impacts.</li> </ul>		

## 5.3 Social and community

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to social and community. Priority risk subsets addressed in this section include:

- Subset D: Public health
- Subset E: Community wellbeing
- Subset F: Recreation

### 5.3.1 Subset D: Public health

#### Priority Risks Addressed

- 4.02: Increase in disease outbreaks associated with food borne bacteria
- 4.03: Increased incidence of heat related morbidity and mortality

#### Focus and Context

**The focus of this section is on the health impacts of climate change on local communities, in particular the impacts of heat waves and disease outbreaks associated with food borne bacteria on vulnerable groups such as elderly residents and infants (see Box 2).**

Climate change projections for the Shire indicate that the frequency of extreme heat days and heat waves could increase substantially over the coming decades. Heat waves place vulnerable sections of the community at risk from dehydration and heat stress. A key determinant of heat stress is the rate of change between temperature extremes. The elderly (>65 years) are especially vulnerable. A key determinant of heat stress is the rate of change between temperature extremes. Another is the threshold at which power infrastructure might conceivably become overloaded by the use of air conditioners.

Brown-outs and black-outs during heatwaves also increase the risk of disease outbreaks due to food contaminated with pathogenic bacteria, viruses or toxins as food is improperly refrigerated.

Council is often the first point of contact for the community, with an expectation that they will provide information and/or referral and advocacy services.

#### Existing Controls

##### **Food Act 1984 and Food Amendment Act 2009, Council's Food Safety Management Framework**

The *Food Act 1984* and the *Food Amendment Act 2009* provide legislation and regulation regarding the storage and handling of food to ensure that food for sale is both safe and suitable for human consumption.

Council's Food Safety Management Framework aims to maximise the compliance of food business in the Shire with the legislation and to educate and inform business operators and staff of their food safety responsibilities, and health and hygiene obligations under the relevant food laws.

##### **Registration of Food Businesses and Inspection Regime**

The *Food Act 1984* requires food businesses to be registered with Council. Council, as the registering authority may inspect a food business at any time in order to ensure compliance with the requirements of Act and with the food safety program for the premises. Council is also responsible for the investigation of food safety and quality complaints received from consumers.

##### **Strathbogie Shire Heatwave Plan**

The Heatwave Plan informs and educates the Strathbogie community on preparing for, responding to and

## Existing Controls

recovering from heatwaves with the aim to support local communities in adapting to heatwave conditions and to improve community health and wellbeing.

The Heatwave Plan identifies vulnerable groups and outlines strategies and actions to implement in the event of a heatwave.

### Heat Health Alert System

The Department of Health's Heat Health Alert system notifies councils, hospitals, and health and community service providers of forecast heatwave conditions that are likely to impact on human health.

### Infrastructure

Infrastructure can help to mitigate the impacts of heatwaves. Artificial cooling is used by a significant and growing proportion of households to regulate thermal comfort. Public buildings, such as an air-conditioned library, can provide informal refuges during extreme heat events. Electricity networks and backup power systems are designed to minimise power losses, especially to major public buildings and infrastructure.

## Gaps and Deficiencies

### Community information and education

The Shire's Heatwave Plan would appear to provide a sound framework for responding to heatwaves in the Shire. Since its inception, the Plan's effectiveness has yet to be tested in a major heatwave though. It is important that the Plan and the measures it contains are fully communicated to the community.

It is also important that the community fully understands the importance of taking extra food safety precautions (in the home) on extreme heat days and of the potential for rapid deterioration of food in the event of loss of refrigeration.

### Back-up power supplies

It is not clear that the cool places / heat refuges, which are an important part of the Heatwave Plan, have emergency back-up power supplies. This is a critical issue in the event of power black-outs or brown-outs.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>20</sup>
#	Description		
D1.	<p><b>Cool places / heat refuges</b></p> <p>Council should review existing heatwave refuges and investigate possible new refuges to ensure that suitable air conditioning and back-up power supplies (e.g. generators) are in place in those refuges, and that safe and cool places are accessible to all community members in the Shire, especially elderly members of the community.</p>	SSC	Short-term
D2.	<p><b>Investigate photo-voltaic system roll out</b></p> <p>Council should investigate potential Commonwealth and state funding sources for increasing the uptake of photo-voltaic systems by Strathbogie residents as a means of reducing demand on electricity supplies in peak times, especially during heatwaves.</p>	SSC	Short-term
D3.	<p><b>Tree and vegetation management</b></p> <p>Council should review its tree and vegetation management and investigate ways to provide additional shading for</p>	SSC	Short-term

<sup>20</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>20</sup>
#	Description		
	buildings and roads through trees and other vegetation. Trees and other vegetation provide shading and reduce temperatures, particularly in urban areas, and can moderate the impacts of heatwaves heatwave effects.		
D4.	<p><b>Integrating Heatwave Plan into MEMP</b></p> <p>Council should ensure that the Heat Wave Plan is fully integrated into the Municipal Emergency Management Plan (MEMP), and should monitor and review the effectiveness of the Heatwave Plan once it has been instigated (see also action A1).</p>	SSC, MEMPC	Short-term

### Box 2: Sections of the Community Vulnerable to Climate Change

The potential impacts of climate change on communities can also be significantly influenced by the sensitivity of those communities to a particular climate change or hazard. There are a number of social and economic characteristics and trends that provide a general indication of the overall sensitivity of communities to climate change. Two important social characteristics are demography and income. Australian and international studies indicate that groups especially vulnerable to extreme climate events such as flooding, storms, bushfires and heat waves include:

- low income earners;
- the elderly; and
- people with existing health conditions (including physical and mental health).

The vulnerability of these groups stems from:

- limited capacity to prepare for impacts due to lack of resources or an inability to access or effectively utilise relevant information;
- difficulty in responding to particular impacts, due to physical incapacity, lack of mobility or lack of resources; and/or
- problems with recovering from impacts, again due to lack of resources or to the absence of strong social networks.

Data for the Shire of Strathbogie indicates that the Shire has a relatively high proportion of vulnerable groups, certainly above the Victorian State average (see Table 13). Responding to the needs of these groups will be an important aspect of climate change adaptation planning.

**Table 13. Vulnerable sections of the community, Strathbogie and Victoria**

Description	Proportion of Community	
	Strathbogie Shire	Victoria
<b>Low income earners</b> (weekly household income < \$500)	<b>28.4%</b>	<b>19.5%</b>
<b>The elderly</b> (aged 65 +)	<b>22.1%</b>	<b>13.7%</b>
<b>Existing health conditions</b> (core activity need for assistance)	<b>5.5%</b>	<b>4.2%</b>

Source: ABS Census 2006

### 5.3.2 Subset E: Community wellbeing

#### Priority Risks Addressed

- 4.04: Increased community anxiety and stress associated with droughts and extreme climate events  
 4.06: Financial stress on households

#### Focus and Context

**This section considers the mental health and stress impacts of climate extremes on the community and individuals within the community.**

Climate extremes such as storms, floods, droughts, heatwaves and bushfires can have a significant impact on the wellbeing of community members. Recent research has pointed to major mental health issues for farmers and farming communities during the last drought, including suicide and family breakdown. Similarly, communities affected by the Black Saturday bushfires have suffered major long term anxiety and stress, even when not directly impacted by the fires. Vulnerable and isolated members of the community in particular can suffer from anxiety and stress, especially if they do not have access to support networks.

An increase in the frequency or severity of climate extremes in the future has the potential to increase flow-on anxiety and health issues. Financial stress is often a major contributing factor to anxiety and emotional stress. The potential for an increase in energy and/or water costs in the future could add to financial stresses.

As with Subset D, Council is often the first point of contact for community members with the expectation that the Council will provide information and/or referral and advocacy services.

#### Existing Controls

##### Community action groups and community actions plans

Community action groups and community actions plans have been developed for local communities and townships within Strathbogie. The plans provide direction to Council on options to strengthen rural townships in the Shire. The groups provide support to Council and the wider community in strengthening townships and community networks.

Funding for priority projects is provided by Council through the Community Action Group Funding program.

##### Community gatherings, forums and events

Events and gatherings organised by Council, community action groups or other clubs / groups provide for social interaction and engagement and strengthen integration and community spirit.

##### Community information

Council provides information and referrals to relevant support groups and initiatives, such as

- Lifeline;
- Beyond Blue;
- Rural Access; and
- “Making Links” Mentoring Program.

##### State and Federal Government assistance

The Commonwealth Government’s *Disaster Assist* provides information on assistance for disasters (e.g. floods, bushfires and storms) as well as advice on managing financial stress, dealing with insurance after a disaster and strengthening (community) resilience.

Exceptional Circumstances Relief Payments, available during declared droughts, provided financial assistance for affected for farmers and small businesses.

##### Rural Outreach Counselling Program

## Existing Controls

The Rural Outreach Counselling Program provides counselling to rural people who are encountering personal or family concerns funded by the Commonwealth Government.

## Gaps and Deficiencies

### Community empowerment

Notwithstanding the community action plans and substantial work of community action groups, there is still scope to improve to further empower local communities, to increase the level of civic engagement, networking and connectedness within local communities.

