Adapting to Climate Change in Melbourne's east

A Regional Risk Assessment for Member Councils of the Eastern Alliance for Greenhouse Action

August 2014



This report is prepared by the Eastern Alliance for Greenhouse Action (EAGA) and has been funded by the Victorian State Government through a *Victorian Adaptation and Sustainability Partnership* (VASP) grant.

EAGA is a formal collaboration of seven Councils in Melbourne's east, working together on regional programs that reduce greenhouse gas emissions and facilitate regional adaptation. EAGA consists of the following member Councils:

- City of Boroondara
- Knox City Council
- Maroondah City Council
- Monash City Council
- City of Stonnington
- City of Whitehorse
- Yarra Ranges Council

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Executive Summary

The following Regional Climate Change Risk Assessment is provided as part of the Eastern Alliance for Greenhouse Action (EAGA) Climate Adaptation Roadmap project. The Climate Change Adaptation Roadmap Project is funded through a Victorian Adaptation and Sustainability Partnership (VASP) grant. The report is based upon the outcomes of a series of workshops and interviews conducted across the EAGA Councils from May to August 2014, as well as an extensive desktop review of existing climate risk assessments. The report presents:

- A summary of the regional climate change observations and projections
- Key priority risks for the eastern Councils from climate change
- A gap analysis of current Council plans, strategies and risk registers
- Key recommendations for integrating climate change into Council risk registers

Climate change is an immediate threat that poses multiple risks to the core functions and service

delivery objectives of Councils in Eastern Melbourne. Melbourne's East is already experiencing the impacts of climate change, with an increase in average and extreme temperatures, and a decline in average rainfall. In the coming decades, it can expect to experience increasingly hotter drier conditions with the following impacts:

"Climate change is an immediate threat creating multiple risks to the core objectives of Councils in Eastern Melbourne"

- Increased frequency, duration and severity of heat waves
- Decreased average rainfall and more severe, prolonged drought conditions
- Less regular but more intense rainfall and storm events
- Significant increase in bushfire danger days

The hotter drier conditions combined with an increase in the frequency, severity and extent of extreme weather events is likely to multiple existing risks faced by Councils. Some of the implications of the changing climate include:

- Reduced service delivery and loss of business continuity
- Increased demand on council facilities and resources
- Increased damage to council assets
- Unbudgeted financial impacts from cumulative impacts of climate change
- Decreased public health and safety and mental and physical wellbeing
- Loss of environmental amenity and biodiversity values
- More frequent energy, transport and communications disruptions
- Reduced regional economic development
- Reduced food, water and energy security
- Increase in liability issues

"Hotter drier conditions and more extreme weather events will multiply many existing risks" Some of these risks are being experienced now. Most if not all of these risks will be exacerbated over coming decades unless there is much more proactive planning and consideration of climate change in decision making across council service areas. Furthermore, it is important to recognise that Councils make many daily decisions that have long time frames such as the planting of street trees, approvals of a new housing estates, and installation of new

drainage infrastructure. Therefore there is an important need to integrate the best available evidence of what climatic conditions and associated stressors might look like over the lifetime of a decision.

Understanding each individual Council's existing vulnerability to climate change is critical in order to prioritise solutions and strategies to reduce the multiple risks that Councils face in the future. The objective of this regional risk assessment is to help each of the Councils identify and understand the breadth of risks faced to their assets, operations and areas of service delivery.

This report strongly recommends that each of the Councils adopt climate change as a key strategic risk. Furthermore, it is important to give greater consideration of the operational risks that climate change poses, and the extent and breadth for how the responsibilities for these risks are allocated across each service area. "It is critical that Councils mainstream climate change in decision making and risk management"

Whilst this report has a regional focus, it has also been developed to be used as a working guide for individual Councils to embed climate change throughout their risk registers. Some guidance is also offered towards mainstreaming climate change in existing plans, strategies and policies across Council.

The priority risks contained in this report will inform the basis of the next phase of the Adaptation Roadmap project. This next phase will seek to identify and prioritise regional adaptation initiatives that can reduce the common risks across the eastern Councils. Importantly, the project will deliver a clear adaptation roadmap that will harmonise regional planning, create economies of scale in response actions and enable sharing and pooling of resources.

"There are many positive opportunities for adapting to climate change that can deliver co benefits to Council and the community"

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1. Introduction

1.1 The Eastern Alliance for Greenhouse Action

The Eastern Alliance for Greenhouse Action (EAGA) is a formal collaboration of seven Councils in Melbourne's east, working together on regional programs that reduce greenhouse gas emissions and facilitate regional adaptation. The Eastern Alliance for Greenhouse Action (EAGA) consists of the following member Councils:

- City of Boroondara
- Knox City Council
- Maroondah City Council
- Monash City Council
- City of Stonnington
- City of Whitehorse
- Yarra Ranges Council

EAGA was formed in 2008 in response to community concerns about climate change and a desire to drive environmental sustainability initiatives in a coordinated manner in the eastern region. EAGA's members identified the need to provide leadership, overcome jurisdictional barriers and work more collaboratively. Accordingly, EAGA is committed to responding to the challenges of climate change through the delivery of programs that aim to:

- Reduce greenhouse gas emissions throughout the region
- Provide support for regional adaptation to climate change impacts



Figure 1: The Eastern Alliance for Greenhouse Action Councils

1.2 Climate Change Adaptation Roadmap project

In October 2013, EAGA was awarded a grant through the Victorian Adaptation Sustainability Partnership (VASP) to develop a *Climate Change Adaptation Roadmap* for decision makers in Melbourne's East.

The objectives of the project are to:

- Ensure Climate Change risk management and adaptation actions are mainstreamed across council operations
- Harmonise regional planning, create economies of scale, enable sharing and pooling of resources

The outputs of the project include:

• An integrated regional risk assessment for the EAGA region, focusing on the risks shared by the member Councils

- A regional adaptation roadmap, prioritising cross municipal response actions addressing the key risk areas
- Revised Council policies, plans and strategies to incorporate adaptation actions (with clearly linked accountabilities)
- An ongoing monitoring and evaluation framework to ensure the roadmap and adaptive responses can evolve over time with changing Council priorities

1.3 Project rationale

This project addresses a number of the national adaptation priorities indentified by COAG's Select Council on Climate Change (2012). It provides a mechanism for the State Government to deliver the strategies within the Victorian Climate Change Adaptation Plan, particularly its commitment to strengthen partnerships with local-government and communities. Adaptation is a key objective within EAGA's Strategic Plan and the roadmap will provide clear direction and momentum for adaptation across Melbourne's east.

1.4 Project Scope

The scope of the following regional risk assessment is limited to climate change risks to council assets, operations and areas of service delivery. Though the next phase of the project is likely to engage other regional stakeholders, EAGA determined this scope was most appropriate considering available resources.

The boundaries of the project scope accord with the EAGA council boundaries. Some climate change risks may be more local in scale or extend beyond the EAGA council boundaries. Nonetheless, the Alliance boundary provides a working governance framework to consider risks that go beyond council boundaries, or for which solutions are best dealt with at a regional scale.

1.5 Regional profile

EAGA's region covers approximately 3,000km², extending from densely populated urban areas in the west to less populated rural areas in the east. The region includes a range of features:

- 18% of Victoria's population (1,046,000 total)
- Future growth expected of 150,000 to 200,000 by the year 2031
- 34% of households considered low income
- 25% of residents are renters and 26% are born overseas
- 62% of businesses in the region are home-based
- 43% of industries (by employment) are in healthcare, professional services, retail and manufacturing sectors
- The industrial areas in Knox, Maroondah and Monash are a core strength of the region's economy and major contributor to Victoria's manufacturing sector

2. Project Methodology

2.1 Risk assessment approach

The project team adopted a standard risk assessment methodology for the project in line with the Australian and New Zealand risk management standard AS4360 and the Australian Greenhouse Office report "Climate Change Impacts: A guide for business and government" (2006). This approach was deemed most suitable as it is consistent with existing frameworks for risk assessment in the Local Government sector. Although there are other approaches that are being increasingly adopted in climate change adaptation planning, such as integrated vulnerability assessments, a standard risk assessment that leveraged on existing risk management frameworks was considered the most appropriate (and value added approach) given time and resource constraints of the project.

This approach also accommodated the fact that each Council is at a different stage with respect to adaptation planning and several of the Councils have already previously undertaken climate change risk assessments.

2.2 Risk Workshops

Risk workshops were held at the Cities of Knox, Monash, Maroondah and Stonnington. Each workshop (2.5 hours) engaged staff from all Councils service areas. This broad representation ensured that there was comprehensive identification of risks across the different areas of Council.

At the beginning of the workshops, the Adaptation Officer gave a short presentation on the project, and introduced the climate change scenario that is used for the risks assessment. An explanation was also given on the difference between climate change mitigation and climate adaptation. It was emphasized that it is unlikely that climate change poses many new risks to Council, but instead is likely to exacerbate existing risks.

It was necessary to present the climate scenario for the workshop in a simplified format. Figure 2.1 was presented to participants in the risk workshops and risks were identified and rated using this scenario to form conditional likelihoods and consequences.



Figure 2.1: Climate change scenario used in the risk workshops

Workshop participants were asked to introduce themselves and how they expected climate change to impact upon their work area. This preliminary discussion helped to highlight the diversity of climate change risks and focus thinking around the scope and purpose of the project. The point was made that climate change is often described by Councils as a discrete risk that is usually "owned" by sustainability teams to manage, and that the purpose of the workshop was to try and break out the climate risks into more detail to allow for broader ownership and mainstreaming of climate change in decision making.

Participants then worked in small groups to identify as many climate risks as possible in a brainstorming session. Each of the groups would spend time on a particular climate impact such as increasing temperatures and heatwaves, reduced water availability and droughts, increased severity of storm and flooding events, and increased bushfire risk. They were guided to describe the risk in terms of the climate impact responsible, the hazard it created and the consequence to council objectives.

Existing controls for each risk were then identified by participants and controls were evaluated for their perceived effectiveness. The risks were then taken away by the Adaptation Officer and rated using each of the Councils own risk management frameworks considering the data gathered on existing controls in the assessment.

A risk register was developed containing all of the Councils identified and rated risks. This register was then themed into Council area of responsibility, and shared with participants via email. Follow up interviews and questionnaires were conducted throughout the Councils to sense check the outputs.

Boorondara, Yarra Ranges and Whitehorse City Council had previously conducted climate change risk assessments and chose to adopt a different approach to the workshop process. For Yarra Ranges and Whitehorse, one hour workshops were held to evaluate progress on their respective adaptation plans. This enabled a sense checking of the relevance of the previous risk assessments conducted in 2009 and facilitated discussion around some of the lessons learnt and barriers since the 2009 process.

For Boorondara, as part of a broader review of their existing adaptation plan, a series of interviews with Council staff were conducted. These interviews focused on recent experiences of climate change events and a discussion about some key priority risks for the relevant Council area. These risks have also been incorporated into the regional risk register.

2.3 Stakeholder engagement

For each workshop, the EAGA Project Control Group worked with the Adaptation Officer to engage staff across various departments to attend the risk workshops. Broad representation was sought from across Council to reflect the diversity of risks posed to Council from climate change. Although each Councils have their own unique organisational structure, representation was sought from across the following key areas of service delivery:

- Community planning, services and health
- Planning and development
- Corporate services
- Infrastructure, assets and operations
- Sustainability and Environment
- Emergency management

A two page briefing note was prepared by the Adaptation Officer and distributed to workshop participants detailing the project and the purpose and agenda for the workshop.

2.4 Regional risk assessment

Data collection tools and workshops activities were designed to both inform an assessment of risk at the regional level and the development of discrete risk registers as each Council.

At the completion of the risk workshops, all identified risks were entered into a risk register, incorporating the previous risk assessments carried out in 2009 for Yarra Ranges and Whitehorse. Risks that were similar to one another were grouped together for each Council. The risks were rated based on each of the Council risk management frameworks, and taking into account the perceived effectiveness of existing controls. Each of the Council risk management frameworks can be found in Appendix 3.

The final risk register included a set of 329 risks. In order to make a more workable regional list of risks it was necessary to theme the risks according to key theme and climate variable.

Each of the risks was first nominated to fall within the responsibility of the following key themes:

- Community planning, services and health
- Planning and development
- Corporate services
- Infrastructure, assets and operations
- Sustainability and Environment
- Emergency management

Although there are many ways to categorise risks, themes were selected to represent the common organisational structures across the EAGA Councils.

The risks were themed by the climate impact variable. For example all risks that were borne from heatwaves were grouped together so as to be able to more easily identify similar and duplicated risks. The following climate impact variables were attributed to each risk:

- All climatic changes
- Increasing bushfire danger
- Increasing average temperatures
- More intense rainfall events
- Reduced water availability/drought
- More frequent and severe extreme weather events (general)
- Increasing frequency, severity and duration of heatwaves
- Increased wind velocity
- Increasing temperatures and drier conditions (combined)

A new regional risk description was used to cover similar or duplicated risks. The end result was a set of regional risks for each key theme. These were then re-rated using the likelihood and consequence tables adapted from the Australian Greenhouse Office "Guide for Business and Government" (2006), and cross checking with the ratings given by the Council assessments (See tables 2.1-2.3).

