

CLIMATE-READY VICTORIA

VICTORIA



How climate change will affect Victoria and how you can be climate-ready

Victoria has already become warmer and drier – a climate trend likely to continue into the future. Local residents, businesses and communities are changing the way they do things in response. Getting climate-ready involves understanding how climate change is likely to affect you and working out ways to adapt. Everyone can contribute to Victoria's climate-ready future.

VICTORIA HAS BEEN GETTING WARMER AND DRIER. IN THE FUTURE THE STATE CAN EXPECT:



temperatures to continue to increase year round



more hot days and warm spells



fewer frosts



less rainfall in winter and spring south of the Divide; less rainfall in autumn, winter and spring north of the Divide



more frequent and more intense downpours



harsher fire weather and longer fire seasons



rising sea level



warmer and more acidic oceans



increased frequency and height of extreme sea level events

HOW WILL THESE CHANGES AFFECT YOU, AND WHAT CAN YOU DO ABOUT THEM?

This publication highlights the impacts climate change will have on Victoria. It gives examples of how people are already becoming climate-ready, with links to more detailed information.

While this publication is about adapting to climate change, reducing your carbon emissions by reducing energy use and switching to renewable energy sources is also important in getting climate-ready. For more information on reducing your emissions, visit www.climatechange.vic.gov.au.

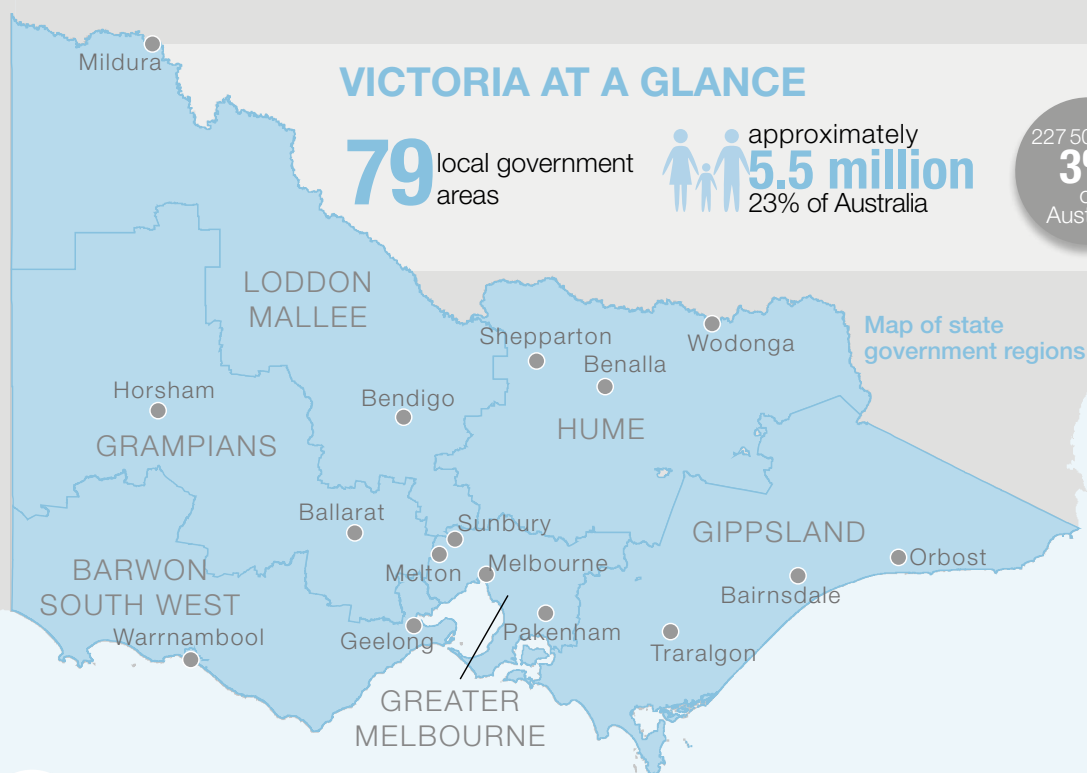
OUR CHANGING CLIMATE

VICTORIA AT A GLANCE

79 local government areas

approximately **5.5 million**
23% of Australia

227 504 km²
3%
of Australia



RECENT CLIMATE

Victoria experiences a wide range of climatic conditions. These range from the hot summers of the northern Loddon Mallee to the winter snow storms of the alpine areas in Hume and Gippsland, and from the relatively dry wheat belt of the Loddon Mallee and the Grampians to the wet elevated areas of Gippsland.

For more information about some of the drivers of Victoria's climate, visit the [Climatedogs website](#).

CLIMATE VARIABILITY AND CHANGE

Our climate varies – it always has and always will. This climate variability means that some periods are cooler and wetter than average (as was the case in the 1970s), while others are hotter and drier (such as during the Millennium Drought). However, due to climate change, the long-term average is changing. Future climate will be different from that in the past.