### Community information on climate change, water and energy measures

Community information and improved communication with community on climate change and variability to

- improve capacity building;
- provide information on heating and cooling strategies,

Council needs to improve and strengthen the relationship and communication with community groups.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>21</sup>
#	Description		
E1.	<p><b>Community Neighbourhood programs</b></p> <p>Council should consider implementing a local Community Neighbourhood program in each of the Shire's major towns, drawing on experience of similar programs that have been implemented in other parts of the state and interstate. The program aims to build a sense of community and empower local communities by encouraging people to get to know their neighbours, supporting local networks and participating in local community activities and organisations. Programs of this nature can be instrumental in contributing to the monitoring and assistance of vulnerable groups and individuals during emergencies.</p> <p>The programs could build on the community actions plans and work of community action groups.</p>	SSC, community action groups	Short-term
E2.	<p><b>Information on payment assistance subsidies and schemes</b></p> <p>Council should ensure that information on the full range of bill payment assistance subsidies and schemes provided by State Government, welfare agencies and utilities is compiled and widely disseminated to community members (e.g. through Council's website and service desks).</p>	SSC	Short-term
E3.	<p><b>Climate change information package</b></p> <p>Council should consider developing and disseminating an information package to the local community on climate change, the potential impacts of climate change in Strathbogje and how residents can respond at the household and business levels.</p> <p>Part of the information package could include information</p>	SSC	Short-term

<sup>21</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>21</sup>
#	Description		
	<p>on energy and water use efficiency. A range of energy and water efficiency grant programs are already provided by Commonwealth and State Governments and by energy and water utilities to households and small businesses. Some of these specifically target low income households. There are also significant information resources available through organisations such as Sustainability Victoria on how households can reduce their energy and water consumption. Council could compile information on relevant programs and information resources as part of the climate change information package.</p> <p>Another part of the package could include resources and information on the importance of self-sufficiency in preparing and responding to climate-related disruptions and emergencies such as floods, bushfires and heat waves.</p> <p>Yet another part of the package could include information on relevant voluntary organisations in the Shire and the benefits of participation in one or other of those organisations (see action B4).</p>		

### 5.3.3 Subset F: Recreation

#### Priority Risks Addressed

- 1.09: Degradation of playing fields and sport fields
- 1.10: Degradation of parks, gardens and streetscapes, footpaths and walking trails
- 1.11: Increased damage to council swimming pools due to ground movement and shifting foundations

#### Focus and Context

**The focus of this section is on outdoor recreational facilities and spaces managed by Council including playing fields, parks, gardens and streetscapes and swimming pools.**

Council managed open spaces, playing fields and swimming pools are key community assets, being important for the long term health and wellbeing of local communities. Communities have expectations of ongoing access to these areas and that their quality and appearance will continue to be maintained by Council, even during times of low water availability.

During the recent drought, open spaces and playing fields in the region experienced significant degradation, including loss of grass and other groundcover, hardness and loss of shrubs and shade trees. Waterways dried up. In some cases, water restrictions and the high cost of alternative water supplies, prevented access to water for irrigation, resulting in the need to close or restrict access to some playing fields or to shorten playing seasons.

Climate projections for the region of reduced average rainfall, increased rainfall variability and a possible increase in the frequency and severity droughts could increase stress on these areas and increase the difficulty for councils of meeting community expectations regarding their maintenance.

#### Existing Controls

##### Asset management plan

Council's asset management plan provides for a review of the existing recreational facilities and guides the works program and procedures for maintenance of these.

## Existing Controls

### Asset management plan

Council's asset management plan provides for a review of the existing recreational facilities and guides the works program and procedures for maintenance of these.

### Bore water access

Council has access to bores in Euroa, Avenel and Longwood and uses bore water for irrigation of some playing fields and parks in these townships. During the recent drought Council improved the efficiency of these bores (i.e. higher extraction rates).

### Drought-proofing of open spaces

Council has a number of controls in place aimed at drought-proofing and maintaining open spaces. These include:

- irrigation of some playing fields, gardens and park areas;
- deep watering of trees;
- tree and garden bed mulching to support their maintenance during dry periods; and
- planting of drought tolerant grass species.

### Volunteer groups

Various sporting clubs and other volunteer groups support the maintenance of playing and sports fields as well as heritage gardens.

## Gaps and Deficiencies

### Information on community recreation requirements

There is scope for improving recreational asset planning in the Shire. Planning needs to be informed by an understanding of how the community utilises and values open spaces and the services provided by those areas.

### Information on alternative water supplies and sustainable water use

There are information gaps on water supplies available to Council and sustainable water use options. Gaps include:

- information on groundwater resources available for irrigation of playing fields, parks and gardens; and
- information on sustainable groundwater extraction rates.

### Aging infrastructure, under-utilisation

Existing recreation infrastructure, such as swimming pools, is aging and there is an ongoing shortage of funds for retrofits and maintenance works.

There is also a lack of adequate shading in playing fields, parks and gardens and some swimming pools, which prevents or reduces the usages of these facilities during hot days.

### Lack of volunteer hours and civic engagement

Despite the support from various sporting clubs and other volunteer groups, there seems to be a decrease in volunteering with regard to the upkeep of open spaces. This puts additional pressure on Council resources to maintain open spaces and other recreational facilities.

### Resilient plantings

While Council has drought-proofed many of its open spaces with drought-tolerant species, in particular the use of drought-tolerant grasses on playing fields, an increase in the intensity of the wet and dry cycle will require a different species mix again or multiple species – species that are drought tolerant **and** able to cope with periods of wet weather.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>22</sup>
#	Description		
F1.	<p><b>Recreation strategy</b></p> <p>Council should consider developing a recreation strategy that identifies community requirements for playing fields, swimming pools and open spaces.</p> <p>This strategy would allow Council to:</p> <ul style="list-style-type: none"> <li>– prioritise and rationalise parks, gardens and playing fields during times of low water availability and droughts;</li> <li>– create a priority watering plan for trees of significance during times of low water availability and droughts;</li> <li>– prioritise maintenance of Council’s open spaces and recreational facilities (e.g. swimming pools);</li> <li>– determine and manage adequate grass species for playing fields; and</li> <li>– determine shading requirements and prioritise installation and/or upgrades of shading / sun protection.</li> </ul> <p>The strategy would include criteria (e.g. utilisation, economic benefits) for prioritising open spaces and recreation facilities.</p> <p>The strategy would require regular reviews (e.g. every 5 years) to take account of changes in community preferences and allow Council to adapt to these changes.</p>	SSC	Short- to medium-term
F2.	<p><b>Bore water management plan</b></p> <p>Council, working with GVW and G-MW, should consider developing a sustainable plan for the usage of bore water across the Shire for irrigation of playing fields, parks and gardens. This plan would determine the sustainable extractions limits of bores within the Shire.</p>	SSC, working with GVW and G-MW	Short-term
F3.	<p><b>Water use efficiency and alternative water supplies</b></p> <p>Council, working with GVW, should investigate medium to long term actions to ensure ongoing viability of priority parks, gardens and playing fields including:</p> <ul style="list-style-type: none"> <li>– recycled water;</li> <li>– water capture and storage opportunities such as wetlands, tanks and (underground) water storages; and</li> <li>– increased efficiency of irrigation.</li> </ul> <p>Council could actively pursue funding for priority projects through established Commonwealth and State funding programs such as the <i>National Water Security Plan for Cities and Towns</i>.</p>	SSC, working with GVW	Medium- to long-term
F4.	<p><b>Review Asset Management Plan</b></p> <p>Upon completion of the proposed recreation strategy (F1)</p>	SSC	Short- to medium-term

<sup>22</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>22</sup>
#	Description		
	and bore water management plan (F2), Council should review its Asset Management Plan and incorporate findings of those plans.		

## 5.4 Environmental management

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to environmental management. Priority risk subsets addressed in this section include:

- Subset G: Biodiversity and wildlife habitats
- Subset H: Waterways (incl. groundwater)

### 5.4.1 Subset G: Biodiversity and wildlife habitats

#### Priority Risks Addressed

- 5.01: Loss or change in composition of native vegetation (including instream vegetation)
- 5.02: Increase in invasive weed and pest species

#### Focus and Context

**The focus of this section is on high conservation value vegetation communities and wildlife habitat in the Shire including riparian vegetation.**

The Shire of Strathbogie encompasses parts of the Northern Inland Slopes and Riverina bioregions and contains significant grassy woodlands and grassland ecosystems. The White Paper *Land and Biodiversity at a Time of Climate Change* (DSE, 2010) and other relevant strategies (e.g. *Goulburn Broken Regional Catchment Strategy* (GBCMA, 2003) point to significant existing threats to biodiversity and ecosystems in the Goulburn Broken Catchment (including in the Shire of Strathbogie) associated with land clearing, fragmentation and pests and weeds. Native vegetation in the catchment is classified as being fragmented and in moderate condition. Climate changes, including increased average and extreme temperatures and water stress associated with increased rainfall variability and more persistent and severe droughts, could add to these threats.

Shared management responsibilities between DSE, GBCMA, Parks Victoria, the Councils and private landholders complicate potential approaches to protecting ecosystems, with Council having direct responsibility for protection of communities only on roadside verges (shared) and through land use planning strategies and processes.

#### Existing Controls

##### Legislative and planning frameworks

A cascading series of legislation, strategies and plans are currently in place at the state, regional and local levels. These are designed to protect biodiversity and ecosystems.

