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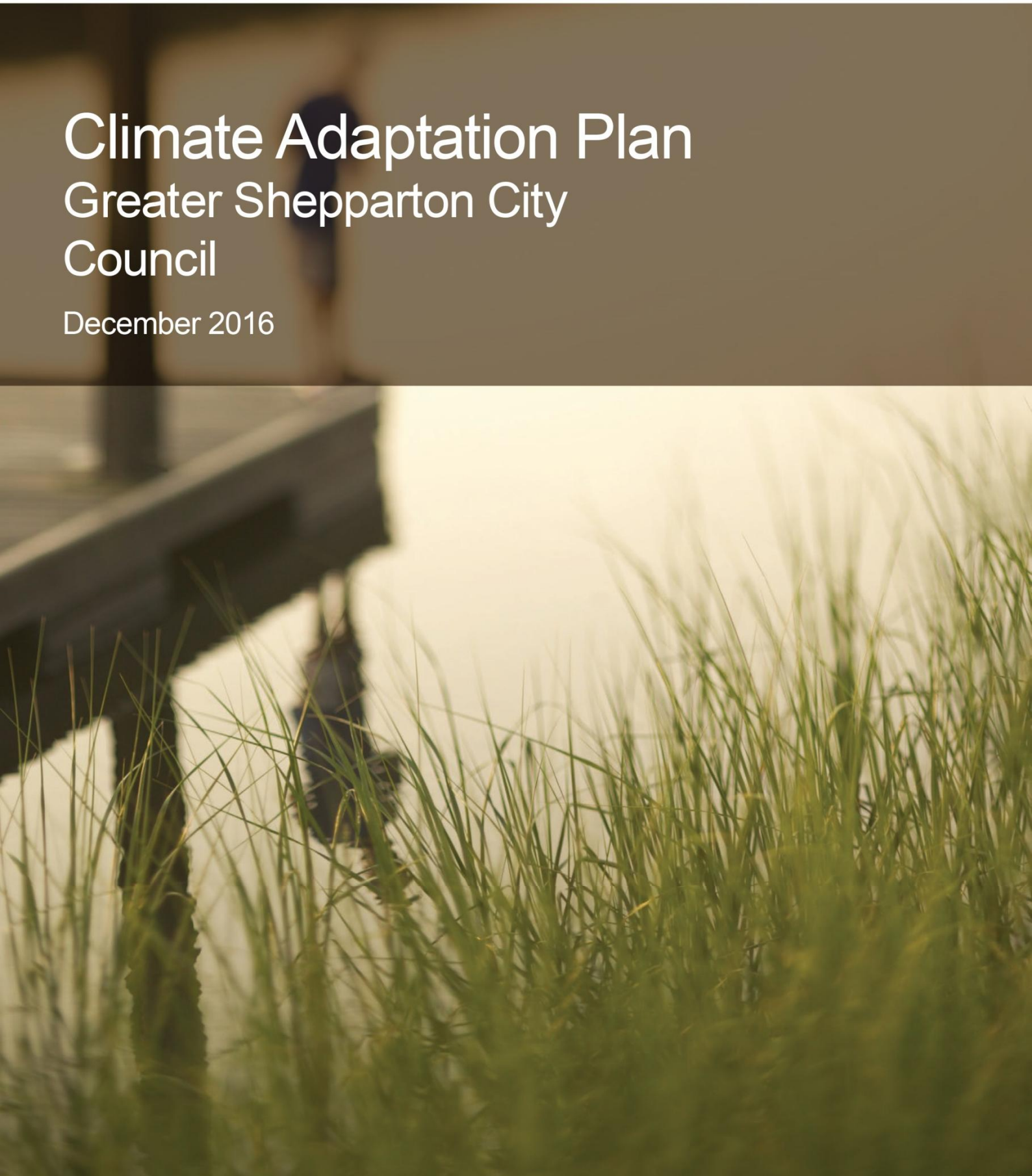
GREATER SHEPPARTON

Climate Adaptation Plan

Greater Shepparton City Council

December 2016



Climate Adaptation Plan

Greater Shepparton City Council

Client:Greater Shepparton City Council

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Prepared by

AECOM Australia Pty Ltd
Level 10, Tower Two, 727 Collins Street, Melbourne VIC 3008, Australia
T +61 3 9653 1234 F +61 3 9654 7117 www.aecom.com
ABN 20 093 846 925

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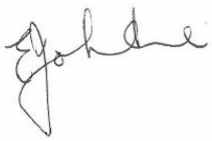
4	14-Dec-2016	Final	Liz Johnstone Associate Direction - Sustainability and Resilience	

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Executive Summary

This 10-year Climate Adaptation Plan (CAP) assists Greater Shepparton City Council (GSCC) to embed climate risk management and adaptation planning into its operations, policy, service delivery and processes to build adaptive capacity and resilience to climate risks. The CAP was developed in parallel with the development of Council's risk framework and updated risk register. The key objectives of this CAP are to:

- Enhance the ability of Councillors and staff to identify, understand and respond to risks to Council from climate change
- Put in place actions to minimise or mitigate climate risks to Council's assets and services

As a regional centre, Greater Shepparton City Council (GSCC) continues to provide significant leadership across its organisation and through regional partnerships to understand climate change impacts and manage climate risk.

The GSCC area is already vulnerable to flooding and extreme temperatures and future changes in climate are likely to exacerbate these conditions and the associated impacts to Council.

The climate change risk assessment identified and rated risks based on the CSIRO's most recent climate change projections for 2030 and 2090 for the Murray Basin natural resource management (NRM) cluster. It indicates that Shepparton is likely to experience:

- Increased *average* temperatures in all seasons (from 0.6 to 1.1°C by 2030).
- Hotter and more frequent hot days and warm spells (days over 40°C and 35°C) and fewer frost days (days below 2°C)
- Continuing decrease in winter rainfall, with annual rainfall projected to decrease and with more time in drought
- Increased intensity of heavy rainfall and associated flood events
- Harsher fire weather and longer fire seasons

Through consultation with Council staff, the community and regional stakeholders, a total of 53 climate risks were identified for Council and the broader Shepparton area. The risk assessment approach is consistent with the *AS/NZS ISO 31000:2009*, and *AS 5334-2013 Climate change adaptation for settlements and infrastructure - A risk based approach*, and Council's risk management framework.

The majority of climate risks (16) relate to Council infrastructure, specifically to buildings and drainage assets. These assets are currently exposed to extreme weather events and are likely to be more so in the future as the intensity and reach of flooding, heatwave, and storm events increase. The identified risks predominantly relate to increased damage resulting in more maintenance by Council and increased service disruptions. Overall, in this category, a total of 11 risks were rated Extreme and High.

16 service related risks were identified relating to Council's emergency management services, the delivery of key community services, such as Home and Community Care (HACC), and environmental management. More frequent extreme events are likely to place greater pressure on Council's staff, resources and services. Overall, five risks were rated Extreme and High.

The local community, particularly vulnerable groups such as the young, elderly, or disadvantaged are also likely to be impacted by a changing climate. 10 climate risks to the local community were identified. They relate to health impacts (e.g. injury or death) to

residents, vulnerable groups or Council staff from extreme flood or heat events. Risks may also result from failed infrastructure or services (e.g. septic tanks), potentially increasing contamination and health risks. Six risks were rated Extreme and High for which adaptation actions were developed.

Climate change will also exacerbate the already existing pressures on the natural environment. Some vegetation and habitat communities are already impacted by warmer temperatures and reduced rainfall in the region. As such, this trend is likely to continue into the future and increase the risk of new and introduced pest species. Overall, three risks relating to the natural environment and environmental management were rated High.

Given the significant role irrigation, agriculture and manufacturing have in Shepparton, region-wide risks and potential impacts to the local economy were assessed. Climate change has the potential to exacerbate risks in the agriculture (e.g. irrigation, horticulture, farming and cropping) and commercial sectors, as well as to the transport sector. Disruptions to essential services (such as power, water and telecommunications) were identified as Extreme and High risks for the municipality, due to their criticality to the local economy and in Council service delivery and emergency or disaster relief situations.

This plan identifies 43 short, medium and long term actions that Council can implement within its own scope of responsibilities and apply to its infrastructure assets, policy, processes, and service delivery. The proposed actions address the following broad areas:

- **Building internal staff awareness and capacity in Council's adaptation efforts.** This includes preparing further guidance for departments and training content for staff inductions and integrating adaptation measures into existing Council programs.
- **Reviewing essential management plans, design standards and business procedures** to incorporate future climate projections and the management of identified climate risks across a project and infrastructure lifecyle. These include reviews of floodplain management reports, management of drainage infrastructure and other Council assets, emergency management plans, planning processes and procedures that address staff safety and risk management.
- **Disseminating sustainability and emergency preparedness information** to the community and groups about climate-related risks and adaptation measures. These include community involvement in planning, recruitment drives for volunteers, or public education programs to build community resilience to increased heat and flooding risks.
- **Protecting essential infrastructure and systems** through enhancing open spaces and the natural environment. This could include green infrastructure.
- **Continuing to protect the natural environment** both locally and regionally to ensure it is able to withstand the impacts of and adapt to our changing climate over the long term.

GSCC is already engaging the community and regional organisations on a number of sustainability and climate change initiatives. Implementing this adaptation plan and continuing to work in partnership with regional leaders, industries, communities and the private sector can help foster a regional approach and further increase climate resilience in the area.

1.0 Introduction

1.1 Background

“Adaptation is about increasing public and private resilience to climate risks through better decisions about managing our built and natural environment and taking advantage of opportunities” (DEPI 2013). Climate change has generated new challenges and opportunities for Councils, organisations and communities across Victoria. In some cases, the interaction of a changing climate with existing environment, social and economic stressors has generated a new series of risks while in other cases, it has exacerbated the consequences of existing risks or created new linkages between risks. Given the potential impacts of these new interactions on Councils’ operations and functions, positioning Council to respond is vitally important.

As a regional centre, GSCC has already provided significant leadership across its organisation and through a range of activities and regional partnerships to understand climate change impacts and manage climate risk. Many of Council’s existing strategies and programs for responding to specific climate change issues such as the *Environmental Sustainability Strategy 2014-2030*, *Heatwave Plan 2012* and *Municipal Emergency Management Plan 2016*, provide a strong foundation to further adapt to a changing climate.

To further enhance and solidify Council’s response, Council commissioned AECOM to assist with the development of a Climate Adaptation Plan. The engagement aimed to identify the risks climate change presents to Council’s services and develop a planned response to manage these risks.

This 10-year Climate Adaptation Plan (CAP) assists GSCC to embed climate risk management and adaptation planning into its operations, policy, service delivery and processes to build greater adaptive capacity and resilience to climate risks. The key objectives of this CAP are to:

- Minimise or mitigate climate risks to Council assets and services; and
- Enhance Councillors and staff abilities to identify, understand and respond to risks to Council from climate change.

This document provides an overview of climate change impacts for the Greater Shepparton area. A description of regional climate projections and relevant variables is presented in Section 3.0, a summary of climate risks relevant to Council in Section 4.0, an Adaptation Plan, that is, a prioritised list of adaptation actions with timeframe and budget for implementation in Section 5.0, and finally, an approach for implementation, monitoring and review is outlined in Section 6.0.

1.2 Local and regional profile

The GSCC is located in north-central Victoria; approximately 180 km by road from Melbourne, as shown in Figure 1. It is the fifth largest city in Victoria. The municipality covers almost 242,136 ha of Victoria and includes the key townships of Mooroopna, Tatura, Murchison and Dookie. Greater Shepparton falls within the Goulburn Broken Catchment Management Authority (GBCMA). Key waterways include the Goulburn and Broken Rivers. The traditional owners of the land are the Yorta Yorta, which incorporates the Bangarang nation.

The Greater Shepparton local government area (LGA) is bounded by Moira Shire in the north, Benalla Shire in the east, Strathbogie Shire in the south and the Shire of Campaspe in

the west. All belong in the Goulburn Valley, which provides 25 per cent of Victoria's agricultural production. The region also has strong food processing and manufacturing industries, which, combined with the healthcare and agriculture sectors, represent one third of local employment. Shepparton is also considered a transport hub of regional Australia, providing a large amount of truck sales and services.

Major utility services are provided by Goulburn Valley Water (GVW) for urban water supply and waste water treatment, and also to support the food processing industry, Goulburn Murray Water (GMW) for irrigation, and by Powercor who provide energy distribution to the area. Septic tank systems are also used in the municipality, mostly in Dookie for reticulate sewage. Major arterial roads are Midland Highway (east to west) and Goulburn Valley Highway (north to south). Shepparton also has other key transport infrastructure such as the VLine rail (Melbourne to Shepparton) and a regional aerodrome.

According to the 2014 Census, Greater Shepparton had a population of 63,269 which is forecast to grow to over 83,000 by 2036 (Profile.id,2016). This represents a 35 per cent increase relative to the local population in 2011 (forecast.id, 2016), with the largest growth happening in Shepparton and Tatura.