IT'S GETTING WARMER AND DRIER

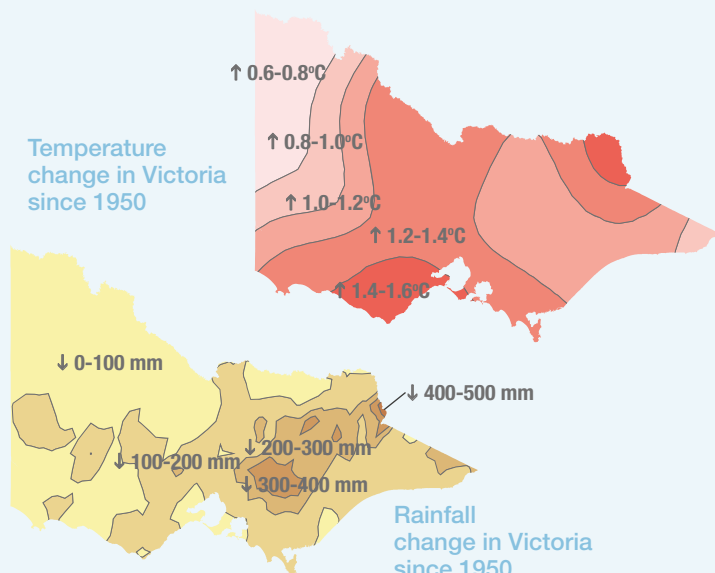
Over the past 100 years, global surface air temperatures have risen by almost 1°C. Both the atmosphere and the oceans have warmed. Human activity is causing climate change through our release of greenhouse gases from the burning of fossil fuels, land use change and agriculture. Atmospheric concentrations of carbon dioxide are now more than 40% higher than they were before industrialisation.

In Victoria, the rate of warming has increased since 1960.

On average, rainfall has declined since the 1950s, especially in autumn. The harsh Millennium Drought (1996 to 2009) followed the wet decades of the 1950s and 1970s.

Sea level today is approximately 225 mm higher than in 1880.

Temperature change in Victoria since 1950



HOW DO WE GET CLIMATE-READY?

Being climate-ready in Victoria involves knowing the climate risks and impacts for the state, and making changes so that we can take advantage of the opportunities and reduce the negative impacts.

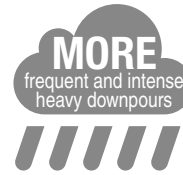
VICTORIA'S CLIMATE RISKS



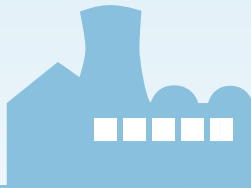
MORE
days of
extreme heat



HARSHER
fire weather



GETTING CLIMATE-READY AT A GLANCE



	Primary production	Infrastructure	Tourism	Health and community	Environment
KEY CLIMATE RISKS	<ul style="list-style-type: none"> ↓ rainfall ↑ temperature ↑ hot days ↑ fire weather 	<ul style="list-style-type: none"> ↑ sea level ↑ fire weather ↑ flooding ↑ hot days ↑ heatwaves ↑ storm surges 	<ul style="list-style-type: none"> ↑ temperature ↑ sea level ↑ fire weather ↑ heatwaves ↓ snow cover 	<ul style="list-style-type: none"> ↑ heatwaves ↑ flooding ↑ fire weather ↑ solar radiation 	<ul style="list-style-type: none"> ↓ rainfall ↑ fire weather ↑ hot days ↑ sea level ↑ ocean acidification
POTENTIAL IMPACTS	<ul style="list-style-type: none"> Earlier flowering and planting times Reduced water security Changed distribution of pests and diseases Farm business affected by bushfire 	<ul style="list-style-type: none"> Increased flood damage Increased maintenance costs Increased disruption to services 	<ul style="list-style-type: none"> Increased threats to tourism infrastructure Damage to popular environmental sites Risks to tourists unfamiliar with conditions 	<ul style="list-style-type: none"> More stress on health and emergency services More heat-related deaths, particularly among the elderly and disadvantaged Mental health effects Changes in disease occurrence 	<ul style="list-style-type: none"> Amplification of existing threats to flora and fauna Changes to habitat Altered disturbance regimes Contraction of alpine ecosystems Changing dynamics of invasive species
CLIMATE-READY ACTIONS	<ul style="list-style-type: none"> Consider enterprise diversification Establish shelter belts to increase shade, e.g. for dairy cows Diversify feed and fodder sources Consider different crop varieties and sowing times Plan for a secure water supply Regularly access long and medium range outlooks, as well as short range weather forecasts Re-sow pastures with varieties that account for changing rainfall patterns 	<ul style="list-style-type: none"> Insure public assets Consider future climate when locating new infrastructure Consider heat resilience in transport upgrades Increase road heights Increase stormwater capacity Adopt water sensitive urban design solutions Diversify sources of power and water, including decentralised technologies 	<ul style="list-style-type: none"> Communicate risk to visitors Implement emergency planning for tourist sites Adopt appropriate cancellation policies Undertake business continuity planning Multi-skill staff Diversify activity offerings Consider enterprise diversification Prepare for changing seasonal demand 	<ul style="list-style-type: none"> Use cost-effective pedestal fans in heatwaves Use existing social networks to support vulnerable community members Implement/use rural mental health care programs Undertake emergency planning for schools, hospitals, services Increase green spaces and cool zones for heat stress Conduct awareness campaigns Implement monitoring and response plans for new vectors of communicable diseases 	<ul style="list-style-type: none"> Target new and emerging diseases and pests Increase green urban infrastructure and urban biodiversity Link habitats to allow species to move Consider moving selected populations to new areas