State government legislation and plans include:

- The *Flora and Fauna Guarantee Act 1988* is the key piece of Victorian legislation for the conservation of threatened species and communities and for the control of potentially threatening processes.
- *Victoria's Biodiversity Strategy*, which fulfils commitments in the National Strategy for the Conservation of Biodiversity and requirements under the Flora and Fauna Guarantee Act 1988.
- *Native Vegetation Management: A Framework for Action* is the State Government's strategy to protect, enhance and revegetate Victoria's native vegetation. It seeks to achieve a reversal of the long-term decline in the extent and quality of native vegetation, leading ultimately to a net gain.
- The *Rural Land-Use Planning Program*, which is a State Government initiative that assists councils to resource work on planning schemes to improve the protection of rural land.

## Existing Controls

Regional and strategies and plans include:

- The *Goulburn Broken Regional Catchment Strategy* (GBCMA), which seeks to balance environmental, social and economic objectives across the catchment, including in relation to biodiversity protection.
- The *Strathbogie Planning Scheme*, which establishes conservation zones and environmental significance overlays and sets requirements for the protection of native vegetation in relation to developments.

### Land management

Regional and local management and restoration programs are implemented to give effect to the objective set out in the plans and strategies outlined above. These include:

- Various sub-regional Biodiversity Action Plans (DSE and GBCMA), which translate Victoria's Biodiversity Strategy to the local scale by directing on-ground works by private landholders and government for the conservation of biodiversity, as well as incentives, education and training.
- 'Bush Returns', a joint initiative between GBCMA and DSE which provides financial incentives to landholders to manage and protect threatened Grassy Woodland remnants on their property.
- Education and works initiatives undertaken by Landcare and town action groups and the Conservation Management Network. Actions include weed eradication and flora and fauna surveys.

### Shire of Strathbogie Environmental Management Strategy (Draft)

The draft strategy includes actions relating to native vegetation protection, roadside management of native vegetation and invasive plants and animal control.

### Environmental Sustainability Committee

The Environmental Sustainability Committee has been established by the Council to establish policies and programs for environmental protection.

## Gaps and Deficiencies

### Native vegetation and biodiversity decline

Notwithstanding the strategies, plans and programs outlined above, the Shire is still experiencing some decline in the extent and quality of vegetation. This trend has been confirmed in the report *Native Vegetation Net Gain Accounting* (DSE, 2010) a 'first approximation' report on progress with the net gain objective of *Native Vegetation Management: A Framework for Action*. Climate changes could exacerbate fragmentation.

The trend indicates that existing programs are having mixed success in meeting their objectives. This can in part be attributed to a lack of coordination between agencies and resourcing of initiatives. There are also insufficient financial incentives for the protection of native vegetation on private and public land. The trend can also be attributed to difficulties in enforcing planning provisions relating to the protection of native vegetation on private land (e.g. unlawful clearing by sub-contractors).

### Information and communication on climate change and catchment health

There is a gap in ongoing information on catchment health and the implications of climate change (in particular increased rainfall variability and reduced water availability) for catchment health in the context of other drivers and trends. This information needs to be communicated to the community.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>23</sup>
#	Description		
G1.	<p><b>Implementation of recommendations in Draft Environmental Management Strategy</b></p> <p>Council should proceed with implementing relevant actions from the Draft Environmental Management Strategy including actions relating to native vegetation protection (5.3 to 5.6), invasive plants and animal control (5.7 to 5.9) and roadside management of native vegetation (6.1 to 6.3).</p>	SSC (various departments)	Short-term
G2.	<p><b>Strengthening regional cooperation and partnerships</b></p> <p>Through its Environmental Sustainability Committee, the Council should seek to strengthen regional cooperation on environmental protection and catchment management through regional partnerships on environmental/ catchment protection. State or Federal funding opportunities can be sought through the partnerships. Potential programs for implementation through a regional partnerships approach include:</p> <ul style="list-style-type: none"> <li>– education and engagement programs with local landholders, highlighting the increasing importance of wildlife corridors / 'refugia' for the long term viability of regionally significant ecological communities in the context of climate change and the implications of land use decisions;</li> <li>– conservation incentive and conservation works programs targeting high conservation value locations that are particularly vulnerable to climate change; and</li> <li>– a co-ordinated program aimed at monitoring changes over time to high conservation value vegetation communities and ecosystems in the region identified as being particularly vulnerable to climate change (this would require the partnership to seek funding).</li> </ul>	SSC <b>Environmental Sustainability Committee,</b> GBCMA, G-MW, GGVW, DSE, DPI	Short-term and ongoing
G3.	<p><b>Strengthen enforcement of native vegetation controls</b></p> <p>Council through its planning team and working with DSE should seek to strengthen enforcement of land clearing planning provisions and controls.</p>	SSC, DSE	Short-term

#### 5.4.2 Subset H: Waterways (incl. groundwater)

##### Priority Risks Addressed

5.05: Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)

5.07: Increased frequency of poor water quality

5.04: Reduction in shallow groundwater recharge

##### Focus and Context

**This section considers responses to reduced flow and water quality in the waterways, wetlands and groundwater of Strathbogie and associated impacts on high conservation value freshwater aquatic**

<sup>23</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

## Priority Risks Addressed

### ecosystems.

The Shire of Strathbogie contains high conservation value waterways and wetlands. These support significant riparian vegetation communities and native fish and amphibian populations. Groundwater resources in the Shire support summer surface water flows and groundwater dependent ecosystems including wetlands and floodplain vegetation communities.

Available climate change projections and modelling for the region and Shire (e.g. CSIRO, 2008) suggest that climate change will add to the stresses on the region's waterways and aquatic ecosystems already being experienced.

## Existing Controls

### Legislative and planning frameworks

Some of the plans and strategies discussed in section 5.4.1 relating to protection of native vegetation also apply to protection of waterways, including in particular:

- the Goulburn Broken Regional Catchment Strategy; and
- the *Strathbogie Planning Scheme*, which contains provisions relating to subdivisions and residential development including Controls on septic tanks/ systems.

In addition, the *Goulburn Broken Regional River Health Strategy* is specifically geared towards protection of waterways.

### Water entitlement framework

The Murray-Darling Basin Cap and Victoria's water entitlement framework set diversion limits and provides for environmental water entitlements, with a share of the available water resource in the Goulburn and Broken Rivers being set aside to meet the Environmental Water Resource (EWR) objective. This objective and associated priorities are being defined through an assessment of environmental water requirements for a number of priority rivers and streams in the Catchment.

### Stormwater Management Plan

The Council's Stormwater Management Plan aims to improve the management of stormwater in urban areas across the Shire in order to protect and enhance the local and downstream receiving water environments.

### Waterways management

As with vegetation management, a number of regional and local management and restoration programs are implemented to give effect to the objective set out in the plans and strategies. These are implemented through GBCMA and Landcare groups and include waterway rehabilitation works to re-establish indigenous vegetation and improve in-stream habitat, stream bed and bank stability works and fencing off streams to exclude cattle.

## Gaps and Deficiencies

### Groundwater use and water use in unregulated systems

There appears to be inconsistent approaches to managing stock and domestic water use in the Shire through planning and development controls. Lack of information about groundwater demand and availability in the Shire could exacerbate this problem. In particular, there are information gaps relating to the number and location of bores for stock and domestic use and stock and domestic water demand from unregulated surface water systems. There is also a need to improve understanding of the links between shallow groundwater and surface water systems.

Climate change adds to the imperative of improving understanding of groundwater and unregulated water supplies and ensuring a consistent approach to their management.

### Information and communication on climate change and waterways health

The gaps and deficiencies identified in relation to biodiversity and wildlife health are also relevant to waterways health. In particular, there is a need to improve landholder and broader community understanding of the implications of climate change for waterways health in the conjunction with other pressures on waterways such as waste runoff from intensive agriculture.

### Misalignment of objectives for waterways

There is also a gap between agency and Council objectives for catchment and waterways protection on the one hand and private land holder responsibilities and objectives on the other. This problem is ongoing and not specific to climate change, although climate change has the potential to exacerbate it. Nor is it unique to the Shire of Strathbogie. Resolution of the problem could ultimately require better alignment of private and public incentives for waterways protection (e.g. through strengthening landholder incentives for waterways protection), a pathway that is largely outside the scope of this strategy.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>24</sup>
#	Description		
H1.	<p><b>Creek management plans</b></p> <p>Council should proceed with implementation of relevant actions from the Draft Environmental Management Strategy including actions 5.1 and 5.2 relating to the development of creek/ waterways management plans.</p>	SSC, GBCMA	Short-term
H2.	<p><b>Coordinated water use conditions in development applications</b></p> <p>Council, working with G-MW and GVW should ensure that water use conditions in development applications are coordinated and consistently applied. Particular attention needs to be paid to groundwater use for stock and domestic purposes and water use from unregulated systems.</p> <p>Council should examine the need for amendments to the Planning Scheme to include provisions relating to groundwater management.</p>	SSC, G-MW, GVW	Short-term
H3.	<p><b>Water use efficiency and alternative water supplies</b></p> <p>See action F3.</p>	SSC, working with GVW	Medium- to long-term

<sup>24</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

## 5.5 Infrastructure and assets

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to infrastructure and assets. Priority risk subsets addressed in this section include:

- Subset I: Stormwater and flooding
- Subset J: Transport infrastructure

### 5.5.1 Subset I: Stormwater and flooding

#### Priority Risks Addressed

- 1.01: Stormwater and drainage systems increasingly overwhelmed or damaged (short-term impacts)
- 1.02: Flooding of low-lying areas without (or with limited) flood mitigation structures in place
- 1.03: Damage to or failure of flood mitigation structures (e.g. levees)

#### Focus and Context

**This section focuses on stormwater drains, other drainage systems and flood mitigation structures managed by Council.**

Many parts of the stormwater system in the Shire of Strathbogie are aging. Only relatively new underground components of the drainage system are designed for a 1:5 year peak flow ARI. The capacity of older assets is largely unknown. Although a 1-in-5 year event does not generally cause major problems, low lying areas are often affected, as are many roads.