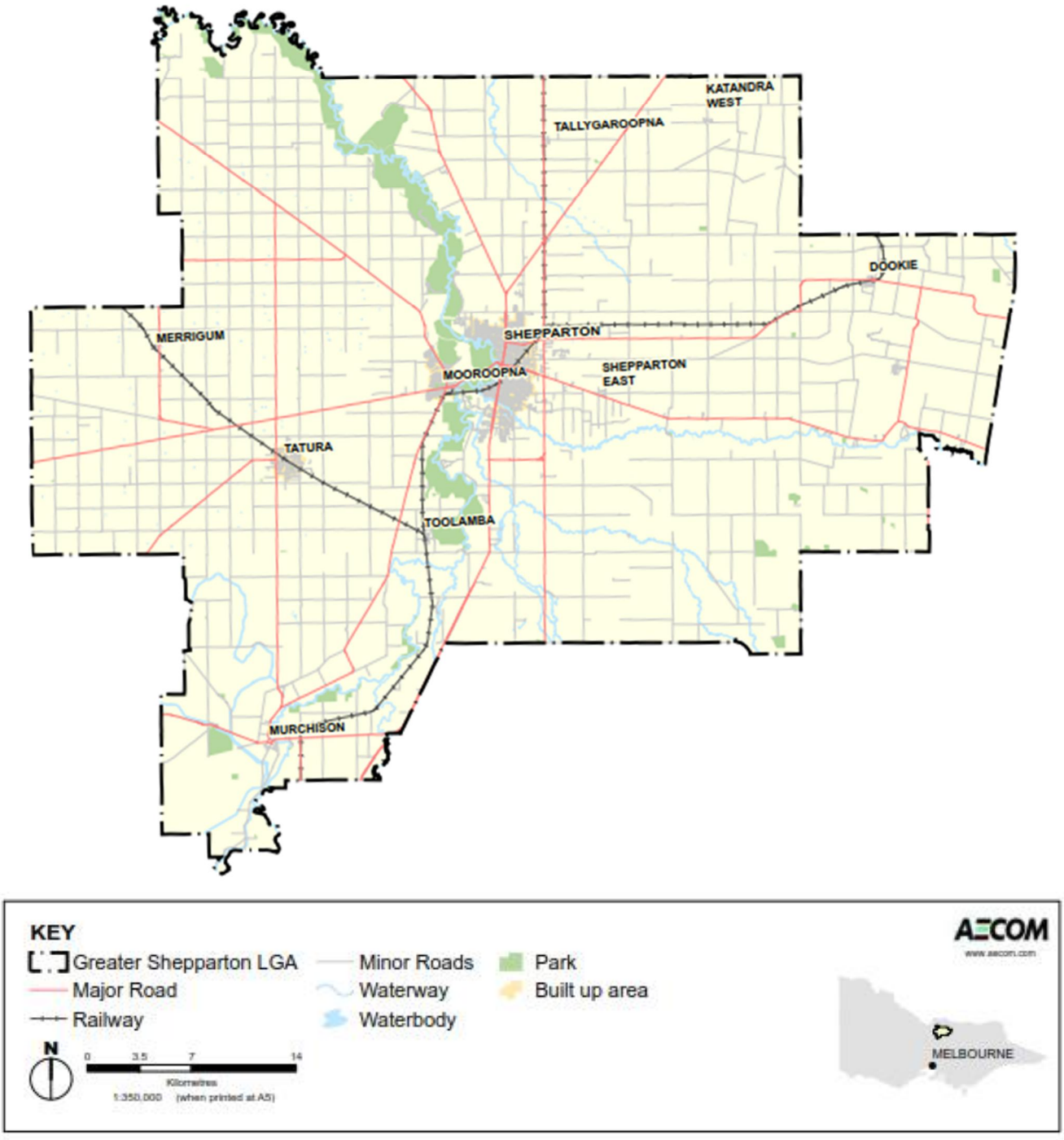


Figure 1 Map of Greater Shepparton City Council.

1.3 Policy context for adaptation

1.3.1 Federal

There are a number of federal policies in place to reduce Australia's greenhouse gas (GHG) emissions, support clean and efficient energy, and respond to climate change.

The Australian Government has released a *National Climate Resilience and Adaptation Strategy.* The Strategy identifies a set of guiding principles for effective adaptation practice and resilience building and sets out how Australia is managing climate risks for the benefit of the community, economy and environment (DOE 2016).

Under the United Nations Framework Convention on Climate Change, Conference of the Parties (COP21), Australia has pledged to reduce emissions to 26-28 per cent on 2005 levels by 2030, representing a 50-52 per cent reduction in emissions per capita and a 64-65 per cent reduction in the emissions intensity of the economy between 2005 and 2030 (UNFCCC, 2015).

Central to Australia's mitigation commitments is the $2.55 billion Emissions Reductions Fund (ERF), a reverse auction mechanism for paying polluters to reduce emissions at the lowest cost. The ERF is supplemented by the Australian Renewable Energy Agency (ARENA), which was established on 1 July 2012 by the Australian Renewable Energy Agency Act 2011, to improve the competitiveness of renewable energy technologies and increase the supply of renewable energy in Australia. With $2.5 billion of funding, the agency is expected to have delivered its objectives by 2022 (ARENA, 2016).

In 2012, the Clean Energy Finance Corporation (CEFC) was established. With $2 billion of funding per year from 2013-2017, the CEFC invests commercially to increase the flow of funds into renewable energy, energy efficiency and low emissions technologies.

As of March 23, 2016, ARENA and the CEFC will jointly administer the new Clean Energy Innovation Fund, allocating up to $100 million per year to commercialise innovative renewable energy projects.

1.3.2 State

In Victoria, the *Climate Change Act 2010* sets the legal framework for responding to climate change for the state. The Act defines arrangements for a carbon sequestration industry, and requires a state Climate Change Adaptation Plan to be developed and reviewed every four years. It also requires decision makers to take climate change into account when making specified decisions under the *Catchment and Land Protection Act 1994, Coastal Management Act 1995, Environment Protection Act 1970, Flora and Fauna Guarantee Act 1988, Public Health and Wellbeing Act 2008* and *Water Act 1989*.

In 2015, the Climate Change Act underwent a State review. Alongside its review, the Victorian Government is developing the Victorian Climate Change Framework, which is scheduled to be released in 2016.

1.3.3 Local

As a regional centre, GSCC has already provided significant leadership on a range of activities, across its organisation, to consider climate change and manage climate risk. The *Environmental Sustainability Strategy 2014-2030* in particular highlights two key objectives around flood preparation and mitigation and preparation for future climate risks and opportunities for the area.

There are also a number of Council policies and action plans such as the *Heatwave Plan 2012* and *Municipal Emergency Management Plan 2014* that directly identify and address

impacts of extreme temperature and responses to bushfire, floods, heatwaves, storms and drought.

Council's recently adopted *Energy Reduction Plan 2016* also actively addresses the mitigation side of climate change. The plan includes energy and carbon reduction targets of 20 percent by 2020 from 2015 levels.

Adapting the broader region to climate change is also supported by the *Economic Development Strategy 2009-2012*, which identifies the need for the local farming economy to cope and thrive during drought conditions.

1.4 Role of Council

Governments at all levels, businesses, households and the community each have important, complementary and differentiated roles in adapting to the impacts of climate change. Adaptation requires strong collaborative effort between governments, businesses, industry and communities and governments play a primary role in creating the right conditions and incentives to facilitate such collaboration.

Local governments, in particular, are on the frontline in dealing with the impacts of climate change and providing leadership in adaptation. They play a critical role in ensuring that particular local circumstances are adequately considered in the overall adaptation response and involving the local community directly in efforts to facilitate effective change. Incorporating adaptation in Council's systems and practices is a good start given that Council:

- is responsible for administering local laws, policies, and planning schemes which affect how land is used and developed, hazards identified and risks avoided.
- works with regional authorities and organisations on a range of issues including regional environmental initiatives and economic development.
- is closest to the community and able to initiate programs and services to access information and build adaptive capacity and resilience
- provides key services to the community (e.g. health, community safety, child care, environmental health, waste management, etc.) which are all essential to health and well-being outcomes.
- manages local infrastructure, public areas and development that enable a range of recreational, commercial, industrial and productive uses to occur.

2.0 How this plan was developed

The development of this 10-year Climate Adaptation Plan followed a five step process. An overview of this process is provided in Figure 2 and a summary of the key steps follow.

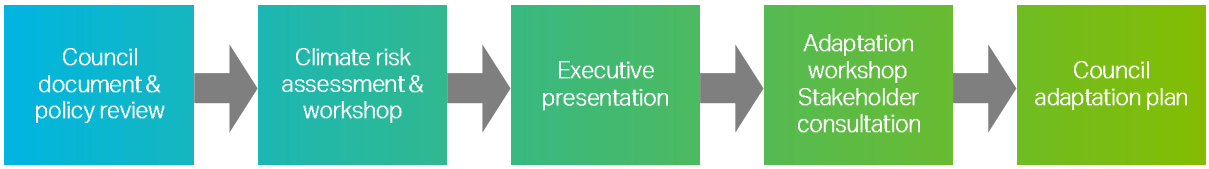


Figure 2 Adaptation plan development methodology

A desktop review of selected Council strategies and policies was done to understand how they can help drive the strategic direction of climate adaptation for the municipality and identify gaps in addressing climate risk and adaptation. Approximately 15 strategies were reviewed. To provide further guidance, AECOM's Adapting to a changing climate self-assessment tool was also used to further conceptualise Council's current state.

Following the document and policy review, a climate risk assessment was undertaken, using GSCC's risk management framework and local climate science and projections. The aim of the risk assessment was to identify climate risk and where future adaptation planning should be focused. This involved the following steps:

- **Risk identification**. This identified the impact changes in climate variables may have to Council's operations and Greater Shepparton. The following categories were used to guide the assessment:
  - Council owned infrastructure: transport and road reserves, drainage infrastructure, recreation facilities, parks and open space, buildings, and cultural assets
  - Council services: local infrastructure provision and maintenance, emergency and disaster management, waste management, community support services e.g. aged and disability, health, elderly, etc., land use planning and development, capital works, corporate services, and economic development
  - People and communities: community residents, vulnerable populations groups and Council staff
  - Broader region: industry, commercial activities, and energy, water and other utility infrastructure and services
- **Inherent risk rating**. A likelihood and consequence approach consistent with the AS 5334-2013 Climate Adaptation for Settlements and Infrastructure and Council's existing risk management framework was used to assess the risks.
- **Consideration of controls**. For each risk, existing controls were identified and the effectiveness of those controls was evaluated.
- **Residual risk rating**. Each risk was rated again considering the effectiveness of controls. Those rated High or Extreme progressed into the adaptation planning phase.

A full description of the risk assessment methodology is provided in Appendix A.

A climate risk assessment workshop was then held with Council staff, State Government and regional authorities to verify risks, mitigation strategies and control measures and ratings.

Broad consultation was undertaken to drive engagement and ensure that all relevant risks and actions have been taken into account prior to the development of the adaptation plan.

This included a Regional Stakeholders Meeting was also held with representatives from Council, Country Fire Authority (CFA), Goulburn Valley Water, Vic Roads, Rural Financial Services and the Department of Health and Human Services.

An adaptation workshop was held with Council staff with representation across a range of Council departments. The objective of the workshop was to identify, evaluate and prioritise adaptation measures. The workshop used a cost/impact matrix to help evaluate potential adaptation measures. Participants were encouraged to consider the adaptation measures that had been identified and placed them in the most appropriate quadrant based on the cost and impact of each measure. Other criteria to be considered included ease of implementation, safety, social and environmental benefits, and reach or scale of the option. Options that offered the best value for money and benefits and could be implemented in the short term were shortlisted for inclusion in this plan.

Additional stakeholder consultation was undertaken in the form of phone interviews with Goulburn Broken Greenhouse Alliance, Goulburn Broken Catchment Management Authority and Powercor. These discussions identified potential opportunities for adaptation with GSCC and gain a better understanding of organisations' current climate change adaptation initiatives.

Community surveys were also distributed to community groups in Mooroopna, Tatura, Dhurringile, Toolamba, Undera, St Georges Road, Seven Creeks, the University of the Third Age in Shepparton, and the Positive Aging Advisory Group to understand what they considered to be priority climate risks and areas that Councils should focus adaptation efforts on. A summary of results is provided in Section 4.3.

Using information and feedback gathered, adaptation actions were developed into this plan.

3.0 The Changing Climate

3.1 Regional climate projections

The most recent regional climate projections for Australia from the Commonwealth Scientific Industry Research Organisation (CSIRO) and the Bureau of Meteorology's (BoM) have been used to consider the municipality's climate risks. CSIRO modelled climate projections for 54 different types of natural resource management (NRM) regions. They have then been broken down into 'clusters', which are broad climate and bio-physical regions around Australia where tailored climate projections have been modelled by CSIRO and BoM. GSCC located in the Murray Basin cluster and sub cluster (see Figure 3; the dotted blue line indicates the state boundary located within the cluster).

Figure 3 Map of the Murray Basin Cluster in Victoria

Based on the projected changes in temperature, rainfall, wind, and bushfires for the region, the Murray Basin cluster is projected to experience:

- Higher average temperatures and more hot days (over 35°C)
- Less rainfall and more drought conditions
- Intense rainfall (downpour) events and more flash flooding
- Harsher bushfire weather and longer bushfire seasons
- Less frost days

Changes in, and impacts from future sea level rise and storm surge were not assessed due to the region's significant distance (over 170km) from Port Philip Bay and the coastline.

3.2 Time frame and emission scenarios

To define the narrative of climate change in Shepparton, two time frames and two emissions scenarios of climate change projections formed the basis of the risk assessment. In the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (5AR), global climate projections have been modelled based on four scenarios of how the world may respond to the challenge of a changing climate. These models factor in continued production and use of energy and resources, global greenhouse gas emissions, as well as incorporating population and economic growth. The scenarios or representative concentration pathways (RCP) selected for Shepparton align with these current climate models and are based on:

- RCP4.5 2030 - medium emissions growth scenario which assumes global GHG emissions peak at 2040, which is a plausible scenario given the recent global Conference of Parties (COP21) agreement by nations, including Australia, committing to keep temperature increase well below 2°C.
- RCP8.5 2090 - high emissions growth scenario for 2090 which assumes continued emissions growth based on increasing population growth, demand on GHG intensive energy sources and an absence of global climate change policies.