Table 2.1: Likelihood ratings (given the climate scenario)(AGO 2006)

| Rating | Recurrent risks | Single events |
|----------------|-----------------------|---|
| Almost certain | Could occur several | More likely than not |
| | times per year | – Probability greater than 50%. |
| Likely | May arise about | As likely as not |
| | once per year | – 50/50 chance. |
| Possible | May arise once | Less likely than not but still appreciable |
| | in ten years | – Probability less than 50% but still quite high. |
| Unlikely | May arise once in ten | Unlikely but not negligible |
| | years to 25 years | – Probability low but noticeably greater than zero. |
| Rare | Unlikely during the | Negligible |
| | next 25 years | – Probability very small, close to zero. |

| SUCCESS CRITERIA | | | | | | |
|------------------|--------------|---|---|--|--|--|
| | Rating | Public safety | Local economy & growth | Community & lifestyle | Environment & sustainability | Public administration |
| | Catastrophic | Large numbers of serious injuries or loss of lives | Regional decline leading to widespread business failure, loss of employment and hardship | The region would be seen as very unattractive, moribund and unable to support its community | Major widespread loss of environmental amenity and progressive irrecoverable environmental damage | Public administration would fall into decay and cease to be effective |
| | Major | Isolated instances of serious injuries or loss of lives | Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth | Severe and widespread decline in services and quality of life within the community | Severe loss of environmental amenity and a danger of continuing environmental damage | Public administration would struggle to remain effective and would be seen to be in danger of failing completely |
| | Moderate | Small numbers of injuries | Significant general reduction in economic performance relative to current forecasts | General appreciable decline in services | Isolated but significant instances of environmental damage that might be reversed with intensive efforts | Public administration would be under severe pressure on several fronts |
| | Minor | Serious near misses or minor injuries | Individually significant but isolated areas of reduction in economic performance relative to current forecasts | Isolated but noticeable examples of decline in services | Minor instances of environmental damage that could be reversed | Isolated instances of public administration being under severe pressure |
| | | Appearance of a threat | Minor shortfall relative to current | There would be minor areas in | No environmental damage | There would be minor instances |

Table 2.2: Consequence scale for regional risks (AGO 2006)

Table 2.3: Priority risk ratings based on likelihood and consequence (AGO 2006)

maintain its

current services

but no actual forecasts which the region was unable to

| | | | Consequences | | |
|----------------|---------------|--------|--------------|---------|--------------|
| Likelihood | Insignificant | Minor | Moderate | Major | Catastrophic |
| Almost certain | Medium | Medium | High | Extreme | Extreme |
| Likely | | Medium | High High | Extreme | |
| Possible | | Medium | Medium | High | High |
| Unlikely | | | Medium | Medium | Medium |
| Rare | | | | | Medium |

of public administration

being under

more than usual stress but it could be managed

3. Climate change in Melbourne's East

3.1 Overview

There is now overwhelming evidence that human induced climate change is occurring and is likely to have significant consequences for local governments. The latest Intergovernmental Panel on Climate Change report (2014) states that the warming of the world's climate is unequivocal and it is extremely likely (>95% confidence) that human activity is the dominant cause of this warming and not natural variability.

Similarly the recent State of the Climate Report (CSIRO & BOM 2014) states that Australia's climate has already warmed by 0.9°C since 1910 and that the frequency of extreme weather has changed, with more extreme heat and fewer cool extremes. For the south east of Australia, extreme fire weather has increased and the fire season lengthened, and rainfall has declined since 1990.

South east Australia can expect even more hotter and drier conditions into the future, with an increase in more extremely hot days and fewer extremely cool days. Average rainfall is expected to decline whilst the intensity of rainfall events is expected to increase when they do occur.

Society must respond to climate change in two ways; through *mitigation* actions whereby greenhouse gas emissions are reduced, and through *adaptation* actions that aim to reduce the impacts of climate change. Climate change adaptation is the focus of this risk assessment.

Box 1: Adaptation versus Mitigation

Responding to climate change requires both mitigation and adaptation responses:

- Mitigation; reducing the magnitude of climate change through emissions reductions and offsets
- Adaptation; actions to reduce the adverse consequences of climate change on human and natural systems

The focus of this project is around adaptation and is defined in the Victorian Climate Change Adaptation plan as:

"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."

Whilst there is scientific certainty that climate change is occurring, the magnitude, timing and distribution of climate impacts across the EAGA region through time is less certain. The Victorian Climate Change Adaptation Plan recognises that making decisions in the context of this uncertainty is a key challenge for local governments undertaking adaptation planning (DSE 2013). However, this uncertainty should not be a basis for inaction. Therefore, climate scenarios are used in the risk assessment process, which are based upon the best available scientific projections.

3.2 Climate change projections for the EAGA region

The climate change scenario used for the risk workshops and as the basis of this regional risk assessment is based upon projections prepared by the CSIRO for the EAGA region. This was updated in 2013 as part of the "Bushland and Biodiversity Management in a Changing Climate" report (EAGA 2013b & CSIRO 2013).

It is necessary to consider uncertainty when making climate projections for any given location. Furthermore, it is unlikely that this level of uncertainty will be significantly reduced through time. Major factors contributing to uncertainty in producing climate projections include:

- 1. Lack of complete knowledge of how the global climate system works
- 2. Natural variability in the global climate system
- 3. Predicting human behaviour and future greenhouse gas emissions

In light of this uncertainty, climate projections were developed by CSIRO based on the Intergovernmental Panel on Climate Change greenhouse gas scenarios (CSIRO 2013). In this study "Most Likely" and "Worst Case" climate futures were considered for the region. The most likely climate future is defined as that represented by the greatest number of models. The worst case is defined as the climate future that would have the greatest impact on ecosystems in the EAGA region i.e. greatest increase in temperature and/or greatest drying. The range of both of these scenarios were utilised in this report. There is little difference between scenarios up to 2030, and the greater differences occur beyond 2055 depending upon future global greenhouse gas emissions (see figure 3.1).

Similarly, it is worth noting that we are currently tracking on the higher emissions scenario which will lock in significant increases in global temperatures by 2100, well in excess of the 2 degrees Celsius that is considered "adaptable". Table 3.1 shows the climate change projections for the Port Phillip and Westernport Region of Victoria for 2030 based on 1980-99 averages. This table shows that the observed changes for 2004-2013 to average and extreme temperatures and winter and summer and rainfall have already exceeded the projections for 2030. This demonstrates that climate change is an immediate threat, not just a future threat and that previous projections have been consistently conservative.

TABLE 3.1 2008 Climate change projections for Melbourne region compared with currentobservations (1980-99 & 2030 projections from DSE 2008 and 2004-13 observed extracted from CSIRO &BOM 2014)

| Climate variable | 1980-99 | 2030 | 2004-13 observed |
|------------------|---------|----------------------|------------------|
| Ann mean temp | 15.6°C | 0.9°C (0.6 to 1.2°C) | 0.9°C |
| Summer rainfall | 155 mm | -1% (-11 to +9%) | +4% |
| Winter rainfall | 153 mm | -4% (-10 to +2%) | -12% |
| Days over 35C | 9 | 11 (10 to 13) | 12 |



Figure 3.1 Global emissions and warming scenarios (Extracted from Meinshausen et al. 2009)

3.3 Timeframes

Climate projections were calculated for the EAGA region by CSIRO for the 30 year climatology centered on outlook periods 2030, 2050 and 2070. Values provided are relative to a 30 year period

centered on 1990 (1975 – 2004). The changes summarised in table 3.1 should be interpreted as an overview of projected changes in aspects of the climate of the EAGA region as provided in "Climate Futures for Eastern Melbourne" (CSIRO 2013).

The timeframes of the risk assessment reflect the timeframes of the CSIRO projections. However, it was considered that 2070 is too long term for most council planning decisions. A review of council climate risk assessments (MAV 2010) found that 2070 was not that realistic for the purposes of adaptation planning and this supported the EAGA decision to focus on 2030 and 2055.

TABLE 3.2: Summary of most likely projected future changes

Temperature

- Average temperatures will increase in all seasons, most significantly in summer and least in
- winter.
- The frequency of hot days will increase.
- The frequency of warm nights will increase in all seasons, but most in summer.

Precipitation

- With higher emissions into the future there are likely to be decreases in average rainfall in all seasons.
- The majority of the models project greatest percentage decreases in average rainfall to occur in spring.
- There will be increases in evaporation across all seasons with most models indicating the largest increases will be in winter.
- Projected decreased rainfall and increased evapotranspiration is likely to lead to decreased average streamflow.
- The frequency of dry days will increase.

Relative humidity

- By 2030 a decrease in annual average relative humidity of around 0.8% (+0.2 to -1.8%) is likely.
- By 2050 decreases in annual average relative humidity of around 0.5% (0.2 to 1.0%) and around
- 2.7% (-2.0 to -3.6%) are likely under low and high emissions scenarios respectively.
- By 2070 decreases in annual average relative humidity of around 2.7% and around 4.1% (-1.8 to -5.2%) are likely under low and high emissions scenarios respectively.

Fire Weather

- The frequency of weather conditions conducive to high forest fire risk will increase.
- The fire season will start earlier and end later in the year.

Extreme Wind Speeds

• The majority of models indicate extreme wind-speeds could decrease in spring, summer and autumn and increase in winter.

Solar Radiation

- By 2030 an increase in annual average solar radiation of around 0.8% (0.1 to 1.6%) is likely.
- By 2050 increases in annual average solar radiation of around 0.9% (-0.1 to 1.9%) and around 2.7% (0.6 to 4.8%) are likely under low and high emissions scenarios respectively.
- By 2070 increases in annual average solar radiation of around 0.6% (0.4 to 2.5%) and around 3.1% (0.5 to 5.4%) are likely under low and high emissions scenarios respectively

4. Priority Regional Risks

The following section summarises regional risks facing the EAGA Councils from climate change. Risks have been grouped into the following key council service areas:

- Community planning, services and health
- Planning and development
- Corporate services
- Infrastructure, assets and operations
- Sustainability and Environmental Management
- Emergency management and disaster preparedness

Although there are many ways to categorise risks, themes were selected to best represent the most common organisational structures across the EAGA Councils.

A full risk register for each council is attached as an Appendix to this report. The regional risks included in this section are of high and extreme ratings only.

Many of the risks highlighted in this section are risks that Councils are currently facing, with climate change acting as a multiplier of these risks. From the follow up interviews with workshop participants, reflections on recent extreme weather events highlighted the existing vulnerability of Council's to climate change. Most participants acknowledged that any increase in the severity, duration or frequency of these events would severely compromise Council's strategic goals.

One of the key limitations of a risk assessment is that it is difficult to capture the consequences of multiple impacts occurring in similar time and space. Many climate change impacts often occur at the same time, such as heatwaves and bushfires, and so risks taken in isolation may not capture the cumulative impact of overlapping risks (See Box 2). Some of the risks have been described in a way that captures the multiple climate change variables. Although this does not capture the breadth of cumulative impacts in this risk assessment, these considerations will be brought forward into the adaptation planning phase with the use of scenario planning.

Box 2: Impacts of the January 2009 Heatwave and Black Saturday Bushfires in Melbourne's East

The January heat wave of 2009 across Melbourne was of unprecedented intensity and duration with maximum temperatures 12-15 degrees Celsius above normal, and 3 consecutive days of temperatures above 43 degrees Celsius. This event that led to the tragic Black Saturday Bushfires demonstrates the risks to Council assets, operations and service delivery that can arise from multiple climatic stressors occurring at once.

Many air conditioning units failed from overloading across EAGA Council buildings. Further brownouts and blackouts occurred due to peak electricity demand across the municipalities leading to damage to critical council assets and plant equipment. Many staff left work early due to high temperatures in the office and the fact that many office buildings demonstrated inadequate passive design qualities. Heat island effects that exacerbated heat wave conditions were observed caused by a lack of green infrastructure and increasing urbanisation. This was contributed to by an overall decline in street tree canopy during the prolonged drought conditions that preceded the heat wave events. In fact the hotter drier conditions led to a longer term decline in the health and appearance of Council parks and reserves, leading to a decline in amenity and loss of biodiversity.

Across the region, health support services were severely strained from the increased demand associated with increased heat related conditions. Across the state the week experienced an additional 374 excess deaths over what would be expected, with reportable deaths in those over 65 years of age doubling.

Transport and energy disruptions were frequent. On the 30th January train cancellations peaked with 24% of trains not running, leading to further restrictions on regional mobility for council staff and community to access and deliver critical assets and services. The economic impacts were widespread for the region, due to the costs of direct damage to infrastructure, the loss of productivity and loss of revenue for small businesses. A decline in strip shopping economic activity was evident, with people preferring the air conditioned refuges of larger shopping malls. CSIRO estimated that for the 28-30th January the south eastern cities of Australia lost an estimated \$800 million due to the heat wave.

Due to the high fire danger during the week urban councils experienced temporary population increases with people migrating away from areas of high fire risk. Council leisure centres were strained due to the increase in demand for air conditioned and shaded refuges. This created significant safety and service delivery issues for staff and the community.

The Black Saturday bushfires placed serious strain on regional emergency services. Councils in neighbouring regions to the fire affected area contributed support staff and resources leading to further disruptions to business continuity. The bushfires created widespread devastation to communities and infrastructure with 173 deaths and the destruction of over 3,500 structures.

Climate change over the next 30–60 years will make the probability of such events in Melbourne's East more likely, and lead to more frequent, longer lasting heatwaves, more extreme bushfire danger and more prolonged drought conditions. The January 2009 heat wave and Black Saturday bushfires demonstrated the importance of proactive planning for climate change, and the risk of relying on reactive response measures only. Many positive adaptation measures have since occurred such as the development of Municipal Heatwave Plans and significant structural changes to emergency management. However there are still many challenges that need to be addressed if the region is to increase its resilience to the impacts of climate change in the coming decades.

(Adapted from research contained in QUT 2010 and EAGA Council interviews and questionnaires)

The following risks have been described in terms of the impacts of climate change on council operations, assets and areas of service delivery. In particular, it attempts to phrase the risks according to the following roles and responsibilities of local government as set out in the COAG

Select Council on Climate Change "Roles and Responsibilities for Climate Change Adaptation" (2012b):

- Administer relevant state and territory and/or Commonwealth legislation to promote adaptation as required, including the application of relevant codes, such as the Building Code of Australia
- Manage risks and impacts to public assets owned and managed by local governments
- Manage risks and impacts to local government service delivery
- Collaborate across Councils and with state and territory governments to manage risks of regional climate change impacts
- Ensure policies and regulations under their jurisdiction, including local planning and development regulations, incorporate climate change considerations and are consistent with State and Commonwealth Government adaptation approaches
- Facilitate building resilience and adaptive capacity in the local community, including through providing information about relevant climate change risks
- Work in partnership with the community, locally-based and relevant non-government organisations, business and other key stakeholders to manage the risks and impacts associated with climate change
- Contribute appropriate resources to prepare, prevent, respond and recover from detrimental climatic impacts.

A formal Memorandum of Understanding is still being developed between the Victorian State Government and Local Government to gain further clarity on these roles and responsibilities, as part of the Victorian Climate Change Adaptation Plan (DSE 2013). However, the above provides a useful working framework for considering risks and understanding roles and responsibilities between the different levels of government.

The following risk descriptions have been phrased in the following way:



In most cases, the risk consequence is described as the most significant consequence and does not describe every possible consequence to council. Although the risks have been identified from the workshops they are supported by existing literature where possible.

4.1 Community Planning, Services and Health

This theme covers areas of Council such as community planning and development, leisure facilities and libraries, community health and wellbeing, aged and disability services, multicultural and Culturally and Linguistically Diverse (CALD) community services, youth and family, recreation, economic development, and Home and Community Care (HACC) services.