GETTING CLIMATE-READY

HOW CLIMATE-READY ARE YOU?

Getting climate-ready is an ongoing process, and there's no single recipe for success. Many of the risks we face are not new. However, there are likely to be changes in duration, frequency and severity of some weather events, as well as changes to the climate.

To determine what's important to you and what climate change responses might work for your situation, consider these questions:

- ▶ How might you – your health, property, business, community, industry – be affected by:
 - higher temperatures and more frequent heatwaves?
 - less cool season rainfall, more time in drought, decreased water availability or flooding?
 - sea level rise, increased height of extreme sea level events and coastal erosion?
 - harsher fire weather?
- ▶ How might your services, suppliers, clients or customers be affected?
- ▶ Are you making any long-term decisions now that will be impacted by future climate change?
- ▶ What action could you take now to prepare? What are others in your region doing? What benefits have they experienced?
- ▶ Can you prioritise actions that also have other benefits, such as emissions reduction, financial, community or environmental advantages?
- ▶ Does climate change present any opportunities you can take advantage of?


The information, case studies and links in this brochure can help get you started.



CLIMATE-READY NOW

Victorians have always been good at managing the ups and downs of climate. Now that we have a clearer picture of the way in which climate is likely to change in future, there's lots that we can do to become climate-ready. Decisions we make now will affect how well we cope with the changing climate, which in turn will affect future economic and employment conditions. Decisions range from simple to complex, and some will need to be made sooner than others. Your decisions may depend on the local climate in your part of the state.



There are many good examples of communities in Victoria preparing for and adapting to climate change. The  links you directly to the source or visit www.climatechange.vic.gov.au for a full list of links.



PRIMARY PRODUCTION

Victoria is Australia's largest producer of mutton, lamb and dairy products. Other important products include wool, beef, grain and fodder crops, and fruit and vegetables.

Higher temperatures causing increased potential evaporation and reduced humidity will contribute to drier conditions, while fewer rain-days will increase the incidence of drought. Although the intensity of rainfall is expected to rise in most seasons, lower soil moisture may affect the sector.

Horticulture and vegetable production is highly sensitive to reduced water availability, and changes in temperature will alter planting and harvesting times. Intensive animal industries will need to provide increased protection for stock from extreme temperatures. While the total annual number of frost days is expected to decrease, an increase in spring frosts is possible, especially over the next decade or so.



Climate Kelpie is a 'one-stop shop' for climate risk management information and tools for Australian farmers and farm advisors. It is a portal to the best available tools and information about climate to help farmers make business decisions. The portal is regularly updated with new links to credible and relevant tools and information.



The Managing Climate Variability Climate Champion Program aims to help farmers manage climate risk by providing the best climate tools, products, practices and seasonal outlooks, and an understanding of their use.





INFRASTRUCTURE

Victoria has a complex matrix of road and rail transport networks. Melbourne has a large international airport, with numerous regional airports throughout the state. The Port of Melbourne is the largest and busiest container port in Australia.

Brown-coal-fired power stations in the Latrobe Valley provide the majority of the state's electricity. The Thomson Dam, located in Gippsland, near Mount Baw Baw, is Victoria's largest reservoir.

Transport infrastructure will be increasingly exposed to periodic flooding and increased heat loading. Long hot spells will weaken road surfaces and exposure to extreme heat events could result in road rutting and cracking, and bridge expansion joint cracking.

Sea level rise in coastal communities will be an increasing challenge.



The Goulburn-Murray Water Connections Project is creating a stronger, more sustainable, future for irrigation agriculture across the Goulburn-Murray Irrigation District. Victoria and the Commonwealth are investing more than \$2 billion to create a network that delivers water when and where it's needed.