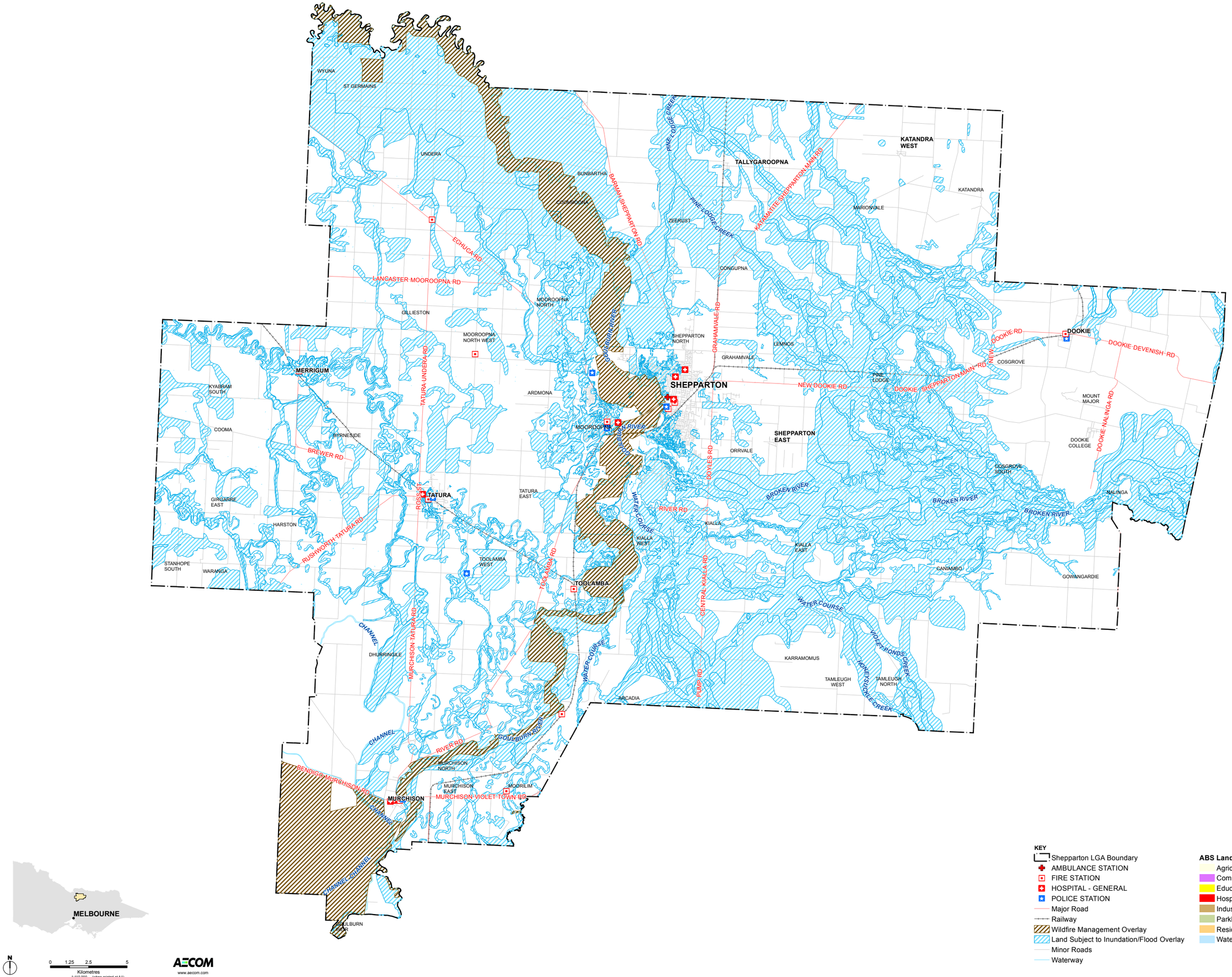
Under any RCP scenario, the extent of climate change is projected to increase over time, and the changes are more uncertain for longer-term projections. While this strategy will have a 10 year time frame, the purpose of assessing an extreme case of change in the risk assessment is to understand how risk and vulnerability may change over time and benefit from a planned adaptation response.

3.3 Climate change in Greater Shepparton

The climate in Greater Shepparton and the broader region is already changing. The Hume region, in which Greater Shepparton is located to the north-west, is already becoming warmer and drier (DELWP 2015). Climate models project a warmer and drier climate, with changing rainfall patterns. Less rainfall (up to 9% less in 2030 and 23% less in 2090) is projected for the Murray Basin cluster. This is likely to mean less rainfall in the cooler seasons, and reduced or no rainfall in warmer seasons.

These gradual changes in average annual temperature and rainfall are projected to lead to more extreme weather ('shock') events. The Shepparton LGA is already vulnerable to flooding, as shown in the land subject to inundation planning overlay in Figure 4. The overlay provides an overview of the area's existing flood risk, which is a majority of the LGA. The frequency and intensity of flooding, heatwaves, and bushfires are likely to increase, and drought conditions in the region are likely to last longer. The 'Millennium Drought' (1996 – 2009) saw rainfall at a record low, 12.4 percent below the average for the 20th Century (CSIRO 2011). While the Millennium Drought ended with the two wettest years on record (2010 – 2011), March 2016 saw prolonged, record breaking heat once again. This trend of increased temperatures, more hot days and warm spells, is likely to continue into the future, causing harsher and longer fire seasons (DELWP 2015). At the same time, the region has also experienced more frequent and intense downpours, as witnessed in October 2015, when a heavy downpour caused damage to council buildings.

A summary of climate change in Shepparton is provided overleaf and a detailed summary of the climate projections from CSIRO and BoM is provided in Appendix B.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DOOKIE SHEPPARTON MAIN RD
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DOOKIE DEVENISH RD
DOOKIE NALINGA RD
TATURA UNDERA RD
BREWER RD
RUSHWORTH TATURA RD
ROSS ST
TOOLAMBA RD
MURCHISON TATURA RD
DOYLES RD
CENTRAL KIALLA RD
PUMP RD
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Shepparton LGA Boundary
AMBULANCE STATION
FIRE STATION
HOSPITAL - GENERAL
POLICE STATION
Major Road
Railway
Wildfire Management Overlay
Land Subject to Inundation/Flood Overlay
Minor Roads
Waterway
ABS Land use
Agricultural
Commercial
Education
Hospital/Medical
Industrial
Parkland
Residential
Water

Climate change in Shepparton

Shepparton at a glance:

- Population: approximately 63,000
- Area: 2,422km^2
- Goulburn Valley produces 25% of Victoria's agricultural production
- Transport hub of Australia - Key road transport industry
- Food processing and manufacturing, agriculture and healthcare represent one third of employment

By 2050, under a high emissions scenario, the climate of Shepparton will be more like Griffith in NSW now.

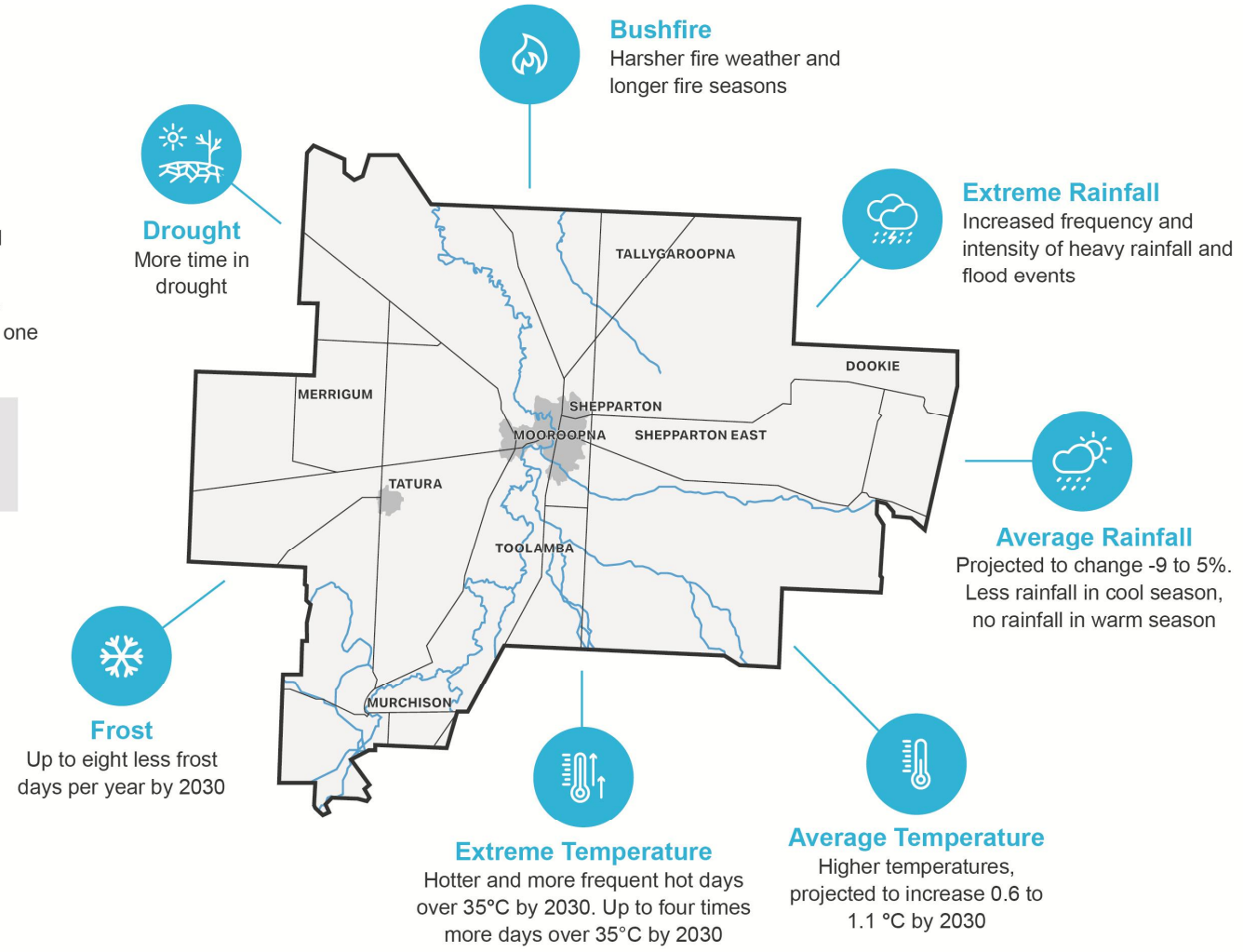

Figure 5 Climate change in Greater Shepparton

4.0 Climate Change Impacts and Risks

The impacts of climate change to Council's operations and services, Council infrastructure, the local population, the natural environment, and the broader region varies by sector. A total of 53 climate risks were identified. The following sections describe the potential impacts from climate change by sector and a summary of the prioritised residual risks for 2030 i.e. the prioritised climate risks for 2030 after considering existing mitigation controls. In addition, supporting case studies are provided to further illustrate the type of impacts extreme weather events may have to GSCC and the region.

Risks to the broader region, such as the local economy as well as critical utility services were also identified. These regional risks are summarised in Section 4.4 for completeness, however no adaptation actions have been developed for regional climate risks in this adaptation plan.

A copy of the full climate risk register for Greater Shepparton City Council is provided in Appendix C.

4.1 Council infrastructure

Changes in temperature, rainfall, and the frequency of storm, bushfire, and drought conditions could impact Council infrastructure in the following ways:

- Accelerate damage of concrete structures, such as buildings and pavements, including materials, such as paints and finishes from extreme temperatures and rainfall. This may result in the need for more frequent repairs and increasing maintenance costs.
- Damage to Council owned and managed property, such as buildings, drainage systems (both natural and infrastructure types), and road assets from heavy rainfall, wind and storm/hail events. Open spaces may also be impacted by damaged trees, reducing canopy cover, or fallen streetlights requiring additional resources for clean-up and maintenance.
- Increase the risk of localised flooding of property, roads, and public spaces from overflowing riverbanks and/or stormwater drainage systems. This would temporarily inundate areas affecting use and accessibility. Underground assets such as septic tanks may also overflow due to local flooding, contaminating water quality and impacting public health.
- Destabilise buried assets such as bridge foundations and drainage pipes as a result of drying soils from drought conditions.
- Power supply disruptions to buildings impacting service provision from higher temperatures and extreme heat days. Electricity use will also increase due to a higher demand to cool buildings, potentially leading to higher operating costs.

The risk assessment identified a total of 16 risks to Council infrastructure, with the majority affecting buildings and drainage assets. These assets are currently exposed to extreme weather events and are more likely to be in the future as the intensity and reach of flooding, heatwave, and storm events increase from a changing climate.

In this sector, a total of 11 risks were rated Extreme and High. Taking into account current controls, such as asset management policies and practices and contingencies, nine risks rated High in relation to council buildings, drainage and transport remained. These are summarised in the tables below.

Council buildings

ID	Risk Description	Residual Risk Rating 2030
1	Damage to and more maintenance of Council buildings from increased intensity and frequency of extreme heatwave and rainfall events.	High
46	Riverine flood damage to Council buildings caused by increased intensity and frequency of extreme rainfall.	High
51	Increased frequency and intensity of storms could expose and damage more Council assets due to hail and rainfall damage and wind-blown debris.	High

Drainage

ID	Risk Description	Residual Risk Rating 2030
5	Damage to infrastructure and buildings from overflowing riverbanks or failure of levees as a result of extreme rainfall.	High
43	Inability of current drainage system to cope with extreme rainfall events.	High
45	Damage to natural and green drainage infrastructure (e.g. wetlands, swales, rain gardens, etc.) due to reduced ground stability of drying soils and vegetation loss from prolonged droughts.	High
52	Damage to drainage infrastructure including septic tanks due to ground movement as a result of drying soils from prolonged droughts.	High

Transport Infrastructure

ID	Risk Description	Residual Risk Rating 2030
1	Damage to transport and road reserves and access disruptions caused by inundation as a result of extreme rainfall and flooding.	High
2	Damage to transport (including bridge foundations) and drainage infrastructure (including septic tanks) due to ground movement as a result of drying soils from prolonged droughts.	High

Case Study: Storm Damage to Council Buildings

A heavy downpour in October 2015 caused significant damage to a number of Council buildings, including the Council Offices, Eastbank, Library and Arthur Dickman Childcare Centre. This resulted in a cost of approximately $8,000 to Council in excess payments, and approximately $20,000 in costs for Council's insuring agent.

Figure 6 Example of roof damage caused by heavy storms.
Image courtesy of Greater Shepparton City Council.

4.2 Council Services

Climate change could impact Council services and operations in the following ways:

- Strain on council resources that continue to provide key community support services or respond to emergency situations during times of floods, heatwaves, or bushfires.
- Accelerate the degradation of the natural environment and local flora and fauna species in the region. Climate change will amplify existing threats to flora and fauna, including changes to habitat, altered disturbance regimes, changes in the distribution of pests and disease from warmer temperatures and reduce rainfall affecting the natural environment. This may also change or weaken the biodiversity in the region. As such, this may require new environmental management responses.
- Disrupt provision of key community services such as waste management, Home and Community Care (HACC) programs, etc. due to roads impacted by floods or bushfires.
- Reduce water flows and the supply of water to the municipality as a result of reduced rainfall. Warmer temperatures could also affect water quality and increase incidents of algal blooms in inland waterways. Recreational services and environmental values of lakes could be impacted.