Summary of key risks

Climate change exacerbates many existing risks faced by the Community Planning, Services and Health service areas of EAGA Councils. Across the region climate change is likely to:

- Increase demand on council support services during and after extreme weather events
- Increase demand on council facilities, particularly air-conditioned and shaded refuges during heatwaves such as libraries and swimming pools
- Reduce Councils ability to service vulnerable members of community, such as aged and disability, low income households and people who rely on frequent medical services
- Potential for significant impacts on mental and physical wellbeing of community due to reduced participation in sport, reduced use of open space, reduced air quality and reduced amenity, increased exposure to water and food borne disease and toxins and increased anxiety from climate change events
- Reduce regional food and water security
- Reduced regional economic development from financial and business interruption impacts of increasing extreme weather events, reduced access to work, increased costs of food, water and energy
- Reduced economic activity in strip shopping centres (or "precincts") in favour of protected and air conditioned shopping centres

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Municipal Public Health and Wellbeing Plan: Having regard to Climate Change (DOH 2012)
- The critical decade: climate change and health (Climate Commission 2011)
- Scoping of climate change impacts on population health and vulnerabilities (DOH 2013)
- Victorian Climate Change Adaptation Plan (DSE 2011)
- Climate change adaptation actions for local government (DEWR 2007)
- Economic impacts of Climate Change (CEDA 2014)

Key relevant Council plans/strategies

Municipal Health and Wellbeing Plans, Municipal Heatwave Plans, Economic Development Strategies, Municipal Emergency Management Plans.

| Risk ID | Regional Risk Description | Risk Rating | | |
|---------|--|-------------|--------|---------|
| | | Current | 2030 | 2055 |
| CSR1 | Service delivery failure in extreme weather | High | High | Extreme |
| | Increased demand on Council recovery and support services from more frequent and severe extreme weather events leads to increased health risks to vulnerable members of community and widespread service delivery failure | | | |
| CSR2 | Increased demand on Council facilities during heatwaves | High | High | Extreme |
| | Higher demand on Council air conditioned and shaded facilities (swimming pools/libraries) from increasing frequency, severity and duration of heatwaves leads to reduced public safety | | | |
| CSR3 | Increased energy disruptions during heatwaves threaten public health | Medium | High | High |
| | More frequent blackout/brownouts from increased electricity demand during heatwaves leads to health and safety issues for low income households, aged, disabled, children and those with chronic health conditions | | | |
| CSR4 | More severe storms reduce mobility and access to critical services | Medium | High | High |
| | More disruptions to transport and communications infrastructure from increased intensity of rainfall events and severe storms reduce mobility and access to critical goods and services for vulnerable members of community | | | |
| CSR5 | Increasing costs of water on economy | Medium | High | High |
| | Increasing costs of water from reduced water availability leads to local economic impacts on water reliant businesses (eg.nurseries, carwashes) and community | | | |
| CSR6 | Reduced wellbeing from sportsground deterioration | Medium | Medium | High |
| | Hardening and deterioration of sporting grounds/reserves as a result of decreased rainfall leading to reduced participation and increased social isolation in community | | | |
| CSR7 | Reduced air quality from dust storms, bushfires and planned burning activities | Medium | Medium | High |
| | Reduced air quality from dust storms and bushfires as a result of hotter drier conditions leading to increase in public health | | | |

TABLE 4.1 Community Planning, Services and Health Regional Risks

| | issues such as respiratory illnesses and Council sees an increase in complaints and loss of reputation | | | |
|-------|--|--------|--------|------|
| CSR8 | Increased disease transmission | Medium | Medium | High |
| | Contaminated water supplies and reduced food hygiene from hotter and drier conditions leads to increase in disease transmission and public health issues particularly affecting low- income households, children and older people | | | |
| CSR9 | Heatwaves reduce mental wellbeing | Medium | Medium | High |
| | Reduced thermal comfort in public spaces from increasing number of hot days leads to detrimental impact on community and staff mental wellbeing | | | |
| CSR10 | Slowing of regional economy | Medium | Medium | High |
| | Greater SME failure or damage due to more frequent business disruptions and financial impacts from more severe extreme weather events leads to regional unemployment and reduced economic development | | | |
| CSR11 | Reduced food security | Medium | Medium | High |
| | Reduced food security from reduced water availability leads to broad economic and social impacts on community | | | |
| CSR12 | Reduced retail economic activity in strip shopping precincts | Medium | Medium | High |
| | Reduced economic activity in strip shopping precincts in favour of air conditioned and protected shopping centres from increasing heatwaves and extreme weather events lead to regional economic and social impacts | | | |

4.2 Planning and Development

The planning and development sector includes strategic planning, statutory planning and development approvals processes. It also covers areas of council such as open space planning and urban design, local laws and building compliance, and major projects. The divisions of strategic and statutory planning differ between Councils, however for the purpose of this report all aspects of planning and urban design are considered together.

Summary of key risks

This theme contains significant opportunities to proactively plan for climate change, particularly strategic planning and urban design. Whilst many other responses to climate change will be reactive and behavioral, it is often this sector that offers advice on longer term decisions such as ESD principles, water sensitive urban design, major projects etc. However, often local government decision making with regards to planning and development approvals is steered by state government legislation. As such some of the following risks have shared responsibilities between State and local government.

The key risks faced by this theme are:

- Strategic failure to adequately plan for climate change impacts into the future
- Current council building stock not designed for projected climate change
- Urban design and land use planning exacerbates climate change impacts such as the 'heat island' effect and flooding impacts
- Resource strain and development approvals slow from more stringent climate change planning laws
- Inadequate water planning exacerbates flooding and requires new infrastructure
- Lack of understanding and guidance for considering climate change impacts by Council planning staff

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Climate Change Vulnerability Assessment of Selected Council Buildings (Whitehorse City Council 2012)
- Infrastructure and Climate Change Risk Assessment for Victoria (CSIRO, Maunsell & Fox 2007)
- Victorian Climate Change Adaptation Plan (DSE 2011)
- Planning policy and practice: the right mechanism to tackle climate change? (Maddocks 2010)
- Climate change adaptation actions for local government (DEWR 2007)
- Responding to the urban heat island: a policy and institutional analysis (Bosomworth et al. 2013)
- Developing the Metropolitan Whole of Water Cycle Strategic Framework Draft Discussion Paper 2014-2024 (OLV 2014 draft)

• Ensuring Australia's urban water supplies under climate change (NCCCARF 2013c)

Relevant Council plans/strategies

Municipal Strategic Statements, planning schemes, ESD policies, National Construction Code, Open Space strategies.

TABLE 4.2: Planning and Development Regional Risks

| Risk | Regional Risk Description | Risk Rating | | |
|------|---|-------------|--------|--------|
| ID | | Current | 2030 | 2055 |
| | Inadequate building design | | | |
| | Current building design standards not adequate for projected | | | |
| | climate conditions leads to increased costs to local Councils for | | | Extrem |
| PR1 | maintenance, retrofitting and replacement | Medium | High | е |
| | Strategic failure to plan for climate change | | | |
| | Council fails to adequately plan for climate change and enact | | | |
| | the precautionary principle leading to loss of reputation, | | | Extrem |
| PR2 | liability issues and increased financial costs | Medium | High | е |
| | Urbanisation and heat island effect | | | |
| | Increasing densification and harder surfaces exacerbate heat | | | |
| | island effect during heatwaves leading to reduced physical and | | | |
| PR3 | mental wellbeing and loss of reputation and amenity | Medium | High | High |
| | Land use planning fails to adequately consider climate change | | | |
| | Failure to plan for climate change in land use planning | | | |
| | framework exacerbates climate change impacts leading to | | | |
| | widespread damage to public and private assets, reduced | | | |
| PR4 | public safety, liability and insurance issues | Medium | High | High |
| | More stringent planning laws | | | |
| | More stringent building and planning requirements due to | | | |
| | increased frequency and severity of extreme events leads to | | | |
| | greater strain on statutory planning resources and | | | |
| PR5 | development approval times | Medium | Medium | High |
| | Inadequate flood infrastructure | | | |
| | Overflowing of drainage systems and inadequate flood | | | |
| | infrastructure from increased intensity rainfall events leads to | | | |
| PR6 | increased damage to council assets and reduced public safety | Medium | Medium | High |
| | Costs of new water capture infrastructure | | | |
| | Increased pressure to design new water capture and reuse | | | |
| | infrastructure due to reduced water availability leads to | | | |
| PR7 | increased capital costs to council | Low | Medium | High |
| | Inadequate capacity to understand impacts of climate change | | | |
| | Lack of understanding of climate change impacts by Council | | | |
| | staff and lack of policies or guidance leads to lack of | | | |
| | consideration and information integration of climate change in | | | |
| PR8 | development approvals | Medium | Medium | High |

4.3 Corporate

The corporate theme includes areas such as finance and governance, human resources, risk management and OH&S, IT, corporate communications and customer service and corporate planning. This area of Council is likely to face the consequences of many realised risks across other areas of Council, that lead to reduced service delivery and disruption of business continuity, and financial and reputational issues.

Summary of key risks

The key risks faced by this theme are:

- Reduced safety and wellbeing for staff and community
- Increased liability issues and insurance premiums
- Cumulative economic impacts of climate change on financial planning
- Loss of business continuity and service delivery from increasing climate events
- Risk of loss of reputation from loss of amenity, service delivery failure and clean up delays
- Reduced human resources and productivity from absenteeism and decline in volunteerism
- Lack of council staff knowledge and capacity to plan for climate change

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Responding to litigation risk from climate change informed decision making (DLA Piper 2014)
- Challenges of adaptation for local governments (NCCCARF 2014)
- Local Council Risk of Liability in the Face of Climate Change Resolving Uncertainties (Baker & Mckenzie 2011)
- Victorian Climate Change Adaptation Plan (DSE 2011)
- Western Alliance for Greenhouse Action Climate Change Risk Assessment (2011)
- Protecting Human Health and safety during severe and extreme heat events (Price Waterhouse Coopers 2011)

Relevant Council plans/strategies

Council plans, long term financial plans, annual budgets, risk registers.

TABLE 4.3: Corporate Regional Risks

| | | | Risk Rating | |
|---------|---|--------|-------------|--------|
| Risk ID | Regional Risk Description | Now | 2030 | 2055 |
| | Reduced safety for staff and community | | | |
| | Increase in severity, frequency and extent of extreme weather | | | |
| | events from climate change leads to increased injury or death | | | Extrem |
| CoR1 | of staff and community | Medium | High | е |
| | Reduced council service delivery | | | |
| | Increased resources required to manage and mitigate | | | |
| | increasing frequency of climate events reduce other areas of | | | Extrem |
| CoR2 | council service delivery | Medium | High | е |
| | Increases in insurance premiums | | | |
| | Change to insurance premiums due to increasing frequency | | | |
| | and severity of extreme weather events leads to increased | | | |
| CoR3 | costs to Council | Medium | High | High |
| | Cumulative costs of CC to financial planning | | | |
| | Failure of long term financial plans and annual budgets due to | | | |
| | cumulative economic impact of climate change leads to | | | |
| | widespread council service delivery failure and failure to meet | | | |
| CoR4 | core objectives | Medium | High | High |
| | Inadequate staff skills and capacity | | | |
| | Lack of knowledge of climate change adaptation amongst | | | |
| | Council staff across departments leads to reduced capacity of | | | |
| | Council to adequately respond leading to loss of reputation | | | |
| CoR5 | and planning failure | Medium | High | High |
| | Reduced volunteerism during heatwaves | | | |
| | Inability to retain volunteer staff due to increasing heatwave | | | |
| CoR6 | events leads to impacts on continuity of service delivery | Medium | High | High |
| | Increased liability issues | | | |
| | Increased rate of claims and liability issues from damage to | | | |
| | property and people from extreme storm events and bushfires | | | |
| | leads to strain on council resources and unexpected financial | | | |
| CoR7 | costs | Medium | High | High |
| | Increased energy demand and costs of cooling | | | |
| | Increased energy demands of maintaining thermal comfort | | | |
| | levels for staff due to increasing frequency and severity of | | | |
| C - D0 | heatwaves leads to increased costs of cooling and maintaining | | | |
| COR8 | buildings | Medium | High | High |
| | Loss of business continuity from power outage | | | |
| | Increased rate of power outages due to more frequent and | | | |
| | protonged extreme weather events such as neatwaves and | | | |
| CoPO | storms leads to loss of business continuity and reduced service | Madium | Llieb | Link |
| CORS | Transport dicruptions roduce convice delivery | Mealum | rign | rign |
| | Transport disruptions due to extreme weather leads to | | | |
| CoP10 | raduced staff attendance and inhibited service delivery | Modium | Modium | High |
| LOKIO | reduced stan attendance and infibiled service delivery | Mealum | Mealum | nign |

| | Increased OH&S risk to outdoor staff | | | |
|-------|---|--------|--------|------|
| | Increased OH&S issues to outdoor council staff from more | | | |
| | frequent and severe heatwave events (heatstroke, sunburn | | | |
| CoR11 | etc.) | Medium | Medium | High |
| | Reduced mental wellbeing of staff | | | |
| | Reduced mental wellbeing of staff due to increase in extreme | | | |
| | weather events and higher temperatures leads to greater | | | |
| CoR12 | absenteeism and reduced productivity | Medium | Medium | High |
| | OH&S policy conflicts with service delivery | | | |
| | OH&S policy of restricting outdoor workers in extreme heat | | | |
| | days reduce Councils ability to service vulnerable members of | | | |
| | the community leading to loss of reputation and reduced | | | |
| CoR13 | public safety | Medium | Medium | High |
| | Clean up delays | | | |
| | Clean up delays and backlogs from more extreme weather | | | |
| | events lead to loss of reputation, community outrage and | | | |
| CoR14 | council service delivery failure | Low | Medium | High |
| | Increased demand on customer service calls | | | |
| | Increased demand on Council's after hours service calls for | | | |
| | clean up and recovery work from more extreme weather | | | |
| | events leads to loss of business continuity and impacts on | | | |
| CoR15 | service delivery | Low | Medium | High |

4.4 Infrastructure and Assets

The infrastructure and assets theme includes buildings and property services, water management and drainage maintenance, capital works, road and footpath maintenance, waste management and recycling, parks/reserves and sporting grounds, and operations.