Rainfall projections for the Shire indicate that the intensity of extreme rainfall events could increase significantly over the coming decades. This will lead to increased peak flows and runoff, reduced drainage system performance and greater frequency and severity of flash flooding as well as riverine flooding of areas not protected by flood mitigation structures.

An increase in rainfall variability - increased in the frequency and/or magnitude of extreme rainfall events, alternating with prolonged dry periods – also increases the potential for damage to flood mitigation structures such as levees, leading to higher maintenance costs and or their potential failure in the future.

#### Existing Controls

##### **Asset management (existing system) and retrofits of stormwater system**

Council's Asset Management Plan guides the works program and procedures for stormwater infrastructure maintenance and (where resources allow) upgrading of the stormwater system.

##### **Stormwater systems design**

New stormwater systems take into account minimum design requirements for stormwater drains in new developments and system capacity for stormwater treatment systems.

##### **Municipal Emergency Management Plan (MEMP)**

(see section 5.2.1)

##### **Flood warning system**

The Bureau of Meteorology (BoM) issues forecasts and warnings, including:

- flood warnings, when flooding is occurring or is expected to occur in a particular location or area; and
- severe weather warnings, when flash flooding is expected.

## Existing Controls

### Euroa Flood Mitigation Scheme

The flood levee along the Castle Creek in Euroa protects the township from a 1-in-30 year flood, combining Castle Creek and Seven Creeks flows.

## Gaps and Deficiencies

### Asset management

The asset management plan requires priority and commitment. However, there is an ongoing shortage of funds for infrastructure retrofits and maintenance works.

There is also an ongoing need for improved assessment and information collation on stormwater asset condition. An obstacle to proactive maintenance is the lack of a complete asset register. This prevents Council from undertaking a structured assets replacement and capital works program, as some inadequate assets, which require replacement, are only detected after an incident has occurred.

Existing infrastructure will need to be reassessed for suitability taking into account consequences under climate change and community needs. Better knowledge of existing assets will also allow Council to specify capacity requirements for stormwater assets in new developments.

### Design standards

Design standards may need to be upgraded to cope with higher intensity rainfall events in the future. One design standard may not be appropriate for both urban and rural areas however, with urban areas requiring a greater capacity compared with rural areas. Requiring the urban standard for all areas could lead to inefficient allocation of resources.

### Flood mitigation

Flood mitigation structures in the Shire are limited. Only Euroa is protected and then only for a 1-in-30 year event. There is a need to investigate additional mitigation structures including use of detention basins across the Shire and sources of funding for flood mitigation works.

### Information on warning systems

Advertising/ communication of early warning systems to public could be improved.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>25</sup>
#	Description		
11.	<p><b>Rainfall intensity modelling and updated flood studies</b></p> <p>Council, in collaboration with GBCMA and state government authorities and other councils in the Goulburn-Broken catchment, should seek to commission (catchment-wide) modelling of changes to extreme rainfall intensities and duration under climate change scenarios.</p> <p>This information should then be used to update flood modelling and flood studies for the Shire of Strathbogie to assess stormwater and drainage system impacts and flood risk (flood levels and Average Recurrence Intervals), in particular in priority areas where the perceived risk is high flood studies do not fully reflect rainfall intensity projections.</p> <p>See also actions K1 and K2.</p>	SSC, GBCMA	Short- to medium-term

<sup>25</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>25</sup>
#	Description		
12.	<p><b>Review of drainage design standards</b></p> <p>Drawing on outputs of Action I1, Council should consider develop a guideline and standards for the design of new and upgraded drainage assets, taking into account local needs.</p>	SSC	Medium-term
13.	<p><b>Infrastructure audit and prioritisation of upgrades</b></p> <p>Council should undertake an infrastructure audit regarding capacity and lifespan of assets to identify deficiencies. Drawing on outputs of actions I1 and I2. Council should then apply a risk management approach to prioritise management and upgrade of vulnerable stormwater assets within the LGA.</p> <p>Council should then assess potential funding sources for flood mitigation and stormwater infrastructure priorities including:</p> <ul style="list-style-type: none"> <li>– federal and state governments infrastructure funding; and</li> <li>– levies (e.g. levy on owners of land benefited by works carried out by Council).</li> </ul>	SSC, working with VicRoads, VicRail and GBCMA	Medium-term
14.	<p><b>Level of service information and education campaign</b></p> <p>Council should develop an infrastructure communications strategy and undertake a level of service information and education campaign. The campaign would target community expectations on levels of service and Council's ability to deliver with regards to maintenance of stormwater and flood management infrastructure. It would also educate the community about responsibilities in order to minimise flood risks, e.g. keeping stormwater drains and flood ways unobstructed.</p>	SSC	Short- to medium-term

### 5.5.2 Subset J: Transport Infrastructure

#### Priority Risks Addressed

1.05: Increased damage to local transport infrastructure (roads, bridges, culverts, footpaths)

1.06: Increased difficulty of maintaining gravel roads

#### Focus and Context

**The focus of this section is on roads (incl. gravel roads), culverts, bridges, low-level crossings and footpaths managed by the Council, especially those subject to frequent flooding, landslides and/or degradation due to extreme rainfall.**

Repairs to roads, bridges, low-level crossings and footpaths damaged as a result of flooding or extreme rainfall are a major budget item for Council, which already has a major backlog of road repairs.

Increases in the frequency and/or magnitude of extreme rainfall events and associated flooding in the future suggests that the difficulty Council currently faces in maintaining roads and other transport infrastructure to the required service level could worsen in the future.

## Existing Controls

### Asset management

Council undertakes ongoing roads and other transport infrastructure maintenance works to its rural, main and urban roads. Works are generally programmed through the Assets Management Plan and a forward works program and maintenance schedule that has been developed from inspections by Council officers and requests from community.

Works include upgrading of unsealed roads, pothole patching, sign replacement, maintenance of culverts and drains and sealing of road shoulders. Although much of the maintenance is reactive, it can also help to prevent further deterioration of road surfaces and other assets.

### Design code

Upgrades are undertaken in accordance with various Australian Standards and Guidelines for road design and planning (e.g. elevation of roads) to maximise protection and durability of roads in face of flooding and extreme rainfall.

## Gaps and Deficiencies

### Asset management and resourcing

The asset management plan for transport assets is up to date, but requires priority and commitment and regular reviews to meet community expectations.

Council already has a significant backlog in its road maintenance and upgrade schedule. Sufficient and timely funding for transport route upgrades is an ongoing issue, likely to be exacerbated by an increase in the frequency and/or magnitude of extreme rainfall events and associated impacts to transport infrastructure

### Community expectations and service levels

As with stormwater and flood management assets and services, there is a need to manage community expectations regarding level and cost of services, particularly in the context of a likely future increase in the cost of transport services under climate change scenarios.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>26</sup>
#	Description		
J1.	<p><b>Identify / review key traffic routes</b></p> <p>Council, in collaboration with VicRoads and local emergency service agencies should:</p> <ul style="list-style-type: none"> <li>– identify and document key local and regional traffic routes likely to be affected by flooding and other extreme events such as bushfires;</li> <li>– identify alternative options during these events; and</li> <li>– provide information to the community on alternative transport and evacuation routes in the event of a flood or other extreme events.</li> </ul>	SSC, MEMPC	Short-term
J2.	<p><b>Infrastructure audit and prioritisation of upgrades</b></p> <p>Council should undertake an infrastructure audit to identify deficiencies in roads and other transport infrastructure. Taking into account outputs of actions I1 and J1, Council should then apply a risk management approach to prioritise management and upgrade of vulnerable transport</p>	SSC	Short- to Medium-term

<sup>26</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>26</sup>
#	Description		
	<p>infrastructure within the Shire.</p> <p>Council should approach federal and state governments to provide funding for implementing transport infrastructure adaptation priorities.</p>		
J3.	<p><b>Level of service information and education campaign</b></p> <p>See action I4. The campaign would be extended to include information aimed at managing community expectations relating to transport infrastructure costs and level of service. For example, low cost / maintenance alternatives could be promoted such as 'downgrading' bridges to low level crossings/ causeways. This option would have lower maintenance costs but would lead to transport routes being blocked for a short time period during flooding / heavy rainfall.</p>	SSC	Short- to medium-term

## 5.6 Planning

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to statutory and land use planning. Priority risk subsets addressed in this section include:

- Subset K: Planning – flood management
- Subset L: Planning – bushfire management

### 5.6.1 Subset K: Planning – flood management

#### Priority Risks Addressed

2.01: Flood modelling and planning scheme fails to reflect the extent of inundation under climate change scenarios

#### Focus and Context

**This section is on planning and development controls in flood prone areas.**

Available information indicates that a number of the Shire's townships are located in areas that are already exposed to flooding. Rainfall projections for the region indicate that the intensity of extreme rainfall events could increase significantly over the coming decades. The impact of new developments on catchment hydrology together with an increase in frequency and severity of extreme rainfalls could lead to an increase in the probable maximum flood level in established flood hazard as well as an increase in the extent of flood hazard areas.