Overall, 16 service related risks were identified for GSCC. These relate to Council's ability to respond to emergency and extreme weather events, and delivery of key community services such as HACC and key environmental management services. A changing climate is likely to lead to more extreme weather events and add more pressure on Council's staff, resources, and services. Taking into account current controls, such as emergency management and business continuity plans, three risks rated High in relation to emergency management and community support services remained.

Protection of the natural environment will continue to be important so it is able to withstand the impacts of and adapt to a changing climate. Emerging weed species are already impacting native vegetation in the region and warmer climates are likely to continue exacerbating the risk over the long term. As such, three environmental management risks are rated High.

These risks are summarised in the tables below.

Emergency management

ID	Risk Description	Residual Risk Rating 2030
17	Increased demands on Council due to increased frequency of extreme events and demand for resources (people and equipment) impacting Council service delivery.	High
19	Failure to include risk information about future climate in emergency management processes.	High

Community support services

ID	Risk Description	Residual Risk Rating 2030
22	Increase in demand for community support services (e.g. for HACC, elderly, youth, etc.) as a result of more frequent heat waves.	High

Natural environment

ID	Risk Description	Residual Risk Rating 2030
11	Changes in climate may introduce new pest, plant and animal species, threatening biodiversity of region.	**High**
24	Deterioration of natural habitats from increases in average temperatures and less rainfall reducing the viability of threatened and endangered species.	**High**
49	Reduced water availability to the environment due to drought and extended dry periods, affecting river health and biodiversity.	**High**

Case Study: Extreme Heat Impacts to Council Services and Community

Prolonged, record-breaking heat in March 2016 disrupted Council outdoor staff activities, impacting Council services the local community and cancelling community events. Council staff significantly modified working hours to adjust for the hotter temperatures. Multiple heat alerts were issued and residents were asked to check on their neighbours (particularly the elderly and vulnerable).

4.3 Population

Climate change could impact the local population, public health, and community groups in the following ways:

- Increase heat related stress, particularly during heat waves, affecting quality of life or increasing injuries or morbidity in the community. Members of the community who are elderly, disadvantaged, socially isolated, or have existing medical conditions are particularly vulnerable.
- Reduce productivity of Council staff working outdoors from longer, higher temperature hot spells. This could impact continuity of community service delivery such as programs delivered to resident homes such as Meals on Wheels.
- Poorer air quality from smoke and air-borne particulates due to more bushfires impacting on community health in the region.
- The wellbeing of the community, including Council staff, may be affected following extreme weather events or during prolonged periods of stress, such as drought conditions.

9 climate risks to the local community were identified. These mainly relate to health impacts such as injury or death to residents, visitors, vulnerable groups or Council staff from extreme flood or heat events. Healthcare providers and emergency services in the region are likely to experience greater stress from an increased incidence of heat-related illness and deaths, particularly among the elderly and disadvantaged. Shepparton has a slightly higher proportion of residents who may be vulnerable or at risk of social isolation due to an aging population, low English proficiency, and labour force qualifications, compared against the regional Victorian average (ABS, 2011). Remote communities are also more vulnerable in emergency situations such as floods and bushfires.

Risks may also result from failed infrastructure or services (e.g. septic tanks), potentially increasing contamination and health risks. Taking into account current controls, such as emergency management arrangements and occupational health and safety plans, two risks rated High in relation to vulnerable groups and residents and visitors remained. These are summarised in the tables below.

Vulnerable groups

ID	Risk Description	Residual Risk Rating 2030
34	Increase in heat related illness in vulnerable population groups as a result of more frequent hot days and duration of warm spells.	Extreme

Residents and visitors

ID	Risk Description	Residual Risk Rating 2030
39	Increase in injury and loss of life to residents and visitors due to extreme weather events.	Extreme

Community Feedback on Climate Change in Shepparton

In developing this climate adaptation plan for GSCC, a community survey was distributed to gauge community risks and understand what the community considers to be focus areas for adaptation. The survey was completed by 47 members from community groups in Mooroopna, Tatura, Dhurringile, Toolamba, Undera, St Georges Road, Seven Creeks, the University of the Third Age in Shepparton, and the Positive Aging Advisory Group. Of the respondents, 9% were aged between 19-40 years, 30% between 41-60 years, and 62% 61 years or older.

When asked to identify climate risks from their perspective as a community member, 36% of responses identified heat and drought risk amongst their top two climate risks, 22% identified flooding, and 18% considered a risk to community wellbeing in the face of heat stress or flooding. Flooding was only chosen as a primary risk; in no responses was it ranked as the second of the top two climate risks. Of note is a relative uniformity of first climate risk amongst those aged between 41-60 years, with all 14 respondents selecting only two responses (heat and drought risk, and flooding).

When asked what the adaptation focus areas should be, 23% of respondents identified a role for council to provide support for energy and water efficiency upgrades for homes and businesses, and 18% identified the need for energy and water efficiency upgrades for community facilities. 15% of respondents identified a need for drought response and planning, and 13% identified the need for more support for vulnerable people to prepare for flood and heatwave events.

Energy and water efficiency upgrades for community facilities, and support for energy and water efficiency upgrades for homes and businesses were the top priority amongst all age groups. The second top priority had no such trend emerge, with drought response and planning, improved community education on climate resilience, and increased support for vulnerable people to prepare for flood and heatwaves garnering the most responses.

Continuing to build community resilience and providing further information to the community about sustainability and emergency preparedness are key focus areas for adaptation. Awareness campaigns, supporting vulnerable groups, and developing a community resilience plan are future actions identified as part of this CAP (see Section 5.0).

4.4 Regional

Given the significant role irrigation, agriculture, and manufacturing have for the broader region of the Goulburn Broken Catchment Management Authority (GBCMA), region-wide risks and potential impacts to the local economy were identified and assessed. Climate change could further impact Shepparton and the broader region in the following ways:

- Services and production from key economic industries may be impacted from more frequent and intense weather events, which could affect business continuity and local employment. Heavy storms and hail events could damage crops impacting yield or commercial buildings.
- Damage to disruption to key utility services such as power, water, and information and communications technology (ICT) from extreme weather events.
- Spread the distribution of invasive flora and fauna across the natural environment, altering habitat, biodiversity, and land use. This could also have flow on impacts to agricultural stock and crops.
- Reduced rainfall can increase the build-up of dust on power lines, increasing the risk of arcing and power supply to the region.
- Temporarily inundate roads leading into and out of the local government area from heavy rainfall and storms. This could impact emergency services, commercial distribution and key transport industries such as truck services within the region.
- Introduction of new pest, plant and animal species, threatening biodiversity of the region and deteriorate habitats.

Climate change and more extreme weather will pose a number of challenges for local residents and businesses in Greater Shepparton. The three largest industries contributing to over one third of employment in the key sectors of Healthcare and Social Assistance, Retail Trade and Agriculture, Forestry and Fishing. These sectors are also likely to feel the impacts of a changing climate through service disruptions and impacts to productivity (National Institute of Economic and Industry Research 2014).

The Goulburn Valley area produces about a quarter of Victoria's agricultural production. For agri-business in particular, climate change increases risks around reduced yield and productivity with changing climate conditions affecting flowering and planting times, pasture growth rates and the distribution of pests and disease as well as reducing water security and potential issues around access, transportation and distribution to market (DELWP 2015). As such, seven risks to the commercial sector and land based industries (farming and cropping) were identified, and four were rated Extreme and High. These relate to reduced agricultural yields and productivity from changed climate conditions, as well as impacts to transportation access and distribution routes.

Disruptions to essential services (such as power, water, and ICT) were identified as Extreme and High risks for the municipality, due to their criticality in Council's service delivery and emergency or disaster relief situations. Taking into account the range of current controls such as emergency management and continuity plans and broader economic development strategies, six risks, two rated Extreme and four rated High, remain. These are summarised in the tables below.

Agriculture and industry

ID	Risk Description	Residual Risk Rating 2030
28	Production and local employment and business impacts to the region in key economic industries due to extreme heat events, extreme rainfall, bushfires, or drought.	Extreme
26	Impacts to commercial distribution in the region due to flooded infrastructure affecting transportation access and critical supply routes.	High
29	Temporary loss of usable land impacting agricultural production due to damage from flooding and bushfires, or drying out from droughts.	High
50	Increased frequency and intensity of storms could lead to crop damage, affecting agricultural yields.	High

Utility Services

ID	Risk Description	Residual Risk Rating 2030
33	Reduction in the availability of water resources due to reduced average rainfall and increased average temperature, increasing costs and/or reduces the amount of water available to Council.	Extreme
31	Disruption of essential utility services due to more frequent extreme weather events (flooding, bushfires, and heat) and prolonged droughts.	High

Case Study: Extreme Heat Impacts to Fruit Industry in Shepparton

For the broader region, in March 2016, fruit growers in the Shepparton area struggled to protect their orchards, with scorching of up to 50 per cent of apples on young trellised trees and many unharvested pears ruined. Some used overhead sprinklers to keep apple crops cool to prevent damage prior to harvest. Others used netting to protect fruit from sunburn. The extreme heat conditions further impacted the area at a time of very high water prices.

5.0 Climate Adaptation Plan

The impacts of climate change are not limited to the municipal boundaries of Greater Shepparton and adapting to future climate change for the region will require a planned response. This plan identifies 43 short, medium and long term actions that Council can implement within its own scope of responsibilities and apply to its infrastructure assets, policy, processes, and service delivery. The proposed actions address the following broad areas:

- Building internal staff education, awareness and capacity in Council's adaptation efforts. This include preparing further guidance for departments and training content for staff inductions, and integrating adaptation measures into existing Council programs.
- Reviewing essential management plans, design standards, and business procedures to incorporate future climate projections and the management of identified climate risks throughout the project and infrastructure lifecycle. These include reviews of floodplain management reports, management of drainage infrastructure and other Council assets, emergency management plans, planning processes, and also procedures that address staff safety and risk management.
- Disseminating sustainability and emergency preparedness information to the community and groups about climate-related risks and adaptation measures. These include community involvement in planning, recruitment drives for volunteers, or public education programs to build community resilience to increased heat and flooding risks.
- Protecting essential infrastructure and systems in a way that also enhances open spaces and the natural environment. This could include green infrastructure.
- Continuing to protect and advocate for the projection of the natural environment both locally and regionally to ensure it is able to withstand the impacts of and adapt to our changing climate over the long term.
- Working with regional agencies and organisations to share knowledge and resources to identify solutions and opportunities for collaboration.

This section outlines the objectives, strategies and actions of the Climate Adaptation Plan by sector. Each action is numbered according to the corresponding assessment categories:

- Council buildings (B)
- Drainage and flood management (D)
- Transport infrastructure management (T)
- Emergency management (EM)
- Community services (C)
- People and communities, including vulnerable groups (P)
- Council staff (S)
- Natural environment (E)

Each action provides the following information to assist with planning and implementation:

- Funding – indicates whether the action can be funded within the current approved Council budget (existing), or whether funding is additional (new)
- Timeframe – indicates the timing for implementation based on the following designations:
  - Short (0-2 years) – actions that should be completed within the next two years. They meet the evaluation criteria of cost, ease of implementation, and potential social and environmental benefits provided or should be implemented first as a foundation to other actions.
  - Medium (3-7 years) – actions that are new to Council and require new policies, practices or operating procedures to be developed.
  - Long (7+ years) – actions that may also be new to Council, but requires further scoping or resource requirements to be determined or clarified.
- Responsibility – indicates the appropriate Council department or role to implement the action.

While broader regional risks have been identified for Greater Shepparton, specific adaptation actions for these risks have not been developed within the scope of this plan.

A full list of the adaptation options are provided in Table 1.

Table 1 Climate adaptation actions for Greater Shepparton City Council

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
Council buildings (B)						
Council owned buildings are able to provide service continuity, a safe working environment and experience minimal damage in a climate event.	Integrate climate adaptation into building standards and design guidelines.	B1.Review Landscaping Guidelines to aid selection of plants that provide more shading to Council buildings. This action would also reduce a building's energy use and support Council's efforts in the *Energy Reduction Plan 2016*.	1, 33	n/a - Existing Operational	Short	Planning Sustainability and Environment
		B2.Develop design or buildings standards/guidelines and zoning controls that address the impacts of climate change. These may include classifying conditions to incentivise consideration of adaptation measures e.g. flood mitigation measures for buildings.	1, 46, 51, 52	n/a - Existing Operational	Medium	Planning
	Embed existing frameworks and processes to mitigate climate risk in infrastructure design, operation, and maintenance procedures.	B3.Review relevant Council procedures and operations (such as decision making processes, service plans, and inspection processes) to ensure climate risk and other environmental impacts to buildings and infrastructure is addressed throughout the infrastructure lifecycle by relevant departments.	1, 43, 46, 51, 52	n/a - Existing Operational	Medium	Infrastructure Strategic Assets Projects

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
		B4.Utilise tools such as Green Star, GBCMA's SAT tool and ISCA's IS Tool to drive consideration of climate risk analysis and adaptation in new infrastructure design.	1, 43, 46, 51, 52	n/a - Existing Operational	Short	Sustainability and Environment Projects
	Strengthen assets and infrastructure through maintenance and capital works to improve service continuity in extreme events.	B5. Formalise outcomes of the Infrastructure Sustainability (IS) pilot within Council operating and asset management procedures. Components or certain practices of the tool can be implemented and tailored to local government practices.	1, 2, 5, 43, 46, 51, 52	n/a - Existing Operational	Short	Projects
Drainage and flood management (D)						
Drainage and flood management infrastructure is designed, built and maintained to minimise risk to people and assets in extreme events now and into the future. Communities and the environment benefit from an integrated approach	Strengthen assets and infrastructure through maintenance and capital works to improve service continuity in extreme events.	D1. Increase inspections of drainage and pumping infrastructure in locations prone to urban flooding to clear debris and audit conditions. Utilise Council's existing asset management system and asset registers to identify critical assets.	5, 45, 52	n/a - Existing Operational	Short	Infrastructure
		D2. Ensure the next review of floodplain management reports consider future climate and the capacity of the drainage network to cope with heavier rainfall events, future growth and development.	2, 5, 26, 43	n/a - Existing Operational	Long	Infrastructure Strategic Assets Sustainability and Environment