Summary of key risks

This theme contains risks associated with asset and infrastructure management which are some of the most common and arguably one of the greatest challenges that local governments face from climate change in terms of financial sustainability and community expectations. Similarly maintenance of sporting grounds and open space will be impacted upon by climate change and these risks cross over a number of other council key themes. The key risks faced by this theme are:

- Reduced asset lifespan and increased maintenance of council assets
- Increased damage to underground infrastructure such as drains, pipes, building foundations
- Reduced thermal comfort of buildings
- Increased costs and resources for managing sporting grounds and reserves
- Higher rates of street tree mortality
- Increased flood and bushfire damage to critical council assets
- Lack of available fresh water and water for irrigation

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Climate Change Vulnerability Assessment of Selected Council Buildings (Whitehorse City Council 2012)
- Infrastructure and Climate Change Risk Assessment for Victoria (CSIRO, Maunsell & Fox 2007)
- Victorian Climate Change Adaptation Plan (DSE 2011)
- Western Alliance for Greenhouse Action Climate Change Risk Assessment (2011)
- Climate Change Adaptation Programme (SALGA 2012)
- Quantifying the costs of climate change impacts on local government assets (SALGA 2012b)
- Climate proofing Australia's infrastructure (NCCCARF 2013)

Relevant Council plans/strategies

Asset management strategies, water management plans, open space strategies, road management plans.

 TABLE 4.4: Infrastructure and assets regional risks

| Risk | | Risk Rating | | 5 |
|----------|---|-------------|--------|---------|
| ID | Regional Risk Description | Now | 2030 | 2055 |
| | Bushfire damage to assets | | | |
| | Increased loss or damage to buildings due to increased bushfire | | | |
| | activity leads to more financial costs of replacing, repairing and | | | |
| InR1 | maintaining building and plant machinery assets | High | High | Extreme |
| | Increased flood damage | | | |
| | Increased flood damage to Council assets such as roads, paths, | | | |
| | drains and buildings from increased intensity rainfall events leads | | | |
| | to increased maintenance and replacement costs and more | | | |
| InR2 | frequent inspections | Medium | High | Extreme |
| | Reduced asset lifespan | | | |
| | Reduced lifespan of Council assets such as buildings, roads, | | | |
| | footpaths from hotter drier conditions and more extreme | | | |
| | weather events leads to increased replacement costs and more | | | |
| InR3 | frequent inspections | Medium | High | Extreme |
| | Damage to underground infrastructure from soil movement | | | |
| | Accelerated deterioration of underground infrastructure such as | | | |
| | drains, pipes and building foundations due to decreased soil | | | |
| | moisture combined with extreme rainfall leads to loss of Council | | | |
| InR5 | service ability, reduced public safety and asset damage | Medium | High | High |
| | Machine and plant failure | | | |
| | Increased machine and plant failures due to increasing duration, | | | |
| | frequency and intensity of heatwaves leading to critical Council | | | |
| InR6 | service delivery disruptions and higher maintenance costs | Medium | High | High |
| | Damage to transport infrastructure | | | |
| | Increased deterioration of transport infrastructure such as roads, | | | |
| | bicycle networks, and paths from hotter drier conditions and | | | |
| | more extreme weather leads to higher maintenance and | | | |
| | replacement costs and reduced mobility and loss of Council | | | |
| InR7 | reputation | Medium | High | High |
| | Damage from power outages | | | |
| | More frequent brown and blackouts from increased energy | | | |
| | demand during more frequent heatwayes leads to damaged | | | |
| INK8 | assets and increased costs of repair and replacement | Medium | High | High |
| | Increasing costs of irrigation | | | |
| | Greater demand for irrigation for parks, reserves, sporting | | | |
| | grounds and open spaces due to reduced water availability leads | Maria | March | 1.12.1 |
| INR9 | to increased costs | Medium | Medium | High |
| | Increased costs of maintenance of open space | | | |
| | wore management interventions of open spaces such as sports | | | |
| | drier conditions loads to increased management costs and strain | | | |
| InR10 | on Council resources | Modium | High | High |
| 1 111/10 | וויייייייייייייייייייייייייייייייייייי | medium | TIUT | TIUI |

| | Reduced use of open spaces Changes to the health, appearance and use of sporting grounds, parks and reserves and open spaces due to hotter drier conditions and more extreme events leads to reduced amenity, reduced public safety and wellbeing and loss of council | | | |
|-------|--|--------|--------|------|
| InR12 | reputation | Medium | Medium | High |
| | Damage from fallen trees | | | |
| | Damage from falling trees on council or private land due to | | | |
| | increase in extreme wind and storm events, and drier hotter | | | |
| InR13 | conditions leads to reduced public safety and liability issues | Medium | Medium | High |
| | Increased costs for water management | | | |
| | Increased need for flushing stormwater drains, clearing buildup | | | |
| | of litter in drains, treating stormwater and importing water due | | | |
| | to prolonged drought conditions leads to increased costs and | | | |
| InR15 | management efforts | Medium | Medium | High |
| | Higher street tree mortality | | | |
| | Increase in street tree mortality from hotter drier conditions | | | |
| | leads to reduced amenity and increased heat island effect and | | | |
| InR19 | more regular maintenance and replacement | Medium | High | High |

4.5 Sustainability and Environment

The sustainability and environment theme includes areas such as biodiversity and weed management, sustainability, and environmental health. Many EAGA Councils have different divisions of these functions with some sustainability teams sitting within integrated planning teams and environmental management sitting within infrastructure and operations. As such there is some overlap between the responsibilities of these themes that should be considered.

Summary of key risks

The key risks faced by this theme are:

- Loss of biodiversity from changing climate and lack of knowledge of appropriate responses
- Loss of amenity and green areas and need for more intervention and maintenance
- Reduced air and water quality from increased bushfires, floods and droughts
- Increased fire management required to offset increased bushfire risk
- Reduced use of sustainable transport options during extreme weather
- Failure to meet energy consumption and greenhouse gas emissions targets due to increased cooling demands

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Bushland and Urban Biodiversity in a Changing Environment (EAGA 2013)
- Victorian Climate Change Adaptation Plan (DSE 2011)
- Climate change and potential distribution of weeds (DPI 2008)
- Climate Change in Port Phillip and Western Port (DSE 2008)
- Climate Change Victoria: The Science, Our People and the State of Play (CES 2012)
- Adapting ecosystems to climate change (NCCCARF 2013d)

Relevant Council plans/strategies

Sustainability strategies, greenhouse action plans, biodiversity and open space strategies.

TABLE 4.5: Sustainability and Environment Regional Risks

| | | | Risk Rating | 5 |
|---------|--|--------|--------------------|---------|
| Risk ID | Regional Risk Description | Now | 2055 | |
| | Loss of biodiversity from changing fire regimes | | | |
| | Changing fire regimes from hotter drier conditions leads to decline | | | |
| EnR1 | and loss of biodiversity and increased management efforts | Medium | High | Extreme |
| | Loss of biodiversity from hotter drier conditions | | | |
| | Hotter drier conditions lead to loss of biodiversity and increased | | | |
| EnR2 | environmental management costs | Medium | High | Extreme |
| | Public to private land bushfire risk | | | |
| | Greater management of interface between Council reserves and | | | |
| | private land due to increasing fire risk requires more resources and | | | |
| EnR3 | management efforts and potential loss of amenity | Medium | High | High |
| | Pollution from flooding events | | | |
| | Increase in pollution entering waterways and sewer inundation | | | |
| | following more intense rainfall events leads to public health issues | | | |
| EnR4 | and reduced amenity | Medium | High | High |
| | Failure to meet energy and GHG targets | | | |
| | Increased demand on electricity consumption from air conditioner | | | |
| | use due to hotter and drier conditions leads to leading to | | | |
| EnR5 | greenhouse targets not being met | Medium | High | High |
| | Erosion from intense rainfall | | | |
| | Greater erosion of creek banks, parks, drains due to increased | | | |
| | intensity of rainfall events leads to reduced public safety and | | | |
| EnR6 | reduced water quality | Medium | High | High |
| | Loss of amenity and green areas | | | |
| | Hotter drier conditions and more extreme weather leads to loss of | | | |
| | environmental amenity and aesthetic value of recreational parks, | | | |
| EnR7 | bushlands and natural areas | Low | Medium | High |
| | Contaminated water supplies from bushfire | | | |
| | Contaminated water supplies due to increasing bushfire activity | | | |
| | leads to public health issues and increased Council resource | | | |
| EnR8 | demand for water treatment and supply | Low | Medium | High |
| | Biodiversity loss from fire management | | | |
| | Requirement for larger fire breaks and more burning off due to | | | |
| | increased bushfire risk leads to impacts on biodiversity and | | | |
| EnR9 | reduced air quality | Medium | Medium | High |
| | Loss of environmental and cultural heritage | | | |
| | Increased maintenance, damage and loss to environmental and | | | |
| EnR10 | cultural heritage due to climatic events. | Medium | Medium | High |
| | Increase in weeds, pest animals and parasites | | | |
| | Increased temperatures causes a loss of vegetation leading to an | | | |
| EnR11 | infestation of pest animals, parasites and weeds | Medium | Medium | High |

| | Reduced water quality | | | |
|-------|---|--------|--------|--------|
| | Reduced average rainfall leads to less flushing events, drying out of | | | |
| | creek beds, and algal blooms in stagnant water bodies leading to | | | |
| EnR12 | public health issues and reduced amenity and habitat | Medium | Medium | High |
| | Lack of knowledge of biodiversity response to a changing climate | | | |
| | Lack of understanding of local flora and fauna species response to | | | |
| | climate change leads to failure to proactively manage for | | | |
| EnR13 | biodiversity under a changing climate | High | High | Medium |
| | Reduced use of sustainable transport in extreme weather | | | |
| | Greater use of cars over cycling, walking and public transport due | | | |
| | to an increase in the frequency of extreme weather and number of | | | |
| | hot days leads to reduced success of active living programs and | | | |
| EnR14 | increase in GHG emissions | Medium | High | High |

4.6 Emergency Management

The emergency management theme is the specific area of Council that deals with emergency preparedness, response and recovery. These units are often working closely with other regional actors such as the SES, the CFA, state government agencies such as Department of Environment and Primary Industries, Department of Justice, Department of Health and Melbourne Water. There is a lot of overlap between the areas of disaster risk reduction and climate change adaptation, however the focus of this report is on risks that climate change will exacerbate, more than existing emergency management risks.

Summary of key risks

The key risks faced by this theme are:

- Increased demand on Council emergency facilities and recovery resources
- Inadequate capacity of staff and plants to deal with more widespread regional events
- Recovery efforts impacted by multiple overlapping events occurring at once and longer standby periods
- More frequent, severe and widespread extreme events leads to greater loss of life
- Failure to communicate adequately to CALD and other vulnerable members of the community

Supporting key documentation/literature

The following reports/plans support the risks identified in the workshop and their associated ratings:

- Emergency risks in Victoria (DOJ 2014)
- Community engagement in the emergency management sector: Developing resilience to climate change (OESC 2012)
- State of the Climate (CSIRO and BOM 2014)
- Climate Change in Port Phillip and Western Port (DSE 2008)
- Climate Change Victoria: The Science, Our People and the State of Play (CES 2012)
- Emergency Management and Climate Change (NCCCARF Policy guidance brief no.10)
- Victorian Bushfire Risk Profiles: A foundational framework for strategic bushfire risk assessment (DEPI 2013)

Relevant Council plans/strategies

Municipal Emergency Management Plans, Heatwave plans, Health and Wellbeing plans, emergency communications strategies/plans.

| TABLE 4.6: Emergency | Management Reg | ional Risks |
|-----------------------------|-----------------------|-------------|
|-----------------------------|-----------------------|-------------|

| | | | Risk Rating | 5 |
|---------|--|--------|--------------------|---------|
| Risk ID | Regional Risk Description | Now | 2030 | 2055 |
| | Inadequate Council emergency facilities | | | |
| | Higher demand on Council emergency and recovery facilities to | | | |
| | cope with increasing frequency, severity and duration of extreme | | | |
| | weather events leads to reduced public safety and service | | | |
| EMR1 | delivery failure | Medium | High | Extreme |
| | Loss of life from more extreme bushfires | | | |
| | Increase in the severity, frequency and extent of wildfires in the | | | |
| | region leads to greater loss of lives and reduced public and staff | | | |
| EMR2 | safety | High | High | High |
| | Failure to communicate in extreme weather | | | |
| | Lack of adequate communication to community including CALD | | | |
| | community during heatwave events that do not activate | | | |
| | emergency management protocols leads to reduced public safety | | | |
| EMR3 | and loss of reputation | Medium | High | High |
| | Recovery hindered by multiple overlapping events | | | |
| | Multiple overlapping events such as bushfires, extreme rainfall | | | |
| | and heatwaves impact emergency management recovery efforts | | | |
| | including staff accessibility to resources/equipment, recruitment | | | |
| EMR5 | & training | Medium | Medium | High |
| | Inadequate capacity of staff/plant equipment | | | |
| | Inadequate capacity of staff/plant equipment to deal with | | | |
| | increasing frequency, severity and extent of extreme weather | | | |
| EMR6 | events | Medium | Medium | High |
| | Loss of services hinder EM response | | | |
| | Loss of services such as electricity, water and | | | |
| | telecommunications due to more extreme and widespread | | | |
| 51407 | emergency events compromises Council's ability to respond to | | | |
| EMIR7 | community needs | Medium | Medium | High |
| | Power outages increase demand on services | | | |
| | Power outages in municipality from storms, heatwaves and | | | |
| | bushfire events increase demand on Council emergency services | | | |
| EIVIR8 | and recovery | Medium | Medium | High |
| | Snared contractors unable to respond to widespread events | | | |
| | inadequate pool of EW response contractors shared between | | | |
| | avtrome events lead to loss of council ability to respond to | | | |
| ENADO | excreme events lead to loss of council ability to respond to | Modium | Madium | High |
| LIVING | energency events | Mealum | Mealum | nign |

5. Council preparedness to deal with Climate Change

5.1 Climate change and strategic risks across EAGA Councils

Prior to the workshops, the Adaptation Officer met with EAGA council representatives and risk managers to discuss existing treatment of climate change in risk management frameworks. Most of the Councils operate with a form of a higher level strategic risk register, and operational risk registers at different levels.