Future population growth, necessitating additional housing and infrastructure, places pressure on Council to allow further development in some of these areas but Council also faces community backlash and liability, if it fails to ensure that appropriate development controls are in place in flood prone areas.

#### Existing Controls

##### Flood management

The *Goulburn Broken Regional Floodplain Management Strategy* (GBCMA, 2002) establishes the overall strategic framework for flood management throughout the Goulburn-Broken catchment, including in the Shire of Strathbogie. The strategy is supported by flood modelling and flood hazard mapping.

Flood studies and floodplain management plans, undertaken or commissioned jointly by the Council and Goulburn-Broken Catchment Management Authority (CGCMA), provide a more detailed understanding of flood risks in particular locations (e.g. Violet Town, Castle & Seven Creeks). The plans are aimed at protecting waterways and reducing the potential of flooding to occupiers and infrastructure, informing emergency management in flood prone areas and ensuring future development in those areas is carefully controlled through appropriate siting and design criteria.

##### Planning and development control framework

A comprehensive legislative and planning framework is used to regulate development in the Shire including in flood prone areas. The legal framework for planning and development control is established through the *Planning and Environment Act 1987*, the *Planning and Environment Regulations 2005* and the *Planning and Environment (Fees) Regulations 2000*.

Victorian Planning Provisions establish a statewide planning template, which is given affect in Strathbogie through the Strathbogie Planning Scheme and accompanying overlays (e.g. Land Subject to Inundation Overlay) and development controls. Development controls in flood hazard areas are informed by the flood studies and floodplain management plans. The Planning Scheme provides for referrals to GBCMA for larger

## Existing Controls

subdivisions where additional controls may be needed reflecting the overall footprint of these developments on runoff and flood hazard.

Limited audits of developments are undertaken to ensure that they meet with controls imposed.

## Gaps and Deficiencies

### Review required of flood modelling, flood hazard mapping and overlays

With the exception of Violet Town (2007), all flood mapping and overlays in the Shire are based on flood modelling undertaken in 1993. Thus flood maps may not reflect current technical understanding of runoff, flows and inundation. Nor do they take account of potential increases in maximum rainfall intensity under climate change scenarios and resulting changes to runoff, floods levels and ARIs.

Revised flood modelling will depend on the availability of improved hydrological data and technical guidance from credible professional groups (e.g. revised Australian Rainfall & Runoff (ARR) guidelines from Engineers Australia) (see Box 3).

### Lack of resources

Council and GBCMA lack staff and resources to:

- plan works and check Development Approvals (DAs);
- enforce conditions of consent - at construction, development hand-over stage; and
- ground truth works against design specifications.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>27</sup>
#	Description		
K1.	<b>Rainfall intensity modelling and flood studies</b> See action I1.	SSC, <b>GBCMA</b> , DSE, other councils	Short- to medium-term
K2.	<b>Integration of flood studies into Planning Scheme</b> Outcomes from action I1 should be reflected in changes to the Planning Scheme and Land Subject to Inundation Overlays to ensure that decisions about future developments take into account climate change and more intense rainfall scenarios.	SSC	Medium-term
K3.	<b>Resourcing of development approvals and audits</b> The Council should examine potential funding sources (e.g. levies) to improve resourcing of development approvals and audits of conditions of consent and works in flood and bushfire hazard areas.	SSC	Short-term
K4.	<b>Climate change information package – flood awareness</b> Council should incorporate information on flood modelling, management and planning processes in the proposed climate change community awareness and information package.  It should also incorporate information on the importance of household self-sufficiency in preparing and responding to climate related emergencies such as floods and bushfires	SSC	Short-term

<sup>27</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>27</sup>
#	Description		
	(see action E3).		

**Box 3: A regionally consistent approach to flood modelling**

Although hydrological modelling and flood hazard mapping has been undertaken by Council and GBCMA in Strathbogie and other parts of the Goulburn-Broken catchment. It is apparent that there are inconsistencies in methods applied to the modelling and mapping, including in relation to whether and how climate change projections have been integrated into the modelling.

Thus it would be desirable to develop a consistent approach to flood hazard modelling and mapping, throughout Strathbogie and the Goulburn-Broken catchment, with climate change scenarios incorporated into the modelling. An initial step towards that end will be to undertake catchment wide modelling of changes to extreme rainfall intensities and duration under climate change scenarios. This regionally specific information would complement and build on Australian Rainfall & Runoff (AR&R) Guidelines for hydrological modelling that are currently being updated nationally by Engineers Australia.

A consistent approach to flood hazard assessment and mapping will be important to informing decision making on planning issues, infrastructure issues such as stormwater and drainage and transport, as well as emergency management.

### 5.6.2 Subset L: Planning – bushfire management

#### Priority Risks Addressed

- 2.02: Planning scheme places inadequate controls on developments in high bushfire risk areas
- 2.03: Lack of compliance with bushfire / flooding protection conditions applied to new developments
- 3.12: Misaligned objectives for vegetation management between agencies and landholders

#### Focus and Context

**The focus of this subset is on planning and development controls in bushfire hazard areas.**

The Shire of Strathbogie has been affected by significant bushfires in the recent past including a fire in the Strathbogie Ranges in December 1990 that resulted in the loss of life, destruction of a significant number of dwellings and large numbers of stock. Planning and other controls currently in place are designed to minimise exposure of people and property to bushfires. However, climate change projections for the region indicate that there will be an increase in the frequency of high and extreme fire risk days and extension in the length of the fire season, raising the question as to whether existing controls are adequate. As well, there are ongoing difficulties for Council in managing potentially competing objectives in relation bushfire management on the one hand and ecological objectives on the other hand, especially in relation to vegetation management on private property.

#### Existing Controls

##### **Bushfire management and development control planning**

As noted under Subset K, a comprehensive planning framework is currently in place at the state, regional and LGA levels. The same framework that controls development in flood hazard areas is also relevant to planning and development in bushfire hazard areas. The Strathbogie Planning Scheme and accompanying overlays (e.g. Wildfire Management Overlay) establish development controls in bushfire prone areas. Wildfire Management Overlay (WMO) areas in the Shire have been identified by the Country Fire Authority

## Existing Controls

(CFA) using information about the density of vegetation. The WMO is applied to forests that are greater than 5 hectares in size and have a vegetation density of greater than 80%. The controls are aimed at protecting the environment and occupiers and infrastructure from bushfires through establishing siting and design criteria for new and upgraded developments.

In conjunction with the MAV, the CFA has developed guidelines about the appropriate location of buildings and the adoption of other fire risk management procedures for developments in WMO areas.

As in flood prone areas, limited audits of developments in WMO areas are undertaken to ensure that they meet with controls imposed.

## Gaps and Deficiencies

### Review of bushfire mapping and planning scheme

Existing mapping may not reflect current bushfire prone areas. In particular buffer zones may need to be introduced to take account of likely increases in the frequency of extreme fire danger and code red days and (possibly) greater areas being prone to bushfire.

This depends on the availability of updated bushfire mapping provided by the CFA.

### Inconsistency in planning and building regulations

Notwithstanding a long established planning and development control framework, Council planners are concerned that there are inconsistencies in between planning and building regulations regarding siting and design controls for residential developments in WMO areas. This creates uncertainty for Council planning and development control decision making.

### Lack of resources

Council and CFA lack staff and resources to:

- plan works and check Development Approvals (DAs) within statutory timeframes;
- enforce conditions of consent - at construction, development hand-over stage; and
- ground truth works against design specifications.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>28</sup>
#	Description		
L1.	<p><b>Bushfire prone areas and buffers</b></p> <p>Working with the CFA and DPCD, Council should review WMOs to ensure that they align with best available data for the Shire on relevant wildfire prone areas – i.e. forests that are greater than 5 hectares in size and have a vegetation density of greater than 80%. Particular attention should be paid in the review to the potential/ need for buffer zones in areas adjacent to forests.</p> <p>Any changes to WMOs, including buffer controls for developments in areas adjacent to forests, should be incorporated into the Planning Scheme.</p>	SSC, CFA, DPCD	Medium-term
L2.	<p><b>Alignment of planning provisions and building regulations</b></p> <p>Council, working with the MAV should approach DPCD and Building Commission to ensure that there is consistency (at the state level) in objectives, approach and terminology</p>	SSC, MAV (advocating to DPCD, Building Commission)	Short-term

<sup>28</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>28</sup>
#	Description		
	between planning provisions and building regulations relating to residential developments in bushfire prone areas.		
L3.	<b>Resourcing of development approvals and audits</b> See action K3.	SSC	Short-term

## 5.7 Economic development

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to economic development. Priority risk subsets addressed in this section include:

Subset M: Agriculture

Subset N: Tourism

### 5.7.1 Subset M: Agriculture

#### Priority Risks Addressed

- 2.06a: Decline in viability of intensive plant industry (e.g. horticulture, viticulture) linked to climate changes
- 2.07: Decline in viability of non-intensive agriculture linked to climate changes
- 2.08: Decline in viability of regional agricultural sector linked to increased operating costs
- 2.11: Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)

#### Focus and Context

**The focus of this subset is on the agricultural sector and associated economic development in the Shire.**

As described in 2.3.2, agriculture is a key industry sector for the Shire of Strathbogie, providing almost 30% of local employment and generating approximately \$80 million in output (\$2006).