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
to water cycle management Strengthen collaboration with water suppliers, regulators and heavy water users to improve integration and effectiveness.		D3. Review current Council communication processes to provide preparedness information via online/ social media/radio to alert the community ahead of heavy rainfall events.	17, 19, 43	n/a - Existing Operational	Short	Communications & Marketing Emergency Management
	Incorporate future climate change projections in flood modelling for Council infrastructure planning and new project processes.	D4. Review flood management policies and procedures to incorporate future climate projections for the region.	43	n/a - Existing Operational	Short	Planning
		D5. Continue to work with the Goulburn Broken Greenhouse Alliance to utilise tools and outcomes from programs such as the Climate Smart Agriculture Development Program into strategic planning and regional investment.	28, 29, 43, 50	n/a - Existing Operational	Short	Environment
		D6. Provide local planning guidance for Council staff to evaluate climate risk and identify adaptation measures as part of planning and permitting applications. New developments could be required to provide a climate vulnerability assessment as part of the permit review process.	2, 5, 19, 26, 33	Existing Operational $30K	Short	Environment Planning

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
	Build on Council's expertise in sustainable water management technologies, including irrigation, water recycling, stormwater capture, storage, use, and infrastructure. Use water to irrigate open spaces and cool the landscape. Work with the CMA, GMW etc. to improve water allocation and water resource management to supply water to the environment and release water during flood events.	D7. Partner with relevant agencies to investigate areas of greatest flood risk due to extreme weather events and drainage failure to identify site specific and broader solutions. This could include initiatives that enable easier release of water or redirection of water flows during floods e.g. retardation basins, increase storm water capacity, etc.	2, 5, 19, 26, 43, 45, 46	Combination: Existing Operational and New $30K	Medium	Infrastructure Strategic Assets
		D8. Continue to investigate and implement green infrastructure initiatives where feasible. Green infrastructure such as swales, rain gardens, and permeable surfaces alongside roads or walk ways, may help capture stormwater runoff and mitigate road flooding. Consideration of these initiatives could tie in with asset renewal cycles.	5, 43, 45	New Operational $50K	Medium - Long	Infrastructure
		D9. Work with State Government to develop and implement an integrated water use program.	2, 5, 33, 43, 45	Grants	Short-medium	Environment

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
Transport infrastructure management (T)						
Reduce damage to transport infrastructure from weather events so that service continuity is assured and disruptions minimised.	Work with VicRoads to manage and reduce climate change impacts to key transport infrastructure.	T1. Prepare a series of checklists based on the IS pilot experience to guide design and maintenance of critical community infrastructure.	1, 2, 3, 17, 26, 31, 33	n/a - Existing Operational	Short - Medium	Infrastructure
Future industry and community transport needs are able to be met.	Strengthen assets and infrastructure through maintenance and capital works to improve service continuity in extreme events. Incorporate into project specifications and procurement processes future climate considerations and design requirements for longer term assets.	T2. Prepare guidance for staff to incorporate climate projections into early stages of business case development, project specifications, procurement and project processes.	19, 43, 50, 51	n/a - Existing Operational	Short - Medium	Infrastructure Corporate Governance Projects Procurement

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
Emergency management (EM)						
Climate considerations are integrated into Municipal Emergency planning and management processes.	Build staff capacity in hazard prevention, mitigation, response and recovery, and disaster preparedness.	EM1. Enhance recruitment drive for more volunteers to assist with emergency events.	22	n/a - Existing Operational	Short - Medium	Emergency Management Communications & Marketing
		EM2. Incorporate an all hazards approach in the next review and update of the Municipal Emergency Management Plan to address compounding effects of shocks and stresses. For a more tailored MEMP, the next review could also include community participation in the design and development of emergency management responses and encouragement to develop their own emergency management plans.	17, 19, 22	n/a - Existing Operational	Medium	Emergency Management
Community risk exposures are reduced through building resilience at a community level.	Reduce exposure to emergency risks through improved education about exposure and vulnerability.	EM3. Promote / develop a community awareness campaign to educate the community in preparedness. This would include providing knowledge of relief centres during emergencies.	17, 22, 34, 39	Combination: New ($10K) and existing operational	Medium	Communications & Marketing Emergency Management
		EM4. Develop a Community Resilience Plan to investigate a broader range of exposures and identify strategies that enhance the community's ability to respond.	17, 22, 34, 39	Combination: New and external funding $180K	Short	Environment

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
Council's capacity in emergency situations is enhanced.		EM5. Collaborate with state or regional agencies to increase capacity and allocate or enable access to additional resources in emergency situations to reduce strain on Council's resources.	17	n/a - Existing Operational	Long	Emergency Management
Community support services (C)						
Community support services are not disrupted by climate events	Integrate climate awareness into Council service planning and delivery.	C1. Ensure that all council service continuity plans include consideration of climate risks, starting with services directly impacting or supporting elderly, the disadvantaged or more remote communities.	17, 19, 22, 33, 34, 39	n/a - Existing Operational	Medium	People and Development Corporate Governance
	Build capacity and contingency into Council service delivery to improve service continuity during extreme weather events.	C2. Investigate resource sharing protocols with neighbouring councils in the region to provide support during extreme climate events.	17, 22	n/a - Existing Operational	Short	Emergency Management Corporate Governance
		C3. Recruit volunteers to support council staff during emergency events.	17, 22	n/a - Existing Operational	Medium	Communications & Marketing Emergency Management
People and communities, including vulnerable groups (P)						
No increase in the number of community members	Initiate a program to provide support to vulnerable community	P1. Investigate a 'linking neighbours' approach in areas most vulnerable to climate impacts.	17, 22, 34, 39	Combination: New and existing	Medium	Citizen Services

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
vulnerable to extreme climate events, particularly hot spells - despite increasing frequency of hot spells and an aging population.	groups during heatwaves.			operational		
		P2. Support HACC staff to increase vulnerable communities' understanding and ability to respond to extreme temperature and hot spells.	22, 34, 39	n/a - Existing Operational	Medium	Citizen Services
		P3. Assist residents to understand how they can keep cool and modify or manage their homes to help keep them cool.	22, 34, 39	New Operational $20K	Short	Communications & Marketing
		P4. Investigate the opportunity of providing rebates to vulnerable community groups that adapt their housing to cope with extreme heat.	22, 34, 39	n/a - Existing Operational	Long	People and Development Finance and Rates
		P5. Review the Landscaping Guidelines document to aid selection of plants that provide more shading to Council buildings. This action would also reduce a building's energy use and support Council's efforts in the *Energy Reduction Plan 2016*.	1, 22, 33	n/a - Existing Operational	Short	Environment
	Broaden existing community based programs to empower communities to become more self-reliant.	P6. Use Council rates notices/website to provide information on sustainability programs and emergency management procedures to the community.	19	n/a - Existing Operational	Short	People and Development Finance and Rates
		P7. Enhance open spaces such as parks, or bus stops through the Urban Forest Strategy	22, 34, 39	New Capital $100K	Medium	Recreation and Parks

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
		to provide further protection (e.g. structure or trees) and relief from sun and extreme heat.				
	Integrate climate adaptation into existing Council strategies and plans.	P8. Ensure Urban Forest Strategy incorporates shade trees on north/west side of Council buildings.	1, 7	n/a - Existing Operational	Short	Environment Recreation and Parks
Council staff (S)						
Governance staff and staff involved in policy and strategy development understand and can respond to Shepparton's climate risk exposure.	Integrate climate risk information into staff induction and policy and planning processes	S1. Include Shepparton's climate risk profile as part of new Councillor briefing packs and staff induction processes. This will aid in setting a clear climate agenda upfront and facilitate culture change throughout the organisation.	19	n/a - Existing Operational	Short	Corporate Services Environment
		S2. Develop tools and supporting information to inform councillors, staff and community of climate impacts and risks.	19	New Operational $15K	Short	Environment Marketing and Communications
		S3. Develop local planning guidelines / or checklists to include climate adaptation guidance through the Council planning and permitting process.	5, 19, 33, 34, 39, 43,	New Operational $20K	Medium	Planning
		S4. Integrate actions from the Climate Adaptation Plan into Interplan and relevant individual staff plans.	All	n/a - Existing Operational	Short	Corporate Governance - Risk

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
		S5. Establish a monitoring procedure to track progress and reviews of the Climate Adaptation Plan.	All	n/a - Existing Operational	Medium	Environment
Outdoor and mobile staff are well-prepared and safe when working in extreme conditions.	Utilise a risk management approach to drive improvements to staff safety	S6. Review and update Council's safety management system processes to address staff safety to climate risks.	19	n/a - Existing Operational	Short	Corporate Governance - Risk
		S7. Update Council's corporate risk register to include climate change risks, and risks particular to outdoor and mobile staff.	19	n/a - Existing Operational	Short	Governance - Risk
		S8. Review and update Council's Heat Wave Management Plan to include management of heat wave risks to Council staff and services.	17, 19, 34, 39	n/a - Existing Operational	Short	Corporate Governance - Risk
Natural environment (E)						
Increase resilience of natural environmental assets to build resilience of region.	Continue to protect and enhance the natural environment both locally and regionally over the long term.	E1. Continue to support and increase funding for the Community Native Tree Planting Program to encourage indigenous tree planting. Increasing genetic diversity of indigenous species and planting species historically grown further inland and adapted to warmer climates will help increase the resilience of native vegetation and habitat.	11, 24, 49	Combination: New and existing operational	Short	Environment
		E2. Utilise relevant planning overlays in the Municipal Strategic Statement e.g. utilise Vegetation Protection Overlays and Environmental Significance Overlays to protect	11, 24	New Operational $2,500	Short	Environment

Objectives	Strategies	Action	Related Risks	Funding	Timeframe Short: (0-2 years) Medium: (3-7 years) Long: (7+ years)	Department Responsibility
		and conserve vegetation values. This will protect endangered ecological vegetation classes and high conservation value roadsides to protect biodiversity values of the region.				
		E3. Actively monitor key habitat and native vegetation areas for new and invasive species. Collaborate with neighbouring councils and the GBCMA to share weed management knowledge and experiences to prepare for emerging weed threats.	11, 24, 49	Combination: New and existing operational	Short	Environment

6.0 Implementation, Monitoring and Review

Implementation of the Adaptation Plan requires a holistic approach within Council and participation from all departments in GSCC. Climate change impacts many facets of business activities and as such, adaptation needs to be driven internally and embedded within Council systems, processes and staff thinking. While this integrated approach to manage climate risks provides the most reach, it is also necessitating a cultural change with how GSCC operates and does business.

This plan is a living document and will continue to be revised as climate change risks and associated opportunities change over time for Council and Greater Shepparton.

To ensure Council's adaptation responses and approaches remain valid and relevant to local priorities and climatic conditions, the following recommendations are provided to aid delivery:

- Specific actions to roles or departments should be integrated into Interplan to allocate delivery of actions to individual staff plans.
- Monitoring and progress of the plan should be conducted regularly. Given the 10 year time frame of the plan, annual progress reviews are recommended. It is recommended a formal review occurs every five years to allow time to evaluate progress and readjust the focus of the plan if necessary.
- Review and update of the plan should be conducted following release of new climate science or if more local and refined climate modelling is available for the region. This would ensure Council's understanding of their risk exposures are up to date and provide an opportunity for existing risks to be reviewed or new ones to be assessed.

GSCC is already engaging the community and regional organisations on a number of sustainability and climate change initiatives. Partnership with regional leaders, industries, communities, and the private sector can help devise a regional approach and consider broader social, economic and environmental drivers to increase resilience in the area.

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Appendix A

Risk Assessment Matrix

Appendix A Risk Assessment Matrix

1.0 Overview

The proposed approach to assess the climate risks for the community of Greater Shepparton considers projected changes in current climate and their interaction with local community assets and services. The approach described below has primarily been informed by *AS5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach*.

2.0 Scope of the assessment

The scope of the assessment will cover the municipality of Greater Shepparton. The municipal boundary is shown below.

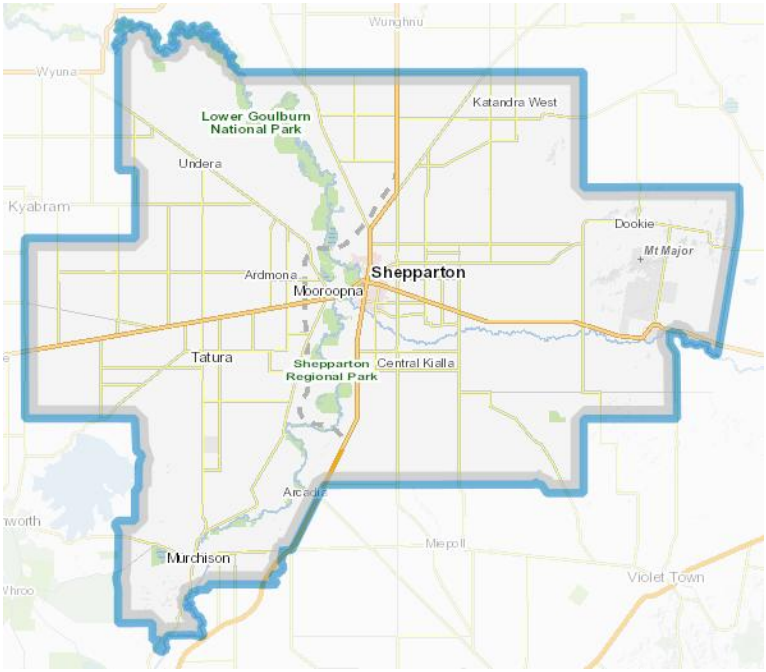

Figure 7 Municipal boundary of Greater Shepparton City Council
Source: Pozi Web GIS

a. Climate variables for assessment

The assessment will consider projected changes from temperature and rainfall which may increase the frequency and intensity of bushfires, flooding, heatwaves, and drought in the region.