The following table highlights the number of Councils with climate change as a specific strategic risk at the time of writing. Many of the Councils have added climate change as a new strategic risk and are in the process of operationalising these risks. Other councils may have discussed climate change as a strategic risk within their executive but did not make the final shortlist.

| EAGA council | Strategic Climate Change Risk? | Comments |
|--------------|-----------------------------------|---|
| Whitehorse | Yes | Rated as a low residual risk |
| Boorondara | Yes | In the process of embedding operational risks across Council |
| Кпох | Yes | Described more generically around natural environmental changes with climate change in brackets |
| Stonnington | Yes | In 2009-2012 risk management strategy but currently being updated and reviewed |
| Yarra Ranges | N/A | Do not utilise a strategic risk register, an operational one only |
| Maroondah | Yes | Considered to be an emerging risk |
| Monash | Νο | Was considered in recent review but did not make the final priority list |

TABLE 5.1: EAGA Councils and climate change as strategic risks

It has been demonstrated by several Councils that having climate change as a key strategic risk can drive more proactive adaptation planning across Councils, and creates a stronger mandate for operationalising risks beyond the typical responsibilities of sustainability and environment teams. Given the breadth of climate risks to Councils and their associated likelihoods and consequences it is therefore a key recommendation of this report that all Councils that operate with a strategic risk register should strive to include climate change as a strategic risk.

Although having climate change as a strategic risk is important, the way it is rated and treated also differs across Councils. For example, in the case of Knox the risk is more generic around natural environmental changes "Failure to appropriately plan and respond to natural environmental changes e.g. Climate change, natural disaster, storm event etc".

Although climate change is listed as a strategic risk for some of the Councils, the rating of the risk does not always reflect the degree of the risk to Councils in terms of likelihood and consequence. Some of the Councils have identified climate change as a strategic risk yet considers the inherent consequence to be insignificant, and the residual rating of the risk to be low. This is unlikely to reflect the nature of the risk and the rating is unlikely to be harmonized with other risks.

5.2 Operational risks across EAGA Councils

Many climate change risks are not new risks to Councils and instead are exacerbated or multiplied by climate change. Interviews with Council employees demonstrated that most areas of Council can appreciate the tangibility of climate risks better when reflecting upon recent experiences of extreme weather events. Participants were asked in follow up interviews to recall recent extreme weather events and consider how well Council dealt with these events. They were then asked to consider how these risks may change if the frequency and severity of them increased, or if certain events happened at the same time. The majority of participants agreed that increasing extreme weather events would place greater strain and demand on Council services and facilities and saw the need for adaptation planning across Council.

Many of the existing operational risks relate to climate events; however they may not be explicitly described as a climate change risk. Although many of the controls that are in place may be considered adequate for current conditions, it is likely that the changes in likelihood and consequence of extreme events and hotter and drier conditions will require new or improved controls.

In many of the Councils, climate change sat as a discrete risk that was the responsibility of sustainability teams within Council to develop appropriate controls, often in the form of climate adaptation plans. However, some of the Councils such as Whitehorse and Boorondara have a much more diverse ownership of climate change risks across Council. This reflects that climate change is a relatively new area of risk for Councils to become familiar with, and through this regional risk assessment, it is hoped that capacity and understanding has increased in regards to the nature of climate change risks facing local government.

It is a key recommendation of this report that Councils adopt and integrate many of the risks contained in the risk registers contained in Appendix 1 into their operational risk registers. The experiences of Boorondara Council demonstrate that this is best done through conversations with the risk manager and Council staff, and preferably with a staff member with sufficient climate adaptation knowledge. It is important that Councils move away from considering climate change as a broad risk that sits within sustainability and environmental planning teams and instead divide the risks and responsibilities out in to the different service areas.

5.3 Council plans, strategies and policies

An important element of mainstreaming climate change in decision making across Councils is to consider how climate change fits into the multiple plans, strategies and policies Council develops. Embedding climate change adaptation into these plans, strategies and policies is a major

opportunity and a key goal of this regional adaptation project. Most of the EAGA Councils follow a similar integrated planning framework, with slight differences in the detail of timing and structure. Figure 5.1 shows the most typical structure of Councils in relation to strategic and operational planning.

Councils will often have a long term vision that may be out to 2020, 2030 or 2040 that is often based upon in depth community engagement and stakeholder analysis to set key long term strategic goals for the municipality. The next level down is the Council Plan that is often developed every 4-5 years and describes Council's objectives, its main activities and how these activities will be resourced. Another element of Council strategic planning is the long term financial plan, which is often reviewed alongside the Council Plan to ensure the objectives of the plan can be adequately resourced.

Many of the operational day-to-day Council decisions are guided by Council strategies, policies, action plans and management plans. These often focus on a particular issue and describe Council's position and priority projects to address that issue. Some strategies and plans are legislated requirements of local government such as the Health and Wellbeing Plans, and Municipal Strategic Statements.



Figure 5.1: Common Council integrated planning frameworks

Table 5.2 lists some of the most relevant existing plans and strategies across EAGA Councils that have some reference to climate change. Although Council plans and strategies may refer to climate change, however often response strategies are either quite vague or focused around mitigation and reducing greenhouse gas emissions. The next step for these plans is to broaden the responses to cover adaptation also.

| Council | Climate Change related plans or strategies |
|--------------|--|
| Maroondah | Council Plan 2013-2017 |
| | Community Wellbeing Plan |
| | Sustainability Strategy |
| | Municipal Emergency Management Plan |
| Yarra Ranges | Adapting to a changing climate and energy future plan |
| | Council Plan 2013-2017 |
| | Health and Wellbeing Strategy |
| | Municipal Emergency Management Plan |
| Knox | City Plan 2013-2017 |
| | Climate Change Response Plan |
| | Knox Sustainable Environment Strategy 2008-2018 |
| | Municipal Emergency Management Plan |
| | Knox Community Health and Wellbeing Strategy 2013-2017 |
| Whitehorse | Sustainability Strategy 2008-2013 |
| | Energy Action Plan 2009-2014 |
| | Whitehorse Climate Change Adaptation Plan 2011 |
| | Water Action Plan 2008-2013 |
| | Whitehorse Climate Change Risk Assessment Report 2009 |
| | Whitehorse Municipal Emergency Management Plan |
| | Council Plan 2014-2018 |
| | Municipal Public Health and Wellbeing Plan 2013-2017 |
| Monash | Health and Wellbeing Partnership Plan 2013-2017 |
| | Environmental Sustainability Road Map 2011-2015 |
| | Municipal Emergency Management Plan |
| Stonnington | Municipal Public Health and Wellbeing Plan 2013-2017 |
| | Municipal Emergency Management Plan |
| | Sustainable Environment Strategy 2013-2017 |
| | Council Plan 2013-2017 |
| Boroondara | Preparing for Climate Change in the City of Boroondara |
| | Our Low Carbon Future |
| | Boroondara Municipal Emergency Management Plan |
| | Municipal Public Health and Wellbeing Plan 2013-2017 |
| | Boroondara Council Plan 2013-2017 |

TABLE 5.2: Existing Council plans and strategies most relevant to climate change

It is also important to identify the best way to embed climate change into the various plans and policies and to consider the nature, geographic scale and timing of various climate change impacts. Table 5.2 describes the different time and geographic scales of climate change impacts in the EAGA region.

Table 5.3: Different time frames and geographic scales of climate change elements (adapted from LGAQLD 2007)

| Climate change element | Specific areas/locations vulnerable? | Sudden, extreme event | Gradual, long term change |
|---------------------------|--|--------------------------|------------------------------|
| Storms (& flooding) | Yes | ✓ | |
| Increasing temps | No | | \checkmark |
| Heat waves | Yes* | \checkmark | |
| Decreasing rainfall | No | | \checkmark |
| Bushfires | Yes | \checkmark | |

*Although heat waves are likely to affect the entire EAGA region at the same time, it is possible to identify particular areas of vulnerability based on heat island effects or socio-economic data

The following questions could be considered when reviewing plans and strategies:

- Does the plan or strategy need to consider climate change? Is it exposed to any of the risks in this report?
- If so, does the plan or strategy already consider climate change in detail?
- Are there specific actions beyond simply referring to the risk of climate change?
- Has the plan captured adaptation challenges as well as mitigation?
- Is there important overlap with other areas of Council that need to be better integrated?

Although it is beyond the scope of this project during this phase, a preliminary review of EAGA Council Health and Wellbeing plans showed that there is much diversity amongst Councils as to how climate change is integrated into these plans. This is an example of where some Councils could seek greater integration and collaboration with other areas of Council to achieve co benefits and knowledge sharing.

Addressing climate change risks across Council operations is likely to have many co-benefits and address many of the strategic goals of Council's longer term visions. This is evident in the state Health and Wellbeing plans, as it shows how climate adaptation strategies such as urban forest strategies, energy efficiency programs, and water sensitive urban design can have multiple benefits to health and wellbeing.

Key Recommendations

This regional risk assessment has considered risks to the EAGA Councils from climate change. The following are key recommendations for improvement of the treatment of climate change in Council risk management frameworks and decision making:

- 1. Climate change is an immediate risk to the eastern Councils threatening multiple core objectives of Council plans and long term visions and should be adopted as a key strategic risk.
- Councils should aim to diversify the responsibilities of climate change risk controls across Council service areas and seek to operationalise as many of the risks contained in this report using the ratings as a working guide
- Existing Council plans, strategies, policies and plans should be regularly reviewed to consider climate change adaptation to ensure greater consideration of climate risks across Council decision making
- 4. Councils should seek out opportunities to work with neighbouring Councils to reduce and share the risks through partnerships

Next Steps

This regional risk assessment is designed for the use of Council staff in the EAGA region working in adaptation such as sustainability officers, risk managers and others wishing to gain a better understanding of climate risks. It is also designed to meet the objectives of the second deliverable of the VASP funded Adaptation Roadmap project. However it is intended that the findings in this report are communicated in more accessible mediums in the next phase of the project, such as through a summary report or a series of online short films for each service area.

Addressing climate change risks across Council operations is likely to have many co-benefits and offer many positive opportunities to address the strategic goals of Council's longer term visions and Council plans. The next stage of the project is to develop a regional adaptation roadmap that identifies opportunities for regional response actions to address the key risk areas highlighted in this report. A series of regional workshops will be conducted bringing together Council staff for each of the key themes in this report.

Following the launch of the Adaptation Roadmap, the next phase of the project will be to develop monitoring and evaluation frameworks to track the progress of the project objectives in the next few years. These M&E frameworks will be ongoing to ensure the roadmap and adaptive responses can evolve over time with changing Council priorities.

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Appendix 1: Council climate risk registers

The following risk registers arose from the climate change risk workshops held at the 4 EAGA Councils; Maroondah, Monash, Knox and Stonnington. The remaining three EAGA Councils already had existing climate risk registers and so are not included here.

City of Stonnington Climate Risk Register

The following risks were identified in a workshop at Stonnington Council held on the 26th June 2014, and reviewed and revised by Rob Law, EAGA.

All risks were rated in the workshop, and then later reviewed and completed using the Stonnington Risk Management Framework, and considering residual risks after taking into account existing council controls and the future climate projections

Climate projections are based upon work completed by CSIRO for EAGA in 2013 for the eastern region of melbourne.

| Council | | | | | | | | | | |
|---------|---|-----|------------------------|------|------|--------|------|------|------|------|
| Dep. | Risk Description | L | Likelihood Consequence | | | Rating | | | | |
| | | Now | 2030 | 2055 | 2015 | 2030 | 2055 | 2015 | 2030 | 2055 |
| City | Increased asset deterioration from increased severity of rainfall events lead | | | | | | | | | |
| Works | to increased maintenance and life cycle costs | U | Р | L | М | Ma | м | М | н | н |
| City | Increased severity of rainfall events leads to damage to roads and footpaths | | | | | | | | | |
| Works | leading to reduced mobility | Р | Р | L | М | М | м | М | М | н |
| City | Reduced average rainfall leads to increased maintenance and life cycle costs | | | | | | | | | |
| Works | of open spaces such as sports grounds, parks etc. | Р | L | L | М | М | М | М | н | н |
| City | | | | | | | | | | |
| Works | Hotter drier conditions lead to loss of biodiversity | Р | L | L | М | М | Ma | М | Н | Е |

| City Works | Loss of public amenity value due to increased temperatures and drier conditions | U | Р | L | м | Ma | Ma | м | н | Е |
|---------------|--|---|---|---|----|----|----|---|---|---|
| City Works | Increased maintenance and costs for water management such as flushing stormwater drains, treating stormwater and importing water | Р | Р | L | М | м | м | м | м | н |
| City Works | Increased asset deterioration from increasing temperatures leading to increased costs of road and paths maintenance | Р | Р | L | М | м | м | м | М | Н |
| City Works | Increasing demand on energy in heatwaves leads to increased costs of operating technology such as air conditioning | Р | L | L | М | м | м | м | н | Н |
| City Works | Reduced water availability leads to increased reliance on irrigation for parks, reserves and sporting grounds leading to increased costs and reduced amenity | U | Ρ | L | Ma | Ma | Ma | м | н | Е |
| City Works | Drier conditions lead to more root damage to property leading to increased insurance claims and maintenance costs | U | Р | Р | М | м | м | м | м | м |
| City Works | Hotter drier conditions leads to deterioration of existing vegetation leading to increased costs for tree replacement and environmental management | U | Ρ | Ρ | М | м | Ma | м | м | н |
| City Works | Increased fire threat in bushland areas leads to increasing maintenance costs associated with fire prevention activities | U | Р | Р | М | м | м | м | М | М |
| City Works | Reduced water availability leads to loss of wetlands impacting upon habitat, wildlife and public amenity | U | U | Р | Ma | Ma | Ma | м | М | Н |
| City Works | Power outages in municipality from storm events increase demand on council emergency services and recovery | Р | Р | Р | М | м | Ma | м | М | Н |
| City Works | Increasing heatwaves lead to council machine and plant failures leading to disruption to council service delivery and operations | Р | L | L | М | м | Ma | м | н | E |
| City Works | Increased demand for emergency response due to increased bushfire danger from urban forests on yarra river fringe | U | U | Р | М | м | м | м | М | м |