Decreased water availability and increased rainfall variability due to climate change have the potential to threaten the long term viability of the sector, in particular of some intensive plant industries. Increased operating costs to the sector, relating to higher costs of energy and other farm inputs such as fertilizers could also impact on the sector's viability.

Any decline in the sector would have significant flow on effects to the local economy and community.

#### Existing Controls

##### Economic development strategies, plans and programs

A range of local, regional and state strategies and programs are currently being implemented with the aim protecting and enhance the resilience and viability of agriculture. These include:

##### Local

- **Shire of Strathbogie Council Plan.** This provides for the economic development, ongoing sustainability, wellbeing and liveability of the Shire and as such serves as an overarching plan for the future of the Shire.
- **Shire of Strathbogie Economic Development Strategy.** This sets out targets and actions for the economic development of Strathbogie including key industries such as agriculture.
- **Shire of Strathbogie Sustainable Land Use Strategy.** The SLUS establishes a planning framework for sustainable, productive and resilient rural areas within the Shire of Strathbogie by protecting key existing agricultural land uses and promoting of other land uses in rural areas such as horse breeding, industry and transport.

##### Regional

- **Hume Strategy for Sustainable Communities.** The Hume Strategy is a multifaceted plan for promoting the long term sustainability and growth of the Hume Region. It includes a number of programs aimed at promoting development of key industries such as agriculture.

## Existing Controls

### State

- **DPI Future Farming Strategy** aims to improve the productivity, competitiveness and sustainability of farm businesses.

### Securing water for agriculture

There are a number of regional and local strategies initiatives aimed at securing water for agriculture into the future:

- **Northern Region Sustainable Water Strategy (NRSWS)** aims to achieve long-term water resource planning by guiding the development, integration and implementation of water management plans prepared by water corporations and catchment management authorities operating within the region. The NRSWS considers all sources and uses of water including the needs of towns, agriculture, industry and the environment.
- **Goulburn Valley Water's Water Plan and Water Supply Demand Strategy** (GVW 2055 a sustainable urban water future) identify actions (such as efficient water delivery and use) aimed at securing sufficient water to ensure future regional development including for intensive agriculture.
- **Strathbogie Shire Council** negotiates with Goulburn Valley Water on behalf of new (intensive agricultural) industries seeking long term water security.

### Competitive advantages

The Shire of Strathbogie has competitive advantages which should serve as a sound basis for promoting the future development of the agricultural sector locally, even under worst case climate change scenarios:

- It is centrally located within Victoria and is readily accessible to most key relevant services (wholesale and retail trade, specialised agricultural services etc).
- It is situated on is can access major transport routes and hubs (Hume Highway, Melbourne-Sydney rail link, Port of Melbourne).
- It has a range of climate zones, enhancing the potential for the future adaptation of agricultural systems.

## Gaps and Deficiencies

### Agriculture change management

As noted in 2.3.2, Strathbogie has characteristics which both increase and decrease the vulnerability of its agricultural sector to climate change and other external 'shocks'. On the one hand, the Shire's small and ageing population acts as a barrier to growth and change. On the other hand, the agricultural sector in Strathbogie is already diversified. This diversity, combined with its low dependence on irrigated agriculture, should improve the Shire's capacity to adapt to a future with lower water availability and increased rainfall variability than might otherwise have been the case.

All of this points to the need to improve change management in agriculture across the Shire through succession planning, integrated education and training programs for landholders and programs to attract rural businesses and promote agricultural development.

### Water security

Notwithstanding current water security planning for the region and Shire, there is significant uncertainty about water security for the Shire's intensive agriculture and dryland farms in drought periods. Although historically this has been the case, long term climate change scenarios add to this uncertainty. Improved understanding of groundwater resources and sustainable use could reduce uncertainties.

### Pests and weeds

There is a gap in understanding of roles and responsibilities for pests and weeds management across the Shire, a key concern given the threat that pests and weeds already pose to agriculture and the uncertain but potential increase in threat posed by pests and weeds under climate change scenarios.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>29</sup>
#	Description		
M1.	<p><b>Agriculture succession plan</b></p> <p>Council, working cooperatively with DPI, VFF and VECCI should consider developing an agriculture succession plan for the Shire. The strategy would seek to promote the long term sustainability and viability of the sector in the face of climate, demographic and other changes. It would contain actions to improve the ability of agricultural industries and landholders to accommodate change including through:</p> <ul style="list-style-type: none"> <li>– integrated education and training programs (e.g. on business development and planning, business sustainability, marketing, carbon farming, land and water management);</li> <li>– local forums and partnerships; and</li> <li>– a marketing campaign to promote Strathbogie as a state agricultural hub (e.g. by demonstrating the competitive advantages of the Shire to industry associations and governments).</li> </ul>	SSC, DPI, VFF, VECCI	Medium-term
M2.	<p><b>Improved groundwater resource information and management</b></p> <p>Council should approach GBCMA, G-MW, DSE and other councils in the Goulburn-Broken catchment about the desirability and feasibility of a establishing a regional groundwater partnership.</p> <p>The partnership would add value to the State Observation Bore Network in terms of improved co-ordination of decision-making on groundwater at the regional level and enhanced local knowledge. Functions of the partnership could include:</p> <ul style="list-style-type: none"> <li>– coordinating information and decision making on groundwater access;</li> <li>– reviewing existing bores (numbers and yields);</li> <li>– coordinating region wide groundwater modelling, ensuring that best available climate change projections are fully incorporated;</li> <li>– developing a shared understanding of the objectives of different organisations in relation to groundwater management and use; and</li> <li>– monitoring the State Observation Bore Network.</li> </ul> <p>Strathbogie Shire’s role in the partnership could include considering groundwater management in development approvals processes (see action H2).</p>	SSC, G-MW, GBCMA, DSE, other councils	Short-term
M3.	<p><b>Draft Environmental Management Strategy - pests and weeds</b></p> <p>Council should proceed to implement actions from the Draft</p>	SSC	Short-term

<sup>29</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>29</sup>
#	Description		
	Environmental Management Strategy relating to pests and weeds control (see action G1).		

## 5.7.2 Subset N: Tourism

### Priority Risks Addressed

- 2.10: Decline in viability of regional tourism sector linked to changed climate
- 2.11: Decreased water reliability in unregulated systems (standing water bodies, wetlands and waterways)
- 2.12: Decreased water reliability in regulated systems (Goulburn River)

### Focus and Context

**This section focuses on the impacts of climate change on the regional tourism sector, in particular on key climate-linked tourism industries such as wine based tourism, tourism to major waterways and nature-based tourism.**

Tourism is a significant industry in the Shire providing approximately 5% of local employment in the Shire. Visitation data is not available specifically for Strathbogie but in the financial year ended June 2011, the Goulburn Valley region received 596,000 overnight visitors (up by 17.8% on the previous year) who spent a total of 1.7 million nights in the region (up by 33.9% the previous year) (GRVT, 2011).

Climate change, including reduced water availability and an increase in climate related extremes, has the potential to impact on major attractions in the region, such as wineries, waterways and nature based tourism. This contention is supported by visitation data which shows that visitation numbers were relatively depressed during the height of the 2000s drought and also in the December quarter of 2010, during and immediately following floods in the region.

### Existing Controls

#### Economic development strategies, plans and programs

Most of the regional and local economic development strategies outlined in section 5.7.1 are also relevant to tourism development in the Shire.

#### Tourism and recreation development and promotion

Additionally, the following strategies, plans and programs specifically target regional and local tourism and recreation.

##### Local

- **Goulburn Murray Water's Goulburn Weir (Lake Nagambie) Land and On-Water Management Plan** (currently in development) will focus on the community values of Lake Nagambie and provide direction and develop recommendations for future management of the waterway.
- Under the region's water allocation arrangements, G-MW provides a guaranteed minimum water level to Lake Nagambie to ensure the viability of recreational activities in the Lake.
- **Shire of Strathbogie Nagambie Waterways Recreational and Commercial Strategy** addresses utilisation of Lake Nagambie by individuals, clubs and agencies and assists in developing and realising the economic, social and environmental benefits of Nagambie's waterways.

##### Regional

- **Goulburn River Valley Tourism Development Plan** (2011 - 2016) sets the strategic direction of Goulburn River Valley Tourism until 2016.
- **Goulburn River Valley Marketing Strategy** (2011 – 2016) provides a cohesive marketing program to attract visitors to the region and ensure that Goulburn River Valley Tourism is a viable and successful

## Existing Controls

entity into the long term.