Changes in and impacts from future sea level rise and storm surge will not be assessed due to the region's significant distance from the coast.

b. Climate change projections

This assessment will use CSIRO and the Bureau of Meteorology's (BoM) most recent regional climate projections for Australia. These are based on 54 different types of natural resource management (NRM) regions. They have been further broken down into 'clusters', which are broader climate and bio-physical regions around Australia whereby tailored climate projections have been modelled by CSIRO and BoM. The Greater Shepparton municipality is located in the Murray Basin cluster and sub cluster (see Figure 3).

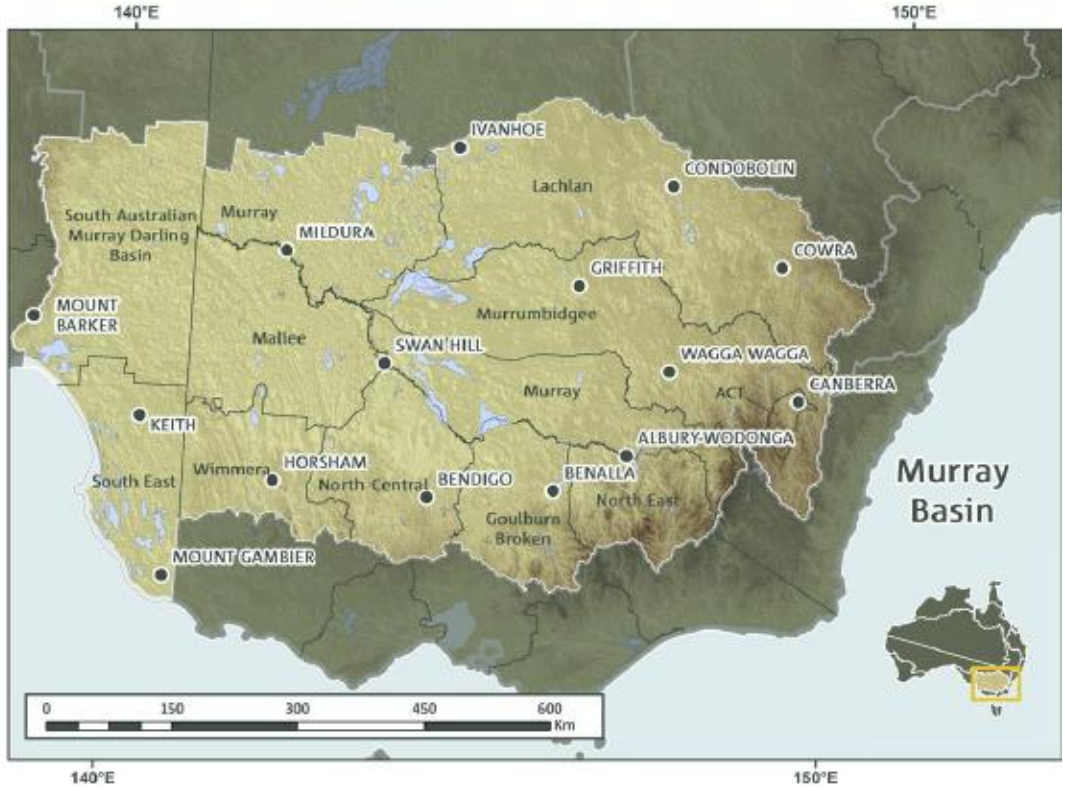

Figure 8 Map of the Murray Basic Cluster (CSIRO, 2015)

Historical climate data from 1996-2015 was obtained from the BoM and the CFA. While historical data may vary from preceding records, this is the latest time period used to project future climate projections and is more indicative of the current state. BoM data was collected from the Shepparton Airport weather station. CFA data for the Northern Country Fire District (Total Fire Ban days) was used as an indicator of bushfire risk. Note that often drought can lead to a more intense bushfire period, so the effects of compounding events will also be considered.

We proposed to assess climate risks over two time frames and two emissions scenarios from the IPCC 5AR. These will be the RCP4.5 medium emissions growth scenario for 2030 and the RCP8.5 high emissions growth scenario for 2090. RCP4.5 assumes global GHG emissions peak at 2040, which is a plausible scenario given the recent global Conference of Parties (COP21) agreement by nations, including Australia, committing to keep temperature increase well below 2C. RCP8.5 assumes continued emissions growth based on increasing population growth, demand on GHG intensive energy sources and an absence of global climate change policies.

A copy of the climate projections is provided in Appendix B.

c. Council asset and service categories

Climate risks to Councils assets and services will be assessed. Table 2 describes what components will be covered in each category.

The assessment will also consider other broader climate risks and opportunities, which may not directly stem from Council's assets and services, but are important for the overall planning for the municipality as a whole. These would relate to populations, communication, water, energy, and other transportation infrastructure and services, whose risks may have cascading consequences to Council's ability to provide various services.

Table 2 Council asset and service categories

Categories	Components
Council assets – owned and managed by Council	· Transport and road reserves including roads, footpaths, kerbs, channels, culverts, and street furniture · Native vegetation on roadsides · Council works depot /transfer station/landfills · Drainage infrastructure including pump stations, wetlands and trees, pipes, pits ,outlet structures, open drains, retardation basins · Recreation facilities including outdoor sports facilities · Parks/open space including park furniture, trees, lakes, wetlands, caravan parks and street trees · Cemeteries · Buildings – council owned, occupied and/or managed · Cultural – heritage, indigenous, community art · Office furniture and equipment, including ICT · Vehicles – cars, trucks (e.g. waste collection) · Plant and equipment · Emergency management – neighbourhood safer places, Emergency relief centres (in a disaster situation)
Council services – provided by Council	· Emergency and disaster management · Local infrastructure provision and maintenance (sealed and unsealed roads, footpaths, etc.) · Maintenance of public areas (e.g. parks, weed control, roadsides etc.) · Waste management · Provision of recreational and cultural facilities and programs (e.g. art centres, libraries, etc.) · Provision of community support services (e.g. aged and disability, health, community safety, family, youth, elderly, etc.), including child care and environmental health services (e.g. septic tank permits and food premises legislation) · Land use planning, capital works, and building services · Environmental sustainability · Strategic/corporate planning · Business and community planning and development · Economic development (e.g. agricultural, tourism, food manufacturing, etc.)

Categories	Components
Other	· Local population including vulnerable groups · Residential and commercial infrastructure · Water infrastructure (i.e. urban and rural supply and treatment) · Communication infrastructure (e.g. towers, underground, NBN, transmission · Energy infrastructure (e.g. generation, transmission and distribution, storage) · Other transportation infrastructure (e.g. major arterial roads, tunnels, bridges, rail, airports, pedestrian and bike tracks, recreational boating, etc.) · Other emergency management infrastructure (e.g. fire stations, police stations, fire hydrants, etc.) · Medical facilities (e.g. hospitals, clinics)

3.0 Risk Assessment Approach

The following steps will be undertaken for the assessment:

i. Identify risks. For each theme, a list of risks will be identified that identify the impact (e.g. an increase in heat related illness in the elderly population) of changes to a particular climate variable (e.g. as a result of more frequent hot days and duration of warm spells).

ii. Inherent risk level rating. Each risk will be rated using the likelihood and consequence approach consistent with the AS 5334-2013 Climate Adaptation for Settlements and Infrastructure and Council's existing risk management framework.

   The definition tables and rating system to be used are presented in Table 3 (Consequence) and Table 4 (Likelihood). The definitions have been adapted from AS 5334 and Council's risk management framework.

iii. Consideration of current controls/adaptive capacity. As per Council's risk management framework, the effectiveness of mitigating controls will be evaluated for each risk. This step allows consideration of current measures in place to manage the risk and also an indication of Council's adaptive capacity. Table 5 presents how controls will be qualitatively assessed. If controls are rated excellent, good, or fair, it is anticipated the consequence or likelihood rating will reduce.

iv. Residual risk rating. Each risk will be rated again to determine its residual risk rating using Table 6. An example of applying the whole risk framework to climate risks is presented in Table 7.

Treatment of the residual risks rated extreme or high will be taken into the next project phase for adaptation planning. The remaining risks (rated low or medium) will be assigned a treatment category (e.g. reduce, transfer, etc.) for completeness with Council's risk management framework.

Table 3 Qualitative measures of consequence

	Assets & Infrastructure Services	Social & Community Wellbeing	Environment	Governance, Reputation & Compliance	Economy & Financial
Negligible	Localised damage to a non-critical asset or little change to service that can be quickly remedied.	No adverse human health effects - no injury or very minor injury nor requiring treatment.	No adverse effects on environment (less than 6 months).	Negligible legal/non-compliance issues Minor reputation concerns raised on an infrequent basis No changes to management required	No effects on the broader economy Little or no financial loss to Council (less than $10K)
Minor	Localised damage or service disruption to one or more non-critical assets that can be quickly remedied.	Short-term disruption to employees, customers or neighbours Slight adverse human health effects - minor injury.	Minimal effects on the environment (6-12 months)	Minor legal/non-compliance issues Minor reputation concerns raised on a periodic basis	Minor effect on the broader economy due to disruption of service provided by the asset Some financial loss $10K – less than $100K
Moderate	Considerable damage to critical or essential assets or services for short to medium period. Damage recoverable by maintenance and minor repair.	Frequent disruptions to employees, customers or neighbours. Adverse human health effects – medical treatment may be required.	Some damage to the environment, including local ecosystems. Some remedial action may be required (1-5 years).	Serious breach of regulation with investigation by regulators Reputation is negatively impacted with short term loss of confidence in Council Changes to management required	High impact on the local economy, with some effect on the wider economy Moderate financial loss $100K – less than $1M
Major	Severe damage to critical or essential assets for an extended period. Major loss of infrastructure services.	Severe disruptions to employees, customers or neighbours. Permanent physical injuries may occur requiring hospitalisation.	Significant effect on the environment and local ecosystems. Remedial action likely to be required (more than 5 years)	Major breach of regulation with investigation by regulators, requiring corrective action Reputation is negatively impacted with medium to long term loss of confidence in Council Changes required in management.	Serious effect on the local economy spreading to the wider economy Significant financial loss $1M - $10M

	Assets & Infrastructure Services	Social & Community Wellbeing	Environment	Governance, Reputation & Compliance	Economy & Financial
Extreme	Significant permanent damage and/or complete loss of the asset and service Loss of infrastructure support and translocation of service to other sites	Severe adverse human health effects, leading to multiple events of total disability or fatalities. Total disruptions to employees, customers or neighbours. Emergency response at a major level.	Very significant loss and irreparable damage to the environment.	Significant breach of regulation resulting in prosecution, fines or litigation. Major policy shifts Change to legislative requirements Reputation is irreparably damaged resulting in state government/Council intervention Full change of management control	Major effect on the local, regional and state economies Huge financial loss more than $10M

Table 4 Qualitative measures of likelihood

	Description	Recurrent or event risks	Longer term risks
Almost certain	Could occur several times a year	Has happened several times in the past year/s Could occur several times a year	80%+ probability of occurring in the identified time period
Likely	May arise once per year	Has happened at least once in the past year/s May arise about once per year	60-80% probability of occurring in the identified time period
Possible	May be a couple of times in a generation	Has happened during the last 5 years but not every year May arise once in 25 years	25-60% probability of occurring in the identified time period
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years May arise once in 25 to 50 years	5-25% probability of occurring in the identified time period
Rare	Maybe once in a lifetime	Not impossible, but has not occurred or has anecdotal evidence Unlikely to happen in the next 50 years	Less than 5% probability of occurring in the identified time period

Table 5 Control effectiveness rating
Source: GSCC, 2015, Risk Management CEO Directive - draft

	Description
Excellent	Nothing more to do except review and monitor existing controls. Controls are well designed for the risk, address the root causes and management believes that they are effective and reliable at all times. Controls effectively and efficiently mitigate risk to an ideal level.
Good	Most controls are designed correctly and are in place and effective. Minor control improvements could be made, but controls already mitigate risk to a tolerable level.
Fair	Controls are partially effective in mitigating risk. Improvements are required to provide further assurance that the risk will not eventuate.
Weak	Controls are largely ineffective. They do not provide reasonable assurance that risks will not eventuate.

Table 6 Residual risk assessment matrix
Source: GSCC, 2015, Risk Management CEO Directive - draft

	Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Extreme (5)
Almost Certain (5)	Low (6)	Medium (7)	High (8)	Extreme (9)	Extreme (10)
Likely (4)	Low (5)	Medium (6)	Medium (7)	High (8)	Extreme (9)
Possible (3)	Low (4)	Low (5)	Medium (6)	High (7)	High (8)
Unlikely (2)	Low (3)	Low (4)	Low (5)	Medium (6)	High (7)
Rare (1)	Low (2)	Low (3)	Low (4)	Medium (5)	High (6)

Table 7 Example of applying the risk assessment framework to Council's climate risks

Category	Risk description	Risk rating		Inherent risk rating	Current controls	Risk rating		Residual risk rating
		L'hood	Consequence			L'hood	Consequence	
Population	An increase in heat related illness in the elderly population as a result of more frequent hot days and duration of warm spells.	Likely	Major	**High**	**Excellent** - Heat Wave Plan in place, specifically targets heat wave risks. Various mechanisms already implemented e.g. seniors register, HCC program, etc.	Possible	Moderate	**Medium**
Infrastructure	More localised flood damage from an increase in rainfall/run off events causing inundation of transport infrastructure and disruption to services and access.	Almost certain – High confidence that extreme rainfall events will increase.	Major	**Extreme**	**Fair** – all storm water goes into river, pumps/gates installed, flood monitoring stations installed, various flood management plans, however not in Road Management Plan.	Almost certain	Major	**Extreme**
Council services	Reduced rainfall limiting Council's ability to maintain/water parks, gardens and public spaces.	Almost certain	Minor	**Medium**	**Good** – assuming some mechanisms have been implemented since the last drought e.g. artificial turf, drought tolerant plant species	Almost certain	Negligible	**Low**

5.0 Interface with ISCA

Under the Infrastructure Sustainability (IS) tool, there are two credits (three levels of each) to award projects for climate adaptation planning. These are:

- CLI-1 – Climate change risk assessment
- CLI-2 – Adaptation measures

For each level, there are slight variations in the level of detail required to comply with the credit. The proposed climate change risk assessment approach described in this document will meet CLI-1 Level 2 and can be used for the planning and design of local infrastructure projects in the municipality.