| City Works | Reduced average rainfall leads to increased need for water storage/retention infrastructure leading to increased costs | Р | L | L | м | м | м | м | н | н |
|---------------|---|---|---|---|----|---|----|---|---|---|
| City | Increasing temperatures and reduced water availability lead to loss of street | P | P | 1 | м | м | м | м | м | L |
| City Works | Loss of biodiversity from hotter drier conditions | P | P | L | м | м | м | M | M | н |
| City Works | Inadequate flood infrastructure to cope with increased intensity of rainfall | Р | L | L | м | м | Ma | м | н | E |
| Corpora te | Increase in public liability claims relating to floods and storm damage | Р | Р | L | Mi | М | м | м | м | н |
| Corpora te | Increasing cost of fresh water reducing capacity to provide and deliver council services | U | Р | L | м | М | м | м | м | Н |
| Corpora te | Increase in liability claims relating to flooding and storm damage to private property from council assets | Р | L | L | м | м | м | м | н | Н |
| Corpora te | Loss of business continuity due to power outages in E weather events | Р | L | L | м | м | м | м | н | н |
| Corpora te | Increasing number of hot days and E heat policy lead to reduction in council productivity and increase in absenteeism | Р | L | L | м | м | м | м | н | н |
| Corpora te | Service delivery reduced due to OH&S policy of outdoor workers in E heat days | Р | L | L | м | м | м | м | н | н |
| Corpora te | Transport disruptions during heatwaves lead to loss of business continuity as staff cant attend work | Р | Р | L | м | м | м | м | м | н |
| Corpora te | Reduced council service delivery due to increased number of brown/black outs during heatwaves and E weather events | Р | L | L | м | м | м | м | н | н |
| Corpora te | Loss of paper based records and historical knowledge due to storm and flooding events | U | U | Р | м | м | м | м | м | М |

| Corpora | Change to insurance premiums due to increasing frequency and severity of E | | | | | | | | | |
|----------|---|---|---|---|---|---|----|---|---|---|
| te | weather events | Р | Р | L | М | Μ | М | М | М | Н |
| Planning | | | | | | | | | | |
| and | | | | | | | | | | |
| Develop | Increased costs of facility upgrades and maintenance to Cri council assets | | | | | | | | | |
| ment | from increasing temperatures and heatwaves | Р | Р | L | М | Μ | М | М | М | Н |
| Planning | | | | | | | | | | |
| and | | | | | | | | | | |
| Develop | Increasing emphasis on design solutions to capture and reuse water leading | | | | | | | | | |
| ment | to increasing capital costs | Р | Р | L | М | Μ | М | М | М | Н |
| Planning | | | | | | | | | | |
| and | | | | | | | | | | |
| Develop | | | | | | | | | | |
| ment | Inadequate building design for projected climate conditions | Р | Р | L | М | Μ | Ma | М | М | Е |
| Planning | | | | | | | | | | |
| and | | | | | | | | | | |
| Develop | | | | | | | | | | |
| ment | Building design and Her density leads to exacerbated heat island effect | Р | L | L | М | Μ | М | М | н | н |
| Planning | | | | | | | | | | |
| and | | | | | | | | | | |
| Develop | Heightened community anxiety over increased fire risk leading to E reactions | | | | | | | | | |
| ment | such as illegal vegetation clearing | Р | Р | L | М | М | М | М | М | н |
| Planning | | | | | | | | | | |
| and | Insufficient green assets/infrastructure (shaded areas, parking options etc.) | | | | | | | | | |
| Develop | to reduce heat island effect during increasing severity and frequency of | | | | | | | | | |
| ment | heatwaves | Р | Р | Р | М | М | м | М | М | М |
| Social | | | | | | | | | | |
| Develop | Reduced average rainfall leads to public health risks associated with | | | | | | | | | |
| ment | stagnant water bodies | U | Р | L | м | М | м | М | М | н |

| Social | | | | | | | | | | |
|----------|--|---|---|---|-----|-----|-----|---|---|---|
| Develop | Increasing heatwaves place greater demand on aged care/maternal | | | | | | | | | |
| ment | health/childcare services | Р | Р | L | М | Ma | Ma | М | н | Е |
| Social | | | | | | | | | | |
| Develop | Inadequate evacuation centres to deal with increasing heatwaves for | | | | | | | | | |
| ment | vulnerable people | Р | Р | L | М | Ma | Ma | М | н | Е |
| Social | | | | | | | | | | |
| Develop | HACC services unable to meet increased demand for service delivery to | | | | | | | | | |
| ment | vulnerable groups due to increased severity and frequency of heatwaves | U | Р | L | М | М | М | М | М | н |
| Social | | | | | | | | | | |
| Develop | Demand on animal welfare issues during E weather events leading to | | | | | | | | | |
| ment | increased call outs and rescues | U | Р | Р | М | М | М | М | М | М |
| Social | | | | | | | | | | |
| Develop | Increased demand on council facilities such as pools and libraries during | | | | | | | | | |
| ment | heatwave events | Р | L | L | М | М | Ma | М | Н | Е |
| Social | | | | | | | | | | |
| Develop | Increasing number of hot days reduce council meal delivery capacity | | | | | | | | | |
| ment | threatening vulnerable people and leading to more isolation | Р | Р | Р | м | М | М | М | М | М |
| Sustaina | | | | | | | | | | |
| ble | E weather events displaces residents increasing demand on council recovery | | | | | | | | | |
| Futures | centres | Р | Р | L | М | М | М | М | М | Н |
| Sustaina | | | | | | | | | | |
| ble | | | | | | | | | | |
| Futures | Increased severity of storms leads to reduced public safety | Р | Р | L | М | Ma | Ma | М | Н | Е |
| Sustaina | | | | | | | | | | |
| ble | Drought conditions reduce residents health and wellbeing due to reduced | | | | | | | | | |
| Futures | use of open spaces for social activity | U | Р | Р | М | М | М | М | М | М |
| Sustaina | Increasing temperatures and heatwaves lead to increased mortality in | | | | | | | | | |
| ble | vulnerable residents | Р | L | L | Cat | Cat | Cat | E | E | E |

| Futures | | | | | | | | | | |
|----------|--|---|---|---|----|----|----|---|---|---|
| | | | | | | | | | | |
| Sustaina | | | | | | | | | | |
| ble | Her temperatures increase incidence of food and water borne diseases | | | | | | | | | |
| Futures | placing greater demand on community health services | U | Р | Р | Μ | Μ | Ma | М | М | н |
| Sustaina | | | | | | | | | | |
| ble | Community connectedness and health and fitness reduced due to closure of | | | | | | | | | |
| Futures | sporting grounds in drier hotter conditions | U | Р | Р | Μ | М | М | М | М | М |
| Sustaina | | | | | | | | | | |
| ble | Increasing climate variation and heatwaves sees reduction in business | | | | | | | | | |
| Futures | activity impacting on regional economic development | Р | Р | Р | Μ | Ma | Ma | М | н | н |
| Sustaina | | | | | | | | | | |
| ble | Council inability to communicate effectively to all community (CAL, | | | | | | | | | |
| Futures | disability, aged etc.) during E weather events | Р | Р | Р | Ma | Ma | Ma | Н | н | Н |

Knox City Council Climate Change Risk Register

The following risks were identified in a workshop at Knox Council held on the 22nd May 2014, and reviewed and revised by Rob Law, EAGA.

All risks were rated in the workshop, and then later reviewed and completed using the Knox Risk Management Framework, and considering residual risks after taking into account existing council controls and the future climate projections

Climate projections are based upon work completed by CSIRO for EAGA in 2013 for the eastern region of melbourne.

| | | | I | Residual | risk ratin | g after ex | kisting co | ntrols | | |
|------------|------------------|--|-----------|----------|------------|------------|------------|--------|--------|------|
| Council | | | Likelihoo | d | Co | onsequen | ce | | Rating | |
| Department | Risk Description | Now 2030 2055 2015 2030 2055 2015 2030 | | | | | | | | 2055 |

| | Inadequate community safe areas during bushfires, | | | | | | | | | |
|------------------|--|------|----|----|----|----|----|---|---|---|
| City development | heatwaves and E events due to increased demand | Р | Р | L | М | М | Ma | М | М | н |
| | Lack of available drinking water and increasing water | | | | | | | | | |
| City development | restrictions due to reduced average rainfall | Р | Р | AC | М | Ma | М | М | н | н |
| | Increasing bushfire activity leading to health issues | | | | | | | | | |
| City development | such as asthma and anxiety in the community | Р | L | L | Mi | М | М | L | М | М |
| City development | Loss of lives due to increased bushfire activity | Р | Р | Р | Ma | Ma | Ma | н | н | н |
| | Food security issues due to rising costs of fresh food | | | | | | | | | |
| City development | due to reduced water availability | Р | Р | L | Mi | М | М | L | М | М |
| | Drought conditions reduce air quality from | | | | | | | | | |
| City development | increasing levels of dust | U | Р | Р | Mi | М | М | L | М | М |
| | Risk that scale of impacts may be on multiple | | | | | | | | | |
| | localities requiring widespread response and | | | | | | | | | |
| City development | reduced capacity | U | Р | L | Mi | М | Ma | L | М | Н |
| | Local economic impact on businesses that heavily | | | | | | | | | |
| City development | rely on water availability | Р | Р | Р | М | М | Ma | М | М | Н |
| | Bushfire activity contaminating water supplies | | | | | | | | | |
| | leading to health issues and increased council | | | | | | | | | |
| City development | resource demand for water treatment and supply | Р | L | AC | Mi | М | Ma | L | М | Н |
| | Impact on access to isolated communities due to | | | | | | | | | |
| City development | flooding | Rare | U | Р | Μ | М | М | L | М | М |
| Community | Increased intensity of weather events lead to | | | | | | | | | |
| services | heightened community anxiety over safety | U | Р | L | Μ | М | М | M | М | М |
| | Increasing demand on electricity leading to more | | | | | | | | | |
| Community | brown and blackouts leading to safety issue for | | | | | | | | | |
| services | vulnerable people | Р | L | L | М | М | М | M | М | М |
| Community | Mortality increased in vulnerable communities due | | | | | | | | | |
| services | to increasing number of heatwaves | Р | L | AC | Ma | Ma | Ma | Н | Н | Н |
| Community | Increasing number of hot days has detrimental | L | AC | AC | Ma | Ma | Ma | Н | Н | Н |

| services | impact on community and staff wellbeing | | | | | | | | | |
|-------------|--|---|---|----|----|----|----|---|---|---|
| Community | Operational costs of bringing in water from other | | | | | | | | | |
| services | regions to meet demand | U | Р | Р | Mi | М | М | L | М | М |
| | Risk of loss of reputation due to lack of planning and | | | | | | | | | |
| Corporate | appropriate resourcing for addressing climate | | | | | | | | | |
| development | change impacts | U | Р | L | Mi | Μ | Ma | L | М | Н |
| | Loss of business continuity and service delivery due | | | | | | | | | |
| Corporate | to black/brown outs from E weather events and | | | | | | | | | |
| development | heatwaves | Р | L | AC | Ma | Ma | Ma | Н | н | Н |
| Corporate | Risk of increased accidents for council staff from | | | | | | | | | |
| development | flooding and E weather | Р | L | AC | М | Μ | Μ | М | М | н |
| Corporate | Inadequate capacity of staff/plant equipment to deal | | | | | | | | | |
| development | with increasing E events | Р | L | AC | Ma | Ma | Ma | н | н | Н |
| Corporate | Risk of reducing service levels due to funding being | | | | | | | | | |
| development | directed to recovery | Р | Р | L | М | Μ | Ma | М | М | Н |
| Corporate | Resource drain due to staff involved in emergency | | | | | | | | | |
| development | management activities | Р | L | AC | М | М | М | М | М | н |
| Corporate | Economic impact of loss of business and council | | | | | | | | | |
| development | services restricted from increasing E weather events | Р | Р | L | М | Μ | Μ | М | М | М |
| Corporate | Increasing temperatures place more demand on | | | | | | | | | |
| development | energy leading to increased energy costs | L | L | AC | М | Ma | Ma | М | н | Н |
| | Increased OH&S risks with council staff working in | | | | | | | | | |
| Corporate | Her temperatures including mental stress and | | | | | | | | | |
| development | fatigue | Р | Р | L | М | Μ | Μ | М | М | М |

| | Inability to retain volunteer staff during heatwave | | | | | | | | | |
|-----------------|--|----|----|----|-----|-----|-----|---|---|---|
| Corporate | conditions impacting on continuity of service | | | | | | | | | |
| development | delivery | Р | L | AC | Cri | Cri | Cri | н | E | E |
| Corporate | Ler council productivity due to road closures from | | | | | | | | | |
| development | increased bushfire activity | U | Р | Р | М | М | М | М | М | М |
| | Failure to build in budget contigency to cover | | | | | | | | | |
| Corporate | environmental events and other emergency events | | | | | | | | | |
| development | that are increasing | U | Р | Р | М | М | Ma | М | М | н |
| Corporate | Public health and safety and liability issues from Her | | | | | | | | | |
| development | risks of limbfall and tree dieback | AC | AC | AC | Neg | Mi | М | М | М | н |
| Engineering and | Current building design standards not adequate for | | | | | | | | | |
| Infrastructure | projected climate conditions | Р | L | AC | Ma | Ma | Cri | н | н | Е |
| Engineering and | | | | | | | | | | |
| Infrastructure | Insufficient cooling strategies for buildings | Р | L | AC | Ma | Ma | Ma | н | н | н |
| Engineering and | E weather events leads to property/assets damage | | | | | | | | | |
| Infrastructure | leading to increased maintenance and life cycle costs | Р | L | AC | М | Ma | Ma | М | н | н |
| Engineering and | Inadequate infrastructure to deal with increasing | | | | | | | | | |
| Infrastructure | rainfall events | Р | Р | L | М | Ma | Ma | М | н | н |
| Engineering and | Increasing demand on electricity leading to more | | | | | | | | | |
| Infrastructure | brown and blackouts leading to damaged assets | Р | L | L | М | М | М | М | М | М |
| | Increasing temperatures leading to increased | | | | | | | | | |
| Engineering and | damage of infrastructure leading to more frequent | | | | | | | | | |
| Infrastructure | replacement costs | Р | Р | L | Μ | М | Ma | М | М | н |
| Engineering and | Increased bushfire risks lead to damage to | | | | | | | | | |
| Infrastructure | assets/infrastructure | Р | L | AC | Ma | Ma | Ma | н | Н | н |
| Engineering and | Decreased soil moisture leading to accelerated | | | | | | | | | |
| Infrastructure | deterioriation of buildings, roads, footpaths | Р | L | L | М | Μ | М | М | М | М |
| Engineering and | Cracked service connections such as broken water or | | | | | | | | | |
| Infrastructure | gas pipelines due to drought conditions | U | Р | Р | Ma | Ma | Ma | М | Н | Н |

| Engineering and | Loss of amenity to community due to damage to | | | | | | | | | |
|-----------------|--|----|----|----|----|-----|-----|---|---|---|
| Infrastructure | natural and built assets from drought conditions | U | Р | L | Mi | М | М | L | М | М |
| Engineering and | Impact of fallen trees/branches in storm events on | | | | | | | | | |
| Infrastructure | property and people | L | L | AC | М | М | M | М | М | н |
| Engineering and | Loss of use of public open space due to flooding and | | | | | | | | | |
| Infrastructure | storm damage | Р | Р | L | М | М | Ma | М | М | н |
| Engineering and | Erosion and damage to sensitive environmental | | | | | | | | | |
| Infrastructure | areas | Р | Р | L | М | М | Ma | М | М | н |
| | Increasing temperatures lead to increased loss of | | | | | | | | | |
| Engineering and | vegetation and changes to composition leading to | | | | | | | | | |
| Infrastructure | loss of biodiversity and amenity | U | L | AC | Ma | Ma | Ma | М | Н | н |
| | Increasing hard surfaces from decreased rainfall on | | | | | | | | | |
| Engineering and | sports grounds poses public safety risks, increased | | | | | | | | | |
| Infrastructure | maintenance costs and Ler patronage | Р | L | L | Ma | Ma | Ma | Н | Н | н |
| Engineering and | Increased bushfire risks lead to damage to bushland | | | | | | | | | |
| Infrastructure | reserves | Р | L | L | М | М | Μ | М | М | М |
| | Changing fire regimes leading to loss and decline in | | | | | | | | | |
| Engineering and | biodiversity leading to increased management | | | | | | | | | |
| Infrastructure | efforts | AC | AC | AC | Ma | Cri | Cri | Н | Е | E |
| Engineering and | Risk of liability issues from bushfires spreading from | | | | | | | | | |
| Infrastructure | reserves to private properties | Р | Р | L | Ma | Ma | Ma | Н | Н | Н |
| Engineering and | | | | | | | | | | |
| Infrastructure | Change to use of parks due to drought conditions | U | Р | L | Mi | М | М | L | М | М |
| Engineering and | Increasing costs of irrigation for parks to combat | | | | | | | | | |
| Infrastructure | reduced average rainfall | U | Р | L | М | М | Ma | М | М | Н |
| Engineering and | More plant and tree mortality from drought requires | | | | | | | | | |
| Infrastructure | more maintenance, removal works | Р | L | L | М | Ma | Ma | М | Н | Н |