### Responding to climate extremes

As discussed in section 5.2.1, a comprehensive Municipal Emergency Management Plan (MEMP) is in place for the Shire, implemented through a Municipal Emergency Management Planning Committee. The MEMPC has established a Municipal Fire Protection Committee (MFPC) which has developed a Municipal Fire Prevention Plan and township protection plans. These plans designate Council Neighbourhood Safer Places (also known as Places of Last Resort), which make provision for visitors.

## Gaps and Deficiencies

### Staff and resourcing for tourism development and promotion

Notwithstanding the work of Goulburn River Valley Tourism (GRVT), the Shire of Strathbogie lacks trained staff and other resources dedicated to the development and promotion of tourism in the Shire.

### Understanding and responding to the impacts of climate related emergencies on tourism and visitation

There are major gaps in understanding of the impacts of climate variability and climate extremes on the viability of tourism in the region – many local tourism businesses do not currently have processes in place (e.g. business continuity) to plan for the impacts of climate change and extreme weather events.

There is also a need to improve visitor management during climate related emergencies (e.g. floods, bushfires), including evacuation and visitor understanding of the potential for extreme weather events in the region and how to act when one occurs.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>30</sup>
#	Description		
N1.	<p><b>Tourism development and promotion in Strathbogie</b></p> <p>Council should explore the feasibility of resourcing a program or programs dedicated to tourism development and promotion across the Shire. The program(s) would highlight and promote the Shire's diverse but positive environments and attractions, and diverse range of tourism opportunities in relation to those environments including nature-base tourism, recreation-based tourism, wine and other agriculture based tourism, and the cultural and social attractions of its towns (e.g. Violet Town market).</p> <p>Council could explore the possibility of sharing resourcing and implementation of the program with GRVT.</p>	SSC, GRVT	Short-term
N2.	<p><b>Visitor emergency communications and exit plan</b></p> <p>Council, working with the MEMC, GRVT and local media (e.g. local radio and newspapers), should consider developing a communications and exit plan for visitors aimed at educating and providing timely information to visitors about the risks of extreme weather events, how to act and where to go when these events occur.</p>	SSC, MEMPC, GRVT and BoM	Medium-term
N3.	<p><b>Tourism business continuity training and planning</b></p> <p>Council working with VECCI and local business associations,</p>	SSC, local business associations,	Medium-term

<sup>30</sup> Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

Recommended Actions		Implementing Organisation(s)	Implementation Timeframe <sup>30</sup>
#	Description		
	<p>should consider developing a training and capacity building program on business continuity planning for tourism businesses in the Shire. The purpose of the program would be to build the resilience of the local tourism businesses to climate variability and change and extreme weather events.</p> <p>The program would train businesses on how to produce business continuity plans and to consider and address disruptions to business associated with the direct impacts of climate change and variability, as well as disruptions to supplies and/or demand for services. Training should be consistent with Australian Standards and best practice on business continuity management.</p> <p>This program could potentially entail significant costs. Council will therefore need to seek funding for the initiative from Regional Development Australia (RDA) or another appropriate state or federal government agency.</p>	VECCI	

## 6. Discussion and next steps

### 6.1 Discussion of actions in the adaptation strategy

Adaptation planning workshops held with Council and the broader community of the Shire of Strathbogie on October 2011 indicate that there is a strong level of interest in ensuring that the Shire is well prepared for the challenges posed by climate change and increased climate variability.

It is apparent from responses at the adaptation planning workshops and through subsequent analysis that Council and other agencies and organisations involved in the Shire have already implemented numerous policies, programs and measures that are important to addressing the priority climate change risks identified in section 3 (see Table 10). This is unsurprising given that many of the climate change risks to Council and the community of Strathbogie add to or intersect with established risks. It is equally apparent that Shire of Strathbogie will need to implement additional measures if the risks posed by climate change and increased climate variability are to be effectively addressed going into the future.

This strategy sets out more than 40 recommended actions for addressing the priority risks. When implemented together, the actions will provide the Shire of Strathbogie with a sound basis for responding to the challenges of reduced water availability and increase rainfall variability. The actions are directed at Strathbogie Shire Council or Council working cooperatively with other organisations.

Table 14 provides an overview of the different types of actions proposed in the adaptation plan, noting that there is overlap between the types of action, with some of the actions in the strategy having multiple components.

**Table 14. Types of adaptation actions proposed in the strategy**

Category of action	Actions	
	Council	Council & other
New or amended strategies and plans	B1, B3, F1, F2, F4	A1, B4, M1
Land-use and statutory planning	K2	G3, H2, L1, L2
Improved decision-making processes and procedures	D4, I3	-
Research and data collection	-	I1, K1
Information, education and training	E2, E3, I4, J3, K4	A2, I2, J1, N2
'On the ground' programs or works	D1, D2, D3, J2	A3, C1, E1, F3, J1, N3
Resourcing	K3, N1	-
Regional cooperation	-	C2, G2, M2
<b>Number of actions</b>	19	22

Information in the table reveals the wide spectrum of action types. There are significant numbers of actions in the 'research and data collection' and 'education and training' categories.

While these types of action might be perceived as being not particularly relevant to climate change adaptation, research and monitoring and education and training are in fact crucial to enhancing the capacity of Council, other organisations and the broader community to respond effectively to the risks posed by climate change (see Box 4).

Ongoing resource and administrative constraints and other regional priorities mean that it will not be feasible to implement all actions in adaptation plan concurrently. It will therefore be necessary to prioritise adaptation actions, a point discussed in the following section.

#### **Box 4: Building Adaptive Capacity**

Numerous research & data collection and education & training collection actions are identified in the adaptation plan, highlighting the need for building adaptive capacity on climate change, within Council and agencies and across the broader community.

As described in Box 1 and discussed in more detail in section 2.3, adaptive capacity is linked to the concept of climate change vulnerability. Vulnerability refers to the effects of climate change on a community after allowing for the potential impacts of climate change and adaptive capacity of the community (with potential impact being closely linked to the concept of risk, as discussed in this report). Whether or how much climate change and associated impacts cause major or lasting harm to the community of Strathbogie or Council will depend on their adaptive capacities. The adaptive capacity of a community, describes its ability to modify or change its characteristics or behaviour to cope better with actual or anticipated impacts and risks of climate change. Improved data and other information or improved knowledge (through education and training) can build the capacity of the community to implement and effectively target adaptation actions.

Listed below are some of the actions in the Adaptation Plan, containing education & training or research & data collection elements that will be useful in helping to build the capacity of Council and the community of Strathbogie to respond to climate change:

- Community awareness program to promote increase preparedness for floods & bushfires (A2).
- Information on subsidies and assistance schemes (E2).
- Community information package on climate change (E3).
- Model local impacts of increased rainfall intensity to flood risk (I1).
- Guidelines for new and upgraded drainage assets (I2).
- Infrastructure and level of service communications and information program (I4).
- Community Information on transport evacuation routes (J1).
- Community information on flood management and planning processes (K4).
- Flood and fire communications plan for visitors to Strathbogie (N2).

## 6.2 Next steps

### 6.2.1 Risk assessment

It is important that the climate change risks discussed in section 3 of this strategy are reviewed on a regular basis. This will ensure that the description and ratings of risks remains consistent with current information and perspectives, and that the strategy addresses the risks of greatest importance to the Shire.

At an individual council and agency level, it is important that risk assessment outputs are integrated with other aspects of Council's strategic risk assessment and planning processes.

As previously noted, this strategy addresses only the 'priority risks'. Nevertheless, risks that are not addressed in this strategy should not be ignored. Council should maintain a 'watching brief' on non-priority risks as a part of the review process mentioned above.

### 6.2.2 Adaptation strategy

#### Coordinated implementation of actions

Many of the actions recommended in this strategy require Council to collaborate with other organisations (see Table 14). Effective implementation of those actions will require extensive dialogue and coordination between Council and the relevant organisations.

Other actions in the strategy are directed primarily at Strathbogie Shire Council. Implementing those actions will also require effective internal coordination, with substantial work needed to ensure that the actions are integrated with other key strategies and plans of Council. Some of the actions specifically refer to relevant strategies and plans.

As well as undertaking direct dialogue with relevant stakeholder organisations in the Shire, Council should be mindful of the climate change adaptation and other priorities of federal and state governments. Policies and programs having relevance in this regards include:

- The Council of Australian Governments (COAG) has developed the **National Climate Change Adaptation Framework** as part of its Plan of Collaborative Action on Climate Change. The framework outlines the future agenda of collaboration between governments to address climate change impacts. A key focus of the framework is to "... support decision-makers understand and incorporate climate change into policy and operational decisions at all scales and across all vulnerable sectors". Priorities identified in the framework that are of relevance to this Adaptation Plan include water, biodiversity, natural disaster management, agriculture and tourism.
- The **National Water Security Plan for Cities and Towns** program, which funds water savings projects in communities with fewer than 50,000 people.
- Funds established through **the Securing a Clean Energy Future Package** and other climate change related programs of the Federal Government including:
  - the *Biodiversity Fund* for projects to protect biodiverse carbon stores and secure environmental outcomes from carbon farming; and
  - the *Low Carbon Communities* program, which can provide funds to local governments to reduce their energy costs through energy efficiency upgrades in community buildings and facilities.
- Programs delivered through **Regional Development Australia** including:
  - the Regional Development Australia Fund (RDAF);

- the Community Infrastructure Grants Program; and
- Promoting Regional Living Program.
- Programs delivered through **Regional Development Victoria** including:
  - the Regional Growth Fund; and
  - the Local Government Infrastructure Program.