Compliance with CLI-2 Level 1 will require evaluating adaptation options for extreme and high priority risks (this also coincides with our project approach) and implementation. Depending on the adaptation measures, projects realise this award during the construction phase of a project once measures have been implemented. The remaining levels require treatment of medium rated risks and consideration of optimal timing to implement options.

AECOM will consider ISCA's requirements under these two credits as we develop Council's climate adaptation plan.

6.0 Technical References

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Appendix B

CSIRO Climate Projections for the Murray Basin Region

Appendix B CSIRO Climate Projections for the Murray Basin Region

Climate Variables	Current (1996 to 2015) (BoM)	2030 RCP4.5 (CSIRO)	2090 RCP8.5 (CSIRO)
Average annual temperature (°C)	22.3	0.6 to 1.1 (0.8)	2.7 to 4.5 (3.8)
Average annual rainfall (%)	441.2mm	-9 to +5	-27 to +9
Drought	18month rainfall deficiencies (considered severe or serious deficiencies in the lowest 5% or lowest 10% percentile) persist across most of western and northern Victoria.	Medium confidence that the percentage of time spent in drought and frequency of extreme drought will increase. The 2013 SoE report for Victoria states "by 2070, drought frequency is likely to increase by between 10 and 60% in the northern half [of the state]".	
Extreme temperature	**Days over 35°C*:** 15 **Days below 2°C*:** 37	19–25 (22) 25–31 (28.5)	34–60 (52.5) 4–11 (8)
Extreme rainfall	Highest daily rainfall recorded was 83mm on 12 Nov 1998. Highest annual rainfall recorded was 770.6mm in 2010.	High confidence that there will be a future increase. However, magnitude of changes cannot be confidently projected.	
Solar	17.4 MJ/(m*m)	Small changes projected.	Projected increased winter and spring radiation.
Bushfires	9 total fire ban (TFB) days in 2015	Harsher fire-weather in the future; low confidence in the magnitude of change. "The number of very high or extreme fire danger days are expected to increase by up to 25% by 2020 and up to 230% by 2050" (SoE, 2013).	
Wind	14.5-17.6 km/h at 9am and 3pm	Changes are likely to be small (±5%).	Likely to decrease over winter.
Frost	48.9 days. Lowest temp recorded was -6.3 on 4 August 1997.	High confidence of a decrease in the number of frost days (see Table 1).	
Humidity	72% (9am relative humidity)	Small changes projected.	Projected decrease.
Snow	N/A	Projected to further decline over time due to warming trends.	

Note: *1980-2010

Appendix C

Climate Risk Register

Appendix C Climate Risk Register

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
1	Council assets - physical infrastructure	Buildings	Damage to and more maintenance of Council buildings from increased intensity and frequency of extreme heatwave and rainfall events.	Likely	Major	High	Almost Certain	Major	Extreme	Asset Management Policy Asset Management Strategy	Fair	Possible	Major	High
2	Council assets - physical infrastructure	Transport and road reserves	Damage to transport and road reserves and access disruptions caused by inundation as a result of extreme rainfall and flooding.	Likely	Major	High	Almost Certain	Extreme	Extreme	The Road Management Plan defines damages - it is a current asset management tool, as well as other asset maintenance measures. Emergency management plan is triggered in the event of flooding, etc.to infrastructure. Council can also tap into national disaster relief fund.	Fair	Possible	Major	High
3	Council assets - physical infrastructure	Transport and road reserves	Damage to transport (including bridge foundations)and drainage infrastructure (including septic tanks) due to ground movement as a result of drying soils from prolonged droughts.	Possible	Major	High	Likely	Major	High	Asset Management Policy Asset Management Strategy	Fair	Possible	Major	High
4	Council assets - physical infrastructure	Sport and recreation facilities	Disruptions to and/or cancellations due to extreme weather events impacting on sport, cultural and recreational facilities and events.	Rare	Minor	Low	Unlikely	Minor	Low	OHS strategies and procedures Planning / permit applications for major events can include active management for extreme events	Excellent	Rare	Minor	Low
5	Council assets - physical infrastructure	Drainage	Damage to infrastructure and buildings from overflowing riverbanks or failure of levees as a result of extreme rainfall.	Likely	Major	High	Almost Certain	Extreme	Extreme	MEMP. Flood Strategy. Drainage plans. Additionally, Goulburn-Murray Water is included in the CERA Risk Register and Treatment Options in the MEMP for dam failures and flooding impacts on drainage systems. Internal operating procedures exist for pumps, penstocks, retardation basins Council has a capacity measuring	Good	Likely	Moderate	Medium

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
										process to manage flood impacts in the municipality				
6	Council assets - physical infrastructure	Sport and recreation facilities	Damage and/or increased maintenance to sport and recreational playing surfaces through drought.	Likely	Major	High	Almost Certain	Major	Extreme	Open Space management strategies Drought management plans WSUD	Good	Possible	Moderate	Medium
7	Council assets - physical infrastructure	Buildings	Interruptions to power supply at Council buildings, and for plant and equipment, during extreme heat or bushfire events.	Likely	Moderate	Medium	Almost Certain	Moderate	High	Business Continuity Plans - all Powerback up for Enviro Health and IT servers. Security of power supply for key assets (e.g. data server & fridges housing vaccinations - has its own back up generator)	Fair	Possible	Moderate	Medium
8	Council assets - physical infrastructure	Heritage and cultural assets	Damage to built heritage assets due to reduced average rainfall, increased temperature and evaporation.	Possible	Minor	Low	Likely	Minor	Medium	Built cultural and heritage assets are protected under legislation such as the Heritage Act and Planning and Environment Act 1987. Risks to these assets from extreme events is briefly outlined in the Municipal Fire Management Plan (MFMP). However, there is a gap in protecting built culture and heritage assets from long term climate change impacts, which may require a separate plan or actions in councils asset management plan.	Fair	Possible	Minor	Low
9	Council assets - physical infrastructure	Heritage and cultural assets	Damage to Indigenous heritage assets due to reduced average rainfall, increased temperature and evaporation.	Possible	Minor	Low	Likely	Minor	Medium	Indigenous culture and heritage assets are protected under legislation such as the Aboriginal Heritage Act 2006. Risks to culture and heritage assets from extreme events is briefly outlined in the Municipal Fire Management Plan (MFMP). However, there is a gap in protecting indigenous culture and heritage assets from long term climate change impacts, which would be required in a separate plan.	Fair	Possible	Minor	Low
10	Council assets - physical infrastructure	Buildings	Damage to Council buildings from increased intensity and frequency of bush fires.	Unlikely	Major	Medium	Possible	Major	High	GSCC currently has its Asset Management Policy and Asset Management Strategy Vulnerable assets register.	Weak	Unlikely	Major	Medium

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
11	Council services - corporate and service delivery	Environmental management	Changes in climate may introduce new pest, plant and animal species, threatening biodiversity of region.	Likely	Major	High	Likely	Major	High	Goulburn Broken Catchment Management Authority (GBCMA) - biodiversity Action Plans map biodiversity within the region and outline priority management actions to prevent species loss from climate change impacts. Broad strategic direction covered by GSCC's Environmental Sustainability Strategy.	Fair	Likely	Major	High
12	Council services - corporate and service delivery	Environmental management	Contamination risks to groundwater caused by the failure of waste storage facilities from flood, fires, and changes in ground stability due to drought (which may affect septic systems).	Unlikely	Moderate	Low	Unlikely	Moderate	Low	Management of groundwater resources is outlined by the GSCC in the Environmental Sustainability Strategy. However, adaptation options for groundwater contamination from improper waste management would be required. Waste management threats to soil and groundwater is mentioned in the Environmental Sustainability Strategy, but primarily focuses on litter and illegal rubbish dumping. Options need to focus on ensuring stable waste management and effective response mechanisms for failed septic systems. These adaptation options plans have to coincide with environmental sustainability goals of the GSCC.	Fair	Unlikely	Moderate	Low
13	Council services - corporate and service delivery	Waste management	Disruptions to waste collection services for residents/businesses due to transport infrastructure (e.g. roads) being affected by floods or bushfire.	Possible	Minor	Low	Possible	Moderate	Medium	Waste management business continuity plan. Waste management is briefly outlined in the MEMP, including sources for advice required for waste management during extreme events. However, adaptation options for waste management during transport disruptions from extreme events would be required.	Weak	Possible	Moderate	Medium

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
14	Council services - corporate and service delivery	Environmental management	Increase temperatures and reduced rainfall could increase algal blooms in inland waterways impacting environmental values and recreational services of the area.	Possible	Moderate	Medium	Possible	Moderate	Medium	The current control involves contacting appropriate authorities to create a Community Response Plan to reduce and manage incidences of toxic blooms. Treatment of algal blooms has responses at a regional level and are monitored by state.	Good	Possible	Minor	Low
15	Council services - corporate and service delivery	Council operations	Financial loss to Council from extreme weather events (e.g. bushfires, flooding, storm) affecting property and business owners.	Likely	Minor	Medium	Likely	Minor	Medium	Council budgets for resource and building maintenance in the Strategic Resource Plan 2015/16 - 2018/19. Insurance	Fair	Possible	Minor	Low
16	Council services - corporate and service delivery	Emergency management	Increase in clean-up costs for council to recover from extreme events.	Likely	Moderate	Medium	Almost Certain	Moderate	High	GSCC currently has its Asset Management Policy and Asset Management Strategy which define multiple mechanisms around asset maintenance activities. These could be utilised further to include climate adaptation measures; however, as they are based on historical climate data, and do not directly address climate risks, they are not completely effective. GSCC has also established a Strategic Resource Plan 2015/16 - 2018/19. This plan summarises Council's resourcing forecasts for the next 4 years as per the Council Plan. This could be adapted further to include potential financial risks from Council's increased costs to recover from extreme events. This would need to be done in conjunction with businesses and industry who utilise public assets for private enterprise (e.g. energy and water)	Fair	Likely	Moderate	Medium

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
17	Council services - corporate and service delivery	Emergency management	Increased demands on Council due to increased frequency of extreme events and demand for resources (people and equipment) impacting Council service delivery.	Likely	Major	High	Almost Certain	Major	Extreme	Municipal Emergency Management Plan (MEMP) - resource sharing capacity within LGA's (i.e. with neighbouring LGAs) Municipal Emergency Coordination Centre (MECC) Emergency Management Legislation and supporting policies and framework	Fair	Likely	Major	High
18	Council services - corporate and service delivery	Land use planning and development	Latest flood and fire hazard information not reflected in Council planning and building controls.	Possible	Minor	Low	Possible	Moderate	Medium	Flood studies/ investigations are undertaken for the municipality to understand flood extents. The Shepparton/ Mooroopna flood mapping and intelligence project is creating high resolution flood impacts of the region- will provide high quality data for flood management. Some flood related matters (e.g. treatment of algal blooms) have responses at a regional level and are monitored by state.	Good	Possible	Minor	Low
19	Council services - corporate and service delivery	Emergency management	Failure to include risk information about future climate in emergency management processes.	Unlikely	Extreme	High	Unlikely	Extreme	High	Community Development Framework 2010 Municipal Fire Management Plans Flood Management Plans. Council continue to assess and respond to events as they occur. Municipal Emergency Management Plan Emergency Management Legislation and supporting policies and framework	Fair	Likely	Major	High
20	Council services - corporate and service delivery	Waste management	More pest and dust management issues at waste facilities due to changes in temperature, rainfall and drought.	Unlikely	Minor	Low	Possible	Minor	Low	Controls for waste management revolve around GSCC's Waste Management Strategy 2013-2023, which outlines the types of waste management (landfills, incineration, etc.) and energy and resource recovery options. Diversion of organic waste from landfills to minimise current and future financial and environmental liabilities is discussed, although adaptation options on how to do so is not detailed.	Good	Unlikely	Negligible	Low

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
21	Council services - corporate and service delivery	Council operations	Limitations to available State and Federal funding for infrastructure repairs due to more frequent extreme weather events, requiring Council to self fund.	Possible	Moderate	Medium	Possible	Major	High	Strategic Resource Plan 2015/16 - 2018/19 A 10 year long term financial plan is also in place, which states financial and non-financial (human) resources	Fair	Possible	Moderate	Medium
22	Council services - corporate and service delivery	Community support services	Increase in demand for community support services (e.g. for HACC, elderly, youth, etc.) as a result of more frequent heat waves.	Likely	Major	High	Almost Certain	Major	Extreme	Municipal Health and Wellbeing Action Plan (MHWAP), the Heatwave Plan. Business Continuity plans and departmental guidelines. Council has a vulnerable persons register - Council contacts them when heat wave conditions arise and make sure have info to stay safe. Delivery times for services may change to take advantage of cooler hours e.g. morning.	Fair	Likely	Major	High
23	Council services - corporate and service delivery	Local asset management	Potential liability to Council from injuries due to hardening of recreational playing surfaces caused by reduced or no rainfall.	Unlikely	Minor	Low	Unlikely	Minor	Low	GSCC have not directly addressed such an issue in previous strategies and plans, as the likelihood of this risk would only grow from significant reductions in rainfall over time. Council's Strategic Resource Plan which allocates finances to assets and services would partially include general maintenance of local recreational assets. Sport and recreation strategy and work with clubs. Insurances	Weak	Unlikely	Minor	Low
24	Council services - corporate and service delivery	Environmental management	Deterioration of natural habitats from increases in average temperatures and less rainfall reducing the viability of threatened and endangered species.	Likely	Major	High	Likely	Major	High	Goulburn Broken Catchment Management Authority (GBCMA) - biodiversity Action Plans map biodiversity within the region and outline priority management actions to prevent species loss from climate change impacts. Broad strategic direction covered by GSCC's Environmental Sustainability Strategy. Council's roadside management Strategy includes measures for biolinks for fauna movement. There are existing vegetation	Fair	Likely	Major	High