Monash City Council Climate Change Risk Register

The following risks were identified in a workshop at Monash Council held on the 26th May 2014, and reviewed and revised by Rob Law, EAGA.

All risks were rated in the workshop, and then later reviewed and completed using the Monash Risk Management Framework, and considering residual risks after taking into account existing council controls and the future climate projections

Climate projections are based upon work completed by CSIRO for EAGA in 2013 for the eastern region of melbourne.

| Council | | Likelihood | | | | | | | | | |
|--------------|---|------------|----------|------|------|---------|------|------|--------|------|--|
| Department | Risk Description | Ľ | ikelihoo | d | Co | nsequer | nce | | Rating | ļ | |
| | | Now | 2030 | 2055 | 2015 | 2030 | 2055 | 2015 | 2030 | 2055 | |
| City | Reduced water availability leads to increased costs of fresh food | | | | | | | | | | |
| development | leading to reduced regional food security | U | Р | Р | М | Μ | Ma | М | М | Н | |
| City | Her temperatures increasing incidence of food and water-borne | | | | | | | | | | |
| development | diseases | U | Р | Р | М | Μ | Ma | М | М | Н | |
| City | Reduced potable water availability leads to increased costs | | | | | | | | | | |
| development | from importing water | U | Р | Р | Mi | М | М | М | М | М | |
| City | Current building design standards not adequate for projected | | | | | | | | | | |
| development | climate conditions | Р | Р | L | М | М | М | М | М | н | |
| Community | | | | | | | | | | | |
| development | E weather events lead to displaced communities straining | | | | | | | | | | |
| and services | council services and refuge centres | Р | Р | L | М | М | Ma | М | М | н | |
| Community | | | | | | | | | | | |
| development | Mortality increased in vulnerable communities due to | | | | | | | | | | |
| and services | increasing number of heatwaves | Р | L | L | Cat | Cat | Cat | Е | Е | Е | |
| Community | | | | | | | | | | | |
| development | Increasing number of hot days has detrimental impact on | | | | | | | | | | |
| and services | community and staff wellbeing | Р | Р | L | М | М | Ma | М | М | Н | |

| Community | | | | | | | | | | |
|--------------|---|---|----|---|-----|-----|-----|---|---|---|
| development | Increasing number of heatwaves places greater strain on | | | | | | | | | |
| and services | medical system and need for council assistance | Р | Р | L | М | М | Ma | М | М | Н |
| Community | | | | | | | | | | |
| development | More Extreme weather events and climate variation impacting | | | | | | | | | |
| and services | on viability of local business and industries | Р | Р | L | М | Ma | Ma | M | Н | Н |
| Community | | | | | | | | | | |
| development | Hotter drier conditions lead to increase in dust storms leading | | | | | | | | | |
| and services | to public health issues | U | Р | Р | М | М | М | M | М | М |
| Community | | | | | | | | | | |
| development | | | | | | | | | | |
| and services | Financial costs associated with prolonged drought conditions | U | Р | L | М | М | М | M | М | Н |
| Community | | | | | | | | | | |
| development | More heatwaves lead to greater risks to vulnerable people of | | | | | | | | | |
| and services | heatstroke and loss of life | Р | L | С | Cat | Cat | Cat | E | E | E |
| Community | | | | | | | | | | |
| development | Inadequate council facilities for the elderly and the young in | | | | | | | | | |
| and services | bushfires, heatwaves and Extreme weather | U | Р | L | М | Ma | М | M | H | Н |
| Community | | | | | | | | | | |
| development | Reduced regional productivity employment due to impacts of | | | | | | | | | |
| and services | climate change | U | Р | Р | М | М | Ma | M | M | Н |
| Community | | | | | | | | | | |
| development | | | _ | | | | | | | |
| and services | Limited water for swimming pools and greater evaporation | U | Р | L | М | М | М | M | M | Н |
| Community | | | | | | | | | | |
| development | Outdoor pools pose greater health issue from sunstroke with | | | - | | | | | | |
| and services | increasing hot days | U | U | Р | Mi | М | М | M | M | М |
| Community | | | | | | | | | | |
| development | Greater demand placed on council pools and air conditioned | | Ι. | ~ | | | | | | |
| and services | buildings leading to safety and resource issues | P | L | C | IVI | IVI | IVI | M | H | H |

| Community | | | | | | | | | | |
|----------------|--|---|---|---|-----|-----|-----|---|---|---|
| development | Increase in allergies and asthma attacks associated with dust | | | | | | | | | |
| and services | and pollen during grass cutting or constructing fire breaks | U | Р | Р | Mi | М | М | М | М | М |
| | E storm events increase damage to council property and | | | | | | | | | |
| | infrastructure resulting in public safety issues and injury or | | | | | | | | | |
| Corporate | death | Р | Р | L | Ma | Ma | Cat | Н | Н | E |
| | E storm events increase damage to council assets resulting in | | | | | | | | | |
| Corporate | reduced public amenity and loss of reputation | Р | Р | L | Mi | М | М | М | М | н |
| | Increased intensity of Extreme weather events leads to | | | | | | | | | |
| Corporate | increased anxiety over community safety and loss of reputation | U | Р | Р | Mi | М | Ma | М | М | н |
| | Increased council vehicle accidents from more Extreme weather | | | | | | | | | |
| Corporate | events | U | Р | Р | Mi | Mi | Mi | М | М | М |
| | Increased Extreme weather leads to reduced public safety and | | | | | | | | | |
| Corporate | risks of injury or death to council staff and community | Р | Р | L | Cat | Cat | Cat | Е | E | Е |
| | Greater demand on council resources from more frequent | | | | | | | | | |
| Corporate | Extreme weather events leads to loss of business continuity | Р | L | С | М | Ma | Cat | М | Н | E |
| | Increased bushfire danger leads to more loss of life of council | | | | | | | | | |
| Corporate | staff and community | U | Р | L | Cat | Cat | Cat | Н | E | E |
| | Increasing temperatures and droughts impact on health and | | | | | | | | | |
| Corporate | wellbeing of staff and residents | Р | Р | L | М | Ma | Ma | М | Н | Н |
| | Financial exposure to increased running costs of cooling council | | | | | | | | | |
| Corporate | buildings | Р | L | L | М | М | М | М | Н | Н |
| | Reduced council service delivery due to council staff supporting | | | | | | | | | |
| Corporate | another council emergency event | U | Р | Р | М | М | М | М | М | М |
| | Transport and energy disruptions reduce council staff ability to | | | | | | | | | |
| Corporate | come to work | Р | Р | L | М | М | М | М | М | Н |
| | Future liability from failure to account for climate change | | | | | | | | | |
| Corporate | properly in council planning | Р | Р | Р | Μ | М | Ma | М | М | Н |
| | E storm events increase damage to council property and | | | | | | | | | |
| Infrastructure | infrastructure resulting in increased maintenance and life cycle | Р | Р | L | М | Ma | Ma | М | н | н |

| | costs | | | | | | | | | |
|----------------|---|---|---|---|----|----|----|---|---|---|
| | Inadequate flood infrastructure and drain size to deal with | | | | | | | | | |
| Infrastructure | increasing intensity of rainfall events | Р | Р | L | Mi | м | М | М | М | н |
| | Increased toxin concentrations/pollution entering waterways | | | | | | | | | |
| Infrastructure | folLing intense rainfall events leading to reduced water quality | U | Р | L | Mi | М | М | М | М | н |
| | Damage to creek ecosystems as a result of increased | | | | | | | | | |
| Infrastructure | H fL rates and greater erosion from more intense rainfall events | Р | Р | L | Mi | М | М | М | М | н |
| | Increased weed spread from flooding events lead to increased | | | | | | | | | |
| Infrastructure | costs of weed management and revegetation | U | Р | Р | М | М | М | М | М | М |
| | Increased Extreme weather leads to more road closures | | | | | | | | | |
| | reducing council service delivery and restricting mobility of | | | | | | | | | |
| Infrastructure | goods and people | U | U | Р | Mi | М | Μ | М | М | М |
| | Damage to Cri assets and services due to Extreme weather | | | | | | | | | |
| Infrastructure | events | U | U | Р | М | М | Ma | М | М | Н |
| | Increased intensity of rainfall events leads to damage to roads, | | | | | | | | | |
| | paths and drainage infrastructure leading to increasing | | | | | | | | | |
| Infrastructure | maintenance and life cycle costs | Р | Р | L | Mi | М | М | M | М | Н |
| | Inadequate council resources (staff/plant) to react to increasing | | | | | | | | | |
| Infrastructure | Extreme weather events and post recovery | U | Р | L | М | Ma | Ma | M | Н | Н |
| | Legislative breaches relating to electrical line clearance from | | | | | | | | | |
| Infrastructure | falling trees induced by droughts and Extreme weather | U | Р | Р | Mi | Mi | М | M | М | М |
| | Hardening of surfaces as erosion response leads to perverse | | | | | | | | | |
| | outcome of increased speed of water entering creeks increasing | | | | | | | | | |
| Infrastructure | erosion | U | Р | Р | М | М | Ma | M | М | Н |
| | Increasing temperatures lead to increased loss of vegetation | | | | | | | | | |
| | and changes to composition leading to loss of biodiversity and | | | | | | | | | |
| Infrastructure | amenity | U | Р | Р | Ma | Ma | Ma | Н | Н | Н |
| | Drier, hotter conditions decrease soil moisture increasing | | | | | | | | | |
| Infrastructure | damage to road surfaces, footpaths and drains | Р | Р | L | Mi | М | M | М | Μ | Н |

| | Increasing demand on electricity leading to more brown and | | | | | | | | | |
|----------------|--|---|---|----|----|----|-----|---|-----|---|
| Infrastructure | blackouts leading to damaged assets and service disruptions | Р | Р | L | М | М | Ma | М | М | н |
| | Damage to transport and built infrastructure due to increased | | | | | | | | | |
| | temperatures and heatwaves leading to Her maintenance and | | | | | | | | | |
| Infrastructure | replacement costs | Р | Р | L | Mi | М | Ma | М | М | Н |
| Infrastructure | Changing fire regimes lead to long term loss of biodiversity | Р | Р | L | М | Ma | Ma | М | н | н |
| | Inadequate council resources to respond to more Extreme fire | | | | | | | | | |
| Infrastructure | danger days | Р | Р | L | М | М | Ma | М | М | Н |
| | Increased loss of private assets due to bushfires leads to strain | | | | | | | | | |
| Infrastructure | on council support resources | U | U | Р | Mi | М | М | М | М | М |
| | Increased bushfire danger leads to more losses or damage to | | | | | | | | | |
| Infrastructure | key council building and infrastructure | Р | Р | L | Ma | Ma | Cat | Н | Н | E |
| | Increased demand on council service provision and shelters | | | | | | | | | |
| Infrastructure | from increasing bushfires | Р | Р | L | М | М | М | М | М | Н |
| | Lack of adequate communication and management of | | | | | | | | | |
| Infrastructure | community in Extreme weather events | U | Р | Р | М | Ma | Ma | М | Н | Н |
| | More Extreme wildfires and planned burning lead to more local | | | | | | | | | |
| Infrastructure | carbon emissions | Р | Р | Р | М | М | М | М | М | М |
| | Hotter drier conditions lead to loss of biodiversity and increased | | | | | | | | | |
| Infrastructure | environmental management costs | Р | L | С | М | Ma | Ma | М | H | E |
| | Hotter drier conditions change animal and insect species | | | | | | | | | |
| Infrastructure | leading to loss of biodiversity and increase in invasive species | U | Р | Р | М | М | М | М | M | М |
| | Reduced water availability leads to greater demand on water | | | | | | | | | |
| Infrastructure | resources and water reuse infrastructure | U | Р | L | М | Ma | Ma | М | H | Н |
| | Poorer water quality due to hotter drier conditions and reduced | | | | | | | | | |
| Infrastructure | rainfall flushing events | U | Р | L | М | М | М | М | M | Н |
| | Reduced water quality and quantity results in less | | | | | | | | | |
| | watering/irrigation of open space and sports grounds leading to | | | 1. | | | | | | |
| Infrastructure | loss of amenity and oval closures | U | L | L | M | M | M | М | H , | H |