Shire of Strathbogie should be aware of these policies and programs as a basis for active petitioning of the Federal and State governments to provide financial and other support to implement actions in the strategy.

### Prioritising adaptation actions

Consistent with the good practice principles of adaptation outlined in section 4.2 of this report, it is important that the process of adapting to climate change is not a resource intensive exercise for the Shire of Strathbogie. This is one reason why the actions identified in this report focus as much as possible on collaborative actions between Council and other organisations. A collaborative approach will significantly enhance the capacity of Council to effectively respond to climate change in a timely and cost-effective manner.

Additionally, many of the proposed actions in this report are intended to build on existing measures. Many others aim to improve understanding of the potential impacts of climate change and potential adaptation responses and designed therefore to prevent pre-emptive actions that lead to ‘maladaptation’ or ‘over adaptation’ . This approach is consistent with the concept of ‘adaptive management’, which is about small-scale, incremental responses, rather than major, resource intensive new programs or investments.

Prioritisation of actions is another aspect of the adaptive management approach. Before implementing recommended measures therefore, it is essential that the measures are prioritised, both within each risk subset and between risk subsets.

Council should consider establishing a reference group to oversee prioritisation, implementation and evaluation of the priority actions. The process of prioritising actions will necessarily be a qualitative one, requiring judgements to be made by reference group members. In undertaking the prioritisation process however, it is recommended that a range of criteria be developed and applied. Suggested criteria would include:

- budgetary implications – precedence being given to actions that have relatively low costs;
- timing – precedence being given to actions that can be implemented in the short to medium terms;
- administrative burden – precedence being given to actions that are not likely to require substantial additional council and agency resources (e.g. staff);
- barriers – precedence being given to measures are not likely to face other significant barriers to implementation such as institutional or political constraints;
- non-climate benefits – precedence being given to measures that are likely to generate benefits beyond addressing the direct impacts of climate change (i.e. ‘win-win’ outcomes); and
- driver of other actions – precedence being given to actions that are precursors to or drivers of other actions.

This last criterion is particularly important given that implementation of a number of actions in the strategy hinge on effective implementation of other actions. One example of an action that

is a key driver of other actions Action 11, which is crucial to better understanding of risks and adaptation responses in a number of areas including stormwater management, flood management, land use planning and emergency management.

In some instances, recommended measures may meet most of the above criteria except that of budgetary implications. In these instances, Council should consider undertaking more detailed assessment of the cost-effectiveness of the action(s).

### 6.2.3 Reviewing the adaptation strategy

This strategy should be reviewed on a regular basis (e.g. every 5 years). This will mean:

- reviewing implementation of adaptation actions for priority risks, their timeliness and effectiveness;
- reviewing the ratings of all risks including non-priority risks as new information comes to light and upgrading a risk to 'priority' should new information indicate a 'high' or 'extreme' risk rating in the short to medium terms and an 'extreme' rating in the longer term;
- consideration of new climate change risks in the light of new scientific information and changing circumstances in the region;
- revising adaptation actions for priority risks in light of the evaluation outlined in the first point; and
- identifying adaptation actions for new and upgraded priority risks.



## Appendix 1 – Risk assessment scales

**Table 15. Likelihood Scale**

Rating	Recurrent Risks	Single Event
Almost certain	Risk is occurring now, or could occur within “days to weeks”, or could occur several times per year	Is expected to occur in most circumstances – probability high (e.g. greater than 90%)
Likely	Could occur within “weeks to months” or may arise about once per year	Will probably occur in most circumstances – at least 50/50 chance or greater
Possible	Could occur within “months to years”	Might occur at some time – less than 50% chance but still quite high
Unlikely	Could occur in “years to decades”	May occur but not anticipated – probability low but noticeably greater than zero
Rare	Only occur as a “100 year event”	May only occur in exceptional circumstances – probability very small, close to zero

**Table 16. Consequence Scale**

Consequence Rating	Health & Safety	Financial Impacts	Environment & Sustainability	Reputation	Economy & Community	Service Delivery	Legal
<b>Catastrophic</b>	One or more deaths	Huge financial loss (e.g. > \$500,000)	Widespread irreparable loss of habitat or environmental amenity	Serious national media outcry, extreme public outrage	General long term regional decline, widespread business failure, loss of employment and community hardship	The Council would be seen as unable to effectively provide its services, or widespread and sustained loss of critical services (e.g. weeks to months)	Serious litigation with prosecution and significant penalties
<b>Major</b>	Extensive injuries or illnesses	Major financial loss (e.g. >\$50,000 – \$500,000)	Significant irreparable loss of habitat or environmental amenity	Serious public or local media outcry, loss of community confidence in Council and damage to reputation	Regional economic stagnation, decline in quality of life within local community	Severe and widespread decline in services or loss of critical services for a significant period of time (e.g. days to weeks)	Serious breach of policy or regulation and exposure to court imposed penalties
<b>Moderate</b>	Some injuries or illnesses – medical treatment required	High financial loss (e.g. >\$10,000 – \$50,000)	Isolated but significant instances of habitat loss or environmental damage that might be reversed with intensive efforts	Widespread community complaints and anger, some adverse local media	Significant general reduction in economic performance or quality of life relative to forecasts or expectations	Appreciable decline in some services or loss of important services for a short period of time (e.g. > a few days)	Moderate breach of policy or regulation leading to low level investigations or penalties
<b>Minor</b>	Minor injuries or illnesses (or serious near misses) – first aid treatment	Medium financial loss (e.g. >\$1,000 – \$10,000)	Minor loss of habitat or instances of environmental damage that can be reversed	Some community concern and complaints, limited adverse local media coverage	Individually significant but isolated areas of shortfall in economic performance or quality of life relative to expectations	Moderate decline in some services and/or brief loss of services for minimum period (e.g. hours to 1 day)	Minor legal and non compliance issues remedied by prompt attention
<b>Insignificant</b>	No injuries - appearance of a threat but no actual	Low financial loss (e.g. < \$1,000)	No environmental damage	No community concern, no adverse	Minor shortfall in economic performance relative	Minor business disruption, resolved in day-to-day	No legal significance

Consequence Rating	Health & Safety	Financial Impacts	Environment & Sustainability	Reputation	Economy & Community	Service Delivery	Legal
	harm			media coverage	to expectations	management	

**Table 17. Priority rating and interpretation**

Consequence	Likelihood				
	(1) Almost Certain	(2) Likely	(3) Possible	(4) Unlikely	(5) Rare
(A) Catastrophic	E	E	E	H	H
(B) Major	E	H	H	H	M
(C) Moderate	H	M	M	M	L
(D) Minor	M	M	L	L	L
(E) Insignificant	L	L	L	L	L
E = extreme risk; immediate action required.					
H = high risk; senior management attention needed					
M = medium risk; management responsibility must be specified					
L = low risk; manage by routine procedures					



## References

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- ABARE/BRS, 2010. *Indicators of community vulnerability and adaptive capacity across the Murray-Darling Basin - a focus on irrigation in agriculture*, ABARE–BRS Client Report, Canberra.
- Abbs and Rafter, 2008. *The Effect of Climate Change on Extreme Rainfall Events in the Westernport Region*, CSIRO, Aspendale.
- ABS, 2010. *National Regional Profile*, Strathbogie, 2005-2009, Catalogue No. 1379.0.55.001
- ABS, 2010. *National Regional Profile*, South Goulburn, 2005-2009, Catalogue No. 1379.0.55.001
- ABS, 2010. *National Regional Profile*, Goulburn, 2005-2009, Catalogue No. 1379.0.55.001
- ABS, 2010. *National Regional Profile*, Victoria, 2005-2009, Catalogue No. 1379.0.55.001
- ABS, 2008, Socio-economic Indexes for Areas 2006.
- CSIRO, 2008. Climate change in Goulburn Broken, Department of Sustainability and Environment, Victoria, Melbourne.
- IPCC (2007). *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. (Eds. Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor M and Miller HL). Cambridge University Press, Cambridge, UK and New York, USA.
- Nelson, R.; Kokic, P; Crimp, S; Meinke, H and Howden, S.M., 2010. 'The Vulnerability of Australian Rural Communities to Climate Variability and Change: Part I—Conceptualising and Measuring Vulnerability'. *Environmental Science and Policy*, 13, pp. 8-17.
- National Institute for Economic and Industry Research (NIEIR), 2011, YourPlace IO.
- Preston, BL and Stafford-Smith, M. 2009, *Framing Vulnerability and Adaptive Capacity Assessment: Discussion Paper*, CSIRO Climate Adaptation Flagship Working paper No. 2.
- Schroter, D., 2004, *Global Change Vulnerability: Assessing the European Human-Environment System*. Potsdam Institute for Climate Impact Research, Potsdam.
- USERB, 2011. United States Bureau of Economic Research classifications, accessed at <http://www.ers.usda.gov/Data/TypologyCodes/>, July 2011.