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				L'hood	Cons		L'hood	Cons				L'hood	Cons	
										conservation and management plans and policies, however they are unlikely to extend to agricultural land because they are privately owned.				
25	Council services - corporate and service delivery	Public area maintenance	Reduced rainfall and long term drought could limit Council's ability to maintain/water parks and gardens and impact amenity values of public spaces.	Likely	Moderate	Medium	Likely	Moderate	Medium	The administration and maintenance of parks and recreational areas are discussed in several GSCC plans, particularly in the Council Plan 2013-17 and Environmental Sustainability Strategy. The Council Plan outlines the need for ensuring parks and gardens remain 'sustainable', while the Environmental Sustainability Strategy more specifically outlines threats to parks and recreational areas from climate change. Improvement and maintenance of amenity of parks and gardens are likely to be the by-product of adaptation options for biodiversity and environmental sustainability.	Good	Likely	Moderate	Medium
26	Economy	Commercial sector	Impacts to commercial distribution in the region due to flooded infrastructure affecting transportation access and critical supply routes.	Likely	Major	High	Almost Certain	Major	Extreme	Broad and strategic direction is provided by the Economic Development Strategy (i.e. it acknowledges that the local farming economy needs to be able to cope and thrive during drought conditions). Weather alert apps to business and transport e.g. Bart & Fire Watch Freight strategy implementation for alternate routes Regional emergency arrangements structures (MAV) Victorian Emergency Arrangements.	Fair	Likely	Major	High

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
27	Economy	Land based industry	Increase in spread and distribution of plant pests and invasive species due to changing climate conditions affecting local agricultural stock/crops.	Likely	Moderate	Medium	Likely	Moderate	Medium	Industry also has pest management measures already in place that would deal with sudden outbreaks (e.g. locusts, mice, etc.). Existing DEWLP on their plans/guidance on invasive flora and fauna. GVW has EMPs for loss of power Externally, regional teams meet regularly and consult with EMV and local industry to discuss likelihood of pests impacting the sector.	Fair	Possible	Moderate	Medium
28	Economy	Land based industry	Production and local employment/business impacts to the region (e.g. from reduced agricultural yields) in key economic industries due to extreme heat events, extreme rainfall, bushfires, or drought.	Almost Certain	Extreme	Extreme	Almost Certain	Extreme	Extreme	Climate Smart Agriculture Project - currently in development Broad strategic direction is provided in the Economic Development Strategy (i.e. it acknowledges that the local farming economy needs to be able to cope and thrive during drought conditions). Few existing controls from Council are in place to manage the consequence of extreme weather and what this economically means for the region	Weak	Likely	Extreme	Extreme
29	Economy	Land based industry	Temporary loss of usable land impacting agricultural production due to damage from flooding and bushfires, or drying out from droughts.	Possible	Major	High	Likely	Extreme	Extreme	Broad and strategic direction is provided by the Economic Development Strategy (i.e. it acknowledges that the local farming economy needs to be able to cope and thrive during drought conditions). State guidelines in place as part of relief recovery arrangements may address this.	Weak	Almost Certain	Major	Extreme
30	Economy	Commercial sector	Loss of power supply to key service industries (e.g. manufacturing, health cares, etc.) during extreme heat events, bushfire or flood events.	Possible	Moderate	Medium	Likely	Moderate	Medium	GSCC does not have direct controls, such as back up power supplies to service independent industries. This is the responsibility of the organisations. Controls rated 'excellent' because nothing more can be done by Council.	Excellent	Unlikely	Moderate	Low

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
										Aged care facilities located in the municipality have back up generators installed.				
31	Other assets	Utility	Reduction in the availability of water resources due to reduced average rainfall and increased average temperature, increasing costs and/or reduces the amount of water available to Council.	Possible	Extreme	High	Almost Certain	Extreme	Extreme	Management of water resources is outlined by the GSCC in the Environmental Sustainability Strategy. Guidelines exist in the event of reduced water availability e.g. Council ceased some public watering during the previous drought and maintained watering of high use parks for social/health benefits. Effective water monitoring within Council is underway, particularly for potable water use Stormwater and sustainable urban water use design and treatment guidelines in place Other measures identified: drought tolerant plants, landscape design guidelines, Urban Forest Strategy	Good	Possible	Major	High
32	Other assets	Utility	Damage to infrastructure foundations and buried assets (e.g. building foundations, water and gas pipelines, underground cables, septic tanks) due to changed soil composition as a result of drying soils.	Possible	Major	High	Likely	Major	High	Controls are in place to manage fire and flooding risk and response during an emergency. Agency roles for rebuilding and utility restoration during and after emergencies have been outlined, including contact information and a brief description of duties. However, there is little information on responding to the long-term impacts of increasing frequency and/or intensity of fire and flooding events. More specifically, there is no information on damage to infrastructure foundations and buried assets. It is assumed this information would be available through utility providers. No hazards from the drying out of soils from droughts are outlined in the CERM Risk Register and Treatment Options. These will need to be incorporated into the MEMP and the CERM Risk Register and	Weak	Possible	Moderate	Medium

#	Category	Component	Risk Description	2030 Risk Rating		Inherent Risk Rating	2090 Risk Rating		Inherent Risk Rating	Current controls	Control Effectiveness Rating	2030 Residual Risk Rating		Residual Risk Rating
				L'hood	Cons		L'hood	Cons				L'hood	Cons	
										Treatment Options which are outlined in the MEMP.				
33	Other assets	Utility	Disruption of essential utility services due to more frequent extreme weather events (flooding, bushfires, and heat) and prolonged droughts.	Likely	Extreme	Extreme	Likely	Extreme	Extreme	Controls are in place to manage fire and flooding risk and response during an emergency. Additionally, Goulburn-Murray Water is included in the CERM Risk Register and Treatment Options in the MEMP for dam failures and flooding impacts on drainage systems.	Fair	Likely	Extreme	Extreme
34	Population	Vulnerable groups	An increase in heat related illness in vulnerable population groups as a result of more frequent hot days and duration of warm spells.	Almost Certain	Extreme	Extreme	Almost Certain	Extreme	Extreme	GSCC's Heatwave Plan - communications/alerts are sent when temperature is 32C for 2 consecutive days before communications/alerts start. Victorian Heatwave Plan and supporting policies and framework. Vulnerable People in Emergencies Policy	Good	Almost Certain	Extreme	Extreme
35	Population	Residents	An increase in the number of bushfires, resulting in an increase in smoke and air-borne pollutants, affecting all residents.	Possible	Moderate	Medium	Likely	Moderate	Medium	Bushfire risk is partially managed for emergency situations (through CERA and the MEMP). However, there is little information on responding to the long-term impacts of increasing frequency in bushfire events. Information regarding specific air quality management measures can be incorporated in the Environmental Sustainability Strategy (and possibly sourced from EPA SEPP guidelines for air quality).	Fair	Possible	Moderate	Medium

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				L'hood	Cons		L'hood	Cons				L'hood	Cons	
36	Other assets	Transportation - other	Disruptions to transport networks due to flooding or bushfires, stranding commuters.	Likely	Minor	Medium	Likely	Minor	Medium	Controls are in place to manage flooding risk and response through the Municipal Fire Management Plan and Municipal Flood Management Plan. Responsibilities for flood and bushfire management is described in the CERM Risk Register and Treatment Options in the MEMP. However, there is little information on responding to the long-term impacts of increasing frequency and/or intensity of flood and bushfire events. These will need to be incorporated into the Fire and Flood Management Plans.	Fair	Possible	Minor	Low
37	Population	Residents	Health impacts to the local population due to harmful algal blooms in inland waterways and vector-borne diseases due to increased average temperatures and reduce annual rainfall.	Possible	Minor	Low	Possible	Moderate	Medium	GSCC manages community health and individual wellbeing services through the Municipal Health and Wellbeing Action Plan (MHWAP) and the Municipal Emergency Management Plan (MEMP). Water sampling & programs are currently in place. Defined thresholds Signage requirements Community notifications and alerts	Good	Unlikely	Minor	Low
38	Population	Council staff	Increase in heat stress illness and injury of Council staff working outdoors due to increase in average temperature and extreme heat events.	Likely	Major	High	Likely	Extreme	Extreme	Council policy and Occupational Health and Safety Procedure deals with extreme weather. Early start times for staff working outdoors (but temperature ranges not in policy - this is generally up to the discretion of the teams). UV Advisory Boards Measures in the Urban Forest Strategy is also likely to assist	Excellent	Likely	Moderate	Medium
39	Population	Residents	Increase in injury and loss of life to residents and visitors due to extreme weather events.	Possible	Extreme	High	Likely	Extreme	Extreme	GSCC has Municipal Emergency Management Plan (MEMP) which covers preparedness and response measures for Fire, Flood, Heatwave, Storm and Drought. Existing risk assessment process for event planning. Victorian Emergency	Fair	Likely	Extreme	Extreme

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				L'hood	Cons		L'hood	Cons				L'hood	Cons	
										Management Legislation and supporting policies and framework.				
40	Population	Residents	Increase in occurrences of mental health related issues among the community as a result of extreme weather events.	Likely	Major	High	Likely	Extreme	Extreme	Municipal Health and Wellbeing Action Plan (MHWAP) and the Municipal Emergency Management Plan (MEMP). Referral services exist to receive specialist mental health support. Strong regional support and partnership to deal with bushfires/droughts and help with recovery efforts (usually targeted).	Good	Likely	Moderate	Medium
41	Population	Residents	An increase in localised urban flooding from high intensity rainfall events.	Likely	Major	High	Likely	Major	High	CERA, MEMP and most specifically, the Municipal Flood Emergency Plan (MFEP). Road markers on road to depict flood height Public communication on what to do during flood. SES The Shepparton/ Mooroopna flood mapping and intelligence project is creating high resolution flood impacts of the region- will provide high quality data for flood management - this will also help manage resident expectations	Good	Possible	Moderate	Medium
42	Population	Residents	Contamination and health risks from the failure of septic tanks due to flood, fires, and changes in ground stability due to drought.	Possible	Major	High	Possible	Major	High	The onus is largely on the individual to monitor the condition of septic tanks. However, Council does issue the permits and can incorporate adaptation measures through the permitting process to ensure future climate risks are considered or communicated. Also addressed in the MEMP. The Shepparton/ Mooroopna flood mapping and intelligence project is creating high resolution flood impacts of the region- will provide high quality data for flood management - this will also help manage resident expectations	Fair	Possible	Moderate	Medium
43	Council assets - physical	Drainage	Inability of current drainage system to cope with extreme	Likely	Major	High	Almost Certain	Extreme	Extreme	Infrastructure Design Manual and existing planning controls. Drainage studies and	Good	Almost Certain	Moderate	High

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				L'hood	Cons		L'hood	Cons				L'hood	Cons	
	infrastructure		rainfall events.							improvement works Municipal Flood Emergency Plan				
44	Council assets - physical infrastructure	Buildings	Increased summer cooling loads on buildings which could result in higher energy demand/costs due to increased temperatures and more frequent extreme heat events.	Possible	Major	High	Likely	Major	High	Council currently has an energy reduction plan which focuses on energy use with Council buildings. Measures in the Urban Forest Strategy coupled with the Energy Reduction Plan may also reduce energy requirements of Council buildings.	Fair	Possible	Moderate	Medium
45	Council assets - physical infrastructure	Drainage	Damage to natural and green drainage infrastructure (e.g. wetlands, swales, rain gardens, etc.) due to reduced ground stability of drying soils and vegetation loss from prolonged droughts.	Likely	Major	High	Almost Certain	Major	Extreme	MEMP and Municipal Flood Emergency Plan.	Good	Likely	Major	High
46	Council assets - physical infrastructure	Buildings	Riverine flood damage to Council buildings caused by increased intensity and frequency of extreme rainfall.	Likely	Major	High	Almost Certain	Major	Extreme	Asset Management Policy Asset Management Strategy MEMP Municipal Flood Emergency Plan	Fair	Likely	Major	High
47	Population	Residents	Areas of the municipality are cut off from essential services (e.g. water and power supply) due to extreme events, increase health and safety risks of community members.	Likely	Moderate	Medium	Likely	Major	High	MEMP SES, CFA Neighbouring emergency management services MAV-MEMEG InterCouncil Resource Sharing Protocol	Good	Possible	Moderate	Medium
48	Economy	Land based industry	Changes in climate may change the incidence and spread of environmental and animal diseases in the area, affecting agricultural crops or harvest.	Unlikely	Moderate	Low	Possible	Moderate	Medium	Industry would have measures in place to monitor/prevent spread of disease. Council has roles under the MEMP.	Fair	Unlikely	Moderate	Low
49	Council services - corporate	Environmental management	Reduced water availability to the environment due to	Possible	Major	High	Likely	Major	High	Murray Darling Basin Plan, although regional focused. Outside of Council's direct	Fair	Likely	Major	High

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				L'hood	Cons		L'hood	Cons				L'hood	Cons	
	and service delivery		drought and extended dry periods, affecting river health and biodiversity.							control. Stormwater Management Plan and Sustainable Water Use Plan to improve water quality discharging into the rivers. GBCMA biodiversity reference group – 8 councils and DEWLP to discuss issues.				
50	Economy	Land based industry	Increased frequency and intensity of storms could lead to crop damage, affecting agricultural yields.	Likely	Major	High	Likely	Major	High	This sits outside Council's control. Industry will have their own measures. Council can play a role educating industry of potential climate risks.	Good	Likely	Major	High
51	Council assets - physical infrastructure	Buildings	Increased frequency and intensity of storms could expose and damage more Council assets due to hail and rainfall damage and wind-blown debris.	Possible	Major	High	Likely	Major	High	Asset Management Policy Asset Management Strategy Building standards and design	Fair	Likely	Major	High
52	Council assets - physical infrastructure	Drainage	Damage to drainage infrastructure (including septic tanks) due to ground movement as a result of drying soils from prolonged droughts.	Possible	Major	High	Likely	Major	High	Environmental health Asset Management Policy Asset Management Strategy	Fair	Possible	Major	High
53	Council assets - physical infrastructure	Buildings	Deterioration of materials and finishes due to increased UV/heat exposure.	Possible	Minor	Low	Possible	Moderate	Medium	General maintenance and repair procedures	Fair	Possible	Moderate	Medium