| | Hotter drier conditions lead to increased need for more regular | | | | | | | | | |
|----------------|--|---|---|---|----|----|----|---|---|---|
| Infrastructure | cleaning of council assets | U | Р | L | Mi | Mi | М | М | М | н |
| | Hotter drier conditions leads to increased maintenance of | | | | | | | | | |
| Infrastructure | drainage infrastructure | U | Р | L | М | М | М | М | М | Н |
| | Reduced water availability leads to hardening of sporting | | | | | | | | | |
| Infrastructure | grounds leading to increased risk of injury | U | Р | L | М | М | М | М | М | Н |
| Infrastructure | Inadequate water supply | U | Р | L | М | М | Ma | М | М | н |
| | Greater probability of tree limb fall due to hotter drier | | | | | | | | | |
| Infrastructure | conditions and more Extreme weather | Р | Р | L | М | М | М | М | М | Н |
| | Loss of cultural and environmental heritage from more E, | | | | | | | | | |
| Infrastructure | frequent bushfires | Р | Р | Р | М | М | Ma | М | М | Н |
| | Increasing temperatures mean less people walk and cycle, | | | | | | | | | |
| Infrastructure | leading to more reliance on cars affecting transport | U | Р | Р | М | М | М | М | М | М |
| | Greater fire risk on public land leads to damage to private | | | | | | | | | |
| Infrastructure | assets and risk of liability | U | Р | Р | М | М | Ma | M | М | Н |
| | Loss of regionally significant biodiversity in valley reserve from | | | | | | | | | |
| Infrastructure | repeated fire events | Р | Р | L | Ma | Ma | Ma | Н | Н | Н |
| | Increased costs for environmental mangement from replacing | | | | | | | | | |
| Infrastructure | vegetation | U | Р | L | М | М | М | М | М | Н |
| | Cost in variation in landscaping design and drought tolerant | | | | | | | | | |
| Infrastructure | plant species as a result of drought conditions | Р | Р | Р | М | М | М | М | М | М |
| | Reduced water leads to increase in algal blooms, drying out of | | _ | | | | | | | |
| Infrastructure | creek beds | U | Р | L | М | М | М | М | М | Н |
| | Increase in street tree mortality leading to reduced amenity and | | | | | | | | | |
| Infrastructure | increased heat island effect | U | L | L | М | М | М | Μ | Н | Н |
| | Increased demand on emergency response and recovery | | | | | | | | | |
| Infrastructure | operations | Р | L | C | М | M | М | Μ | Н | Н |
| | Lack of collaboration between neighbouring upstream councils | | | | | | | | | |
| Infrastructure | In flood plone areas leads to increased flood damage | U | Р | P | M | M | M | M | M | M |

Maroondah City Council Climate Risk Register

The following risks were identified in a workshop at Maroondah Council held on the 10th June 2014, and reviewed and revised by Rob Law, EAGA. Further refining occurred through interviews with participants carried out by Lynn Hebblethwaite in July and August.

All risks were rated in the workshop, and then later reviewed and completed using the Maroondah Risk Management Framework, and considering residual risks after taking into account existing council controls and the future climate projections

Climate projections are based upon work completed by CSIRO for EAGA in 2013 for the eastern region of Melbourne.

| | | Likelih | lood | | Consequence | | | Residual risk rating | | |
|--------------|--|---------|------|------|-------------|------|------|----------------------|------|------|
| Council work | | | | | | | | | | |
| area | Risk Description | Now | 2030 | 2055 | Now | 2030 | 2055 | Now | 2030 | 2055 |
| | Changing weather events increasing exposure to | | | | | | | | | |
| Risk | Council Property Insurance Program (Claims, | | | | | | | | | |
| Management | administration and premiums) | L | L | L | М | М | Ma | Н | н | E |
| | Council unable to meet increased demand on council | | | | | | | | | |
| Operations | services during E weather events | L | L | С | М | М | Ma | н | н | Е |
| | Increased bushfire danger leads to more losses or | | | | | | | | | |
| Assets | damage to council building and infrastructure | L | L | L | Ma | Ma | Ma | Е | Е | Е |
| | Council emergency and recovery facilities unable to | | | | | | | | | |
| Emergency | cope with increased frequency and severity of E | | | | | | | | | |
| Management | weather events | Р | L | С | М | М | Ma | н | н | E |
| | More E bushfires lead to loss of biodiversity and long | | | | | | | | | |
| Bushland & | term recovery impacts requiring more management | | | | | | | | | |
| Planning | interventions | U | Р | Р | Ma | Ma | Ma | н | Е | Е |
| | Increased risk of chemical contamination and loss of | | | | | | | | | |
| | industrial assets in bayswater north precinct due to | | | | | | | | | |
| Planning | increased bushfires | U | U | U | Ma | Ma | Ma | Н | н | н |

| | Her fire risk leads to requirement for larger fire breaks | | | | | | | | | |
|--------------|---|---|---|---|----|----|----|---|---|---|
| Bushland & | and more burning off leading to impacts on | | | | | | | | | |
| Planning | biodiversity and reduced air quality | Р | L | L | Mi | Mi | M | М | М | н |
| | More bushfire danger days lead to more council staff | | | | | | | | | |
| Finance & | working on emergency response disrupting business | | | | | | | | | |
| Governance | continuity | Р | L | L | М | М | Ma | н | н | E |
| | Weeds favoured due to drier and hotter conditions | | | | | | | | | |
| Bushland, | increasing competion against native species | Р | Р | L | Mi | М | М | М | н | н |
| Emergency | Loss of public assets during bushfires reduce councils | | | | | | | | | |
| Management | ability to service community | U | U | Р | М | М | М | М | м | н |
| | Increased resources required to manage and mitigate | | | | | | | | | |
| | increasing frequency of climate events reduce other | | | | | | | | | |
| Finance | areas of council service delivery | Р | L | С | Mi | М | Ma | М | н | E |
| Emergency | Lack of adequate communication to community | | | | | | | | | |
| Management | during E weather events | Р | Р | Р | М | М | М | н | н | н |
| | Changing weather events increasing exposure to | | | | | | | | | |
| Risk | Council Liability Insurance Program (Claims, | | | | | | | | | |
| Management | administration and premiums). | L | L | L | М | М | Ma | н | н | E |
| | More E climate conditions and weather events | | | | | | | | | |
| | damage Council and community infrastructure | | | | | | | | | |
| | increasing maintenance and operating costs and | | | | | | | | | |
| Assets | reduce asset lifespans and degradation | Р | L | L | М | Ma | Ma | н | Е | E |
| Openspace, | | | | | | | | | | |
| Operations, | Increased intensity of rainfall events leads to greater | | | | | | | | | |
| Assets, | erosion of creek banks, parks, drains leading to | | | | | | | | | |
| Planning | reduced public safety and reduced water quality | Р | Р | L | Mi | Mi | М | М | М | н |
| Engineering, | | | | | | | | | | |
| Assets, | Damage to road and drain infrastructure due to | | | | | | | | | |
| Operations | increased intensity of rainfall events | Р | Р | Р | Mi | М | Μ | М | н | Н |
| | | | | | | | 1 | | | |

| | Openspace & | waterways folLing intense rainfall events | | | | | | | | | |
|---|----------------|--|---|---|---|----|----|----|---|---|---|
| ļ | Sustainability | | | | | | | | | | |
| | | Increased weed spread from flooding events lead to | | | | | | | | | |
| | | increased costs of weed management and | | | | | | | | | |
| | Operations | revegetation | Р | Р | Р | М | М | М | Н | Н | Н |
| | | Human health issues as a result of sewer inundation | | | | | | | | | |
| | Public Health | from more intense rainfall events | U | U | U | М | М | Μ | М | М | М |
| ſ | | Potential increase in water borne viruses from | | | | | | | | | |
| | Public Health | pollution due to flooding. | U | Р | Р | М | М | M | М | н | н |
| ſ | | Severe rainfall events overwhelm existing drains and | | | | | | | | | |
| | Engineering, | retarding basins causing overfL events, localised | | | | | | | | | |
| | Assets, | flooding, damage to infrastructure and environmental | | | | | | | | | |
| | Operations | contamination. | Р | L | С | М | Ma | Ma | н | E | E |
| ĺ | Leisure | Increased intensity of rainfall events leads to | | | | | | | | | |
| | Services | increased management and closure of sports grounds | U | U | U | In | Mi | Mi | L | L | L |
| ſ | | Increased E weather events leads to more damaged | | | | | | | | | |
| | | and fallen trees posing risk to safety, loss of services | | | | | | | | | |
| | Operations | and increased maintenance costs | Р | L | L | М | Ma | Ma | н | E | Е |
| ĺ | Human | Increased physical injuries to council staff from E | | | | | | | | | |
| | Resources | weather events | Р | Р | Р | М | М | Ma | н | н | E |
| ĺ | Building | | | | | | | | | | |
| | Services & | Change to building and planning requirements due to | | | | | | | | | |
| | Planning | increased frequency and severity of E events | Р | Р | L | In | Mi | М | L | М | н |
| ĺ | Operations, | Increased cost of clean up and recovery from | | | | | | | | | |
| | Finance | increased frequency and severity of E weather events | L | L | L | Mi | М | Ma | М | н | Е |
| ĺ | Strategic | | | | | | | | | | |
| | Planning & | Future liability from failure to account for climate | | | | | | | | | |
| | Sustainability | change in planning | U | U | U | Mi | М | М | L | М | М |
| İ | | Increased infrastructure costs of alternative water | | | | | | | | | |
| | Operations | supply to deal with reduced water availability | U | Р | Р | Mi | Mi | М | L | М | н |

| | Hotter and drier conditions leads to loss of | | | | | | | | | |
|----------------|---|---|---|---|----|----|----|---|---|---|
| Bushland & | biodiversity reducing amenity and environmental | | | | | | | | | |
| openspace | values | Р | Р | L | Ma | Ma | Ma | E | E | E |
| Community | Reduced water availability leads to reduced regional | | | | | | | | | |
| Planning | food security | U | U | Р | М | Ma | Ma | м | н | E |
| | Reduced water availability leads to increased water | | | | | | | | | |
| Community | and fresh food costs leading to broad economic | | | | | | | | | |
| Planning | impacts on community | U | Р | Р | М | М | Ma | M | н | E |
| | Reduced soil moisture levels lead to increase soil | | | | | | | | | |
| | movement damaging underground infrastructure such | | | | | | | | | |
| Assets | as drains and building foundations | U | Р | Р | Mi | М | М | L | н | Н |
| Leisure | Drier and hotter conditions lead to increased | | | | | | | | | |
| Services, | hardening of sports grounds leads to Her rate of | | | | | | | | | |
| Operations | injuries | L | L | С | Mi | Mi | Mi | M | М | Н |
| | Reduced water availability leads to greater demand | | | | | | | | | |
| Finance | for and costs of irrigation | Р | L | L | М | М | М | Н | Н | Н |
| Sustainability | Inadequate alternative water supply for community | | | | | | | | | |
| & | and community concerns over water reuse and | | | | | | | | | |
| Engineering | storage | U | Р | Р | М | М | М | M | Н | Н |
| Public health | Increase in dust storms leading to public health issues | U | Р | L | М | М | М | М | н | н |
| | Lack of cleaning, flushing effect of waterways and | | | | | | | | | |
| Operations | roads due to reduced rainfall | Р | Р | L | Mi | М | М | M | н | Н |
| | Her fire risk requires greater management of interface | | | | | | | | | |
| Planning | between council reserves and private land | Р | Р | L | Mi | М | М | M | Н | Н |
| | Reduced water availability leads to Her tree mortality | | | | | | | | | |
| Operations & | and reduction in biodiversity leading to tree failure | | | | | | | | | |
| openspace | and less green areas | Р | L | L | М | М | М | н | Н | Н |
| | Damage to transport infrastructure during heatwaves | | | | | | | | | |
| | leading to Her maintenance and replacement costs | | | | | | | | | |
| Engineering | and mobility issues | Р | Р | Р | M | М | м | н | н | Н |

| | Increasing number of heatwaves impacts on | | | | | | | | | | |
|----------------|--|---|---|---|----|----|----|---|---|---|--|
| | community leading to greater council demand on | | | | | | | | | | |
| Public Health | support services | Р | L | L | М | Ma | Ma | н | E | Е | |
| | Increasing temperatures leads to increased energy | | | | | | | | | | |
| | demand from cooling leading to Her financial costs | | | | | | | | | | |
| Sustainability | and GHG emissions | Р | L | L | Ma | Ma | Ma | Е | E | E | |
| Community | Power and communication outages during heatwaves | | | | | | | | | | |
| Services | leads to loss of council service ability | Р | Р | Р | М | М | Ma | н | н | E | |
| | Increasing temperatures lead to loss of biodiversity | | | | | | | | | | |
| Operations | and increased environmental management costs | Р | L | L | М | М | Ma | н | н | E | |
| Community | Reduced council services during heatwave events | | | | | | | | | | |
| Planning and | pose health risks to vulnerable members of | | | | | | | | | | |
| Services | community | Р | Р | Р | М | М | Ma | н | н | Е | |
| | Heatwaves place greater demand on council | | | | | | | | | | |
| Ma Leisure | swimming pools posing risks to staff and public safety | Р | Р | L | М | Ma | Ma | н | E | E | |
| Strategic | | | | | | | | | | | |
| Planning & | Her energy costs lead to reduced disposable income | | | | | | | | | | |
| Sustainability | leading to regional economic sLdown | U | Р | Р | М | М | М | M | H | Н | |
| | Current building design standards not adequate for | | | | | | | | | | |
| Planning | projected climate conditions | Р | L | L | Mi | М | Ma | M | H | E | |
| | Risk of mortality to vulnerable members of | | | | | | | | | | |
| Public Health | community during heatwaves | Р | Р | L | Ma | Ma | Ma | Е | E | E | |
| Community | | | | | | | | | | | |
| Planning and | Increasing temperatures and hot days reduce mental | | | | | | | | | | |
| Services | wellbeing in community | Р | L | L | Mi | Μ | М | M | H | Н | |
| | Increased odour and amenity complaints to council | | | | | | | | | | |
| Public Health | due to rising temperatures and drier conditions | Р | Р | Р | In | In | In | L | L | L | |
| Finance & | Transport disruptions during E weather events lead to | | | | | | | | | | |
| Governance | reduced staff able to attend work | Р | Р | Р | Mi | М | М | M | Н | Н | |
| Community | Hotter weather leading to greater likelihood of | Р | P | | м | м | м | н | н | н | |

| Health | congregation of people leading to pandemics | | | | | | | | | |
|----------|--|---|---|---|----|----|----|---|---|---|
| Services | | | | | | | | | | |
| | Temperature increases leading to changes in pest | | | | | | | | | |
| Bushland | visitation ranges | U | U | Р | Ma | Ma | Ma | Н | Н | Е |