The Port Fairy Local Coastal Hazard Assessment is providing a detailed assessment of sea level rise impacts on the community and developing a comprehensive response plan.



TOURISM

Victoria features iconic natural attractions such as the Twelve Apostles, Gippsland Lakes, Grampians, Dandenong Ranges, Australian Alps and Wilsons Promontory. Melbourne's myriad attractions include shops, restaurants, museums, theatres, sports stadiums, parks and zoos.

The impacts of climate change on tourism in Victoria are likely to include increased heatwaves, harsher fire weather and flooding risk, which may threaten tourism infrastructure and damage popular environmental sites. Significant reductions in stream flows will adversely affect water-based tourism. In the warmer climate, alpine areas are likely to experience shorter snow seasons and decreased natural snow cover. Conversely, areas relying on a warmer climate may experience longer tourism seasons.



Mount Baw Baw has worked to develop the resort as a year-round destination to counter the effects of a reduced snow season. 'Green season' activities such as cycling (including new mountain bike trails), bushwalking, disc golf, trail running and special events are promoted and have seen increased visitor numbers in summer.



HEALTH AND COMMUNITY

Around 5.5 million people live in Victoria, with more than 70% of the population living in Melbourne.

Increased hot days and heatwaves will exacerbate existing health risks, putting greater pressure on hospitals and emergency services. Vulnerable groups may need assistance to manage the impacts of climate change. More frequent extreme weather events and impacts on the economy and jobs due to climate change may affect the mental health of the community.



The Hobsons Bay Heat Health Response Plan supports people most vulnerable to heatwaves. It describes the way in which council departments, community groups and state government agencies can work together during dangerous extreme heat events.



The Millennium Drought (1996–2009) had a major impact on the farming sector. In response, the Western District Health Service established the Sustainable Farm Families Program. The objective was to improve mental wellbeing and encourage sustainable and balanced farming lifestyles.



ENVIRONMENT

Victoria's land area supports a wide range of ecosystems: alpine, mallee, grasslands and grassy woodlands, forests, heathlands and heathy woodlands, inland waters and estuaries, and coasts. These ecosystems are home to many thousands of species of plants and animals, some of which are found nowhere else in the world.

More frequent and more intense extreme rainfall events may lead to increased periodic flooding. Conversely, increases in demand for water, and warmer conditions will make protecting the state's world-class wetlands and surrounding environments a priority.

Victoria is home to many species and ecological communities that are at risk, including the state's faunal emblems: the Leadbeater's Possum and Helmeted Honeyeater. The impacts of climate change, such as alterations to habitat and water availability and harsher fire weather, are likely to increase pressure on already threatened species and communities.



Victoria's Catchment Management Authorities are developing climate change adaptation plans to provide further information about the impacts of climate change on natural resources. The plans will also identify priority actions for adaptation and mitigation and will be available in 2016.

FUTURE CLIMATE

LOOKING AHEAD

Climate projections for Victoria are based on sophisticated national and international **global climate models**. These models use the physical laws that govern the way the world's climate works to simulate the climate from high in the atmosphere to the depths of the oceans. The models run on some of the world's most powerful supercomputers, and successfully represent the important features of today's climate as well as those of past climate.

Maths and physics do not govern social and economic aspects of the future, so we don't know the impacts of population, the economy, policy decisions and technology on greenhouse gas emissions. To cover a range of possibilities, scientists use **emissions scenarios** called Representative Concentration Pathways (RCPs) to develop climate projections. These projections describe a **high emissions** future (using RCP8.5) and a **lower emissions** future (using RCP4.5). For the past 10 years we've tracked along the high emissions pathway. More information about how the projections were produced and guidance on their application are at climatechangeinaustralia.gov.au.

The climate is projected to continue to change over the coming century. The projections are given for **20-year periods centred on 2030 and 2070**, so the 2030 projections are for the period 2020–2039 and the 2070 projections are for the period 2060–2079. Given the similarity of the emissions scenarios up to 2030, only projections for the high emissions scenario for 2030 are used in this publication. Projections are represented as a change relative to the period 1986–2005.

CONFIDENCE IN THE PROJECTIONS

Our confidence in the projections is based on a combination of scientific understanding, past climate changes, evaluation of climate model performance and the extent of climate model agreement. Very high confidence indicates robust evidence and high model agreement.

very high confidence ****
high confidence ***
medium confidence **



TEMPERATURE

Average temperatures will continue to increase in all seasons ****

For the near future (2030), the annually averaged warming is projected to range from around 0.6 to 1.2°C in Barwon South West to 0.6 to 1.3°C in Loddon Mallee above the climate of 1986–2005. By the year 2070, the projected range of warming is 1.1 to 2.9°C in Barwon South West to 1.2 to 3.3°C in Loddon Mallee, depending on future emissions.

There will be more hot days and warm spells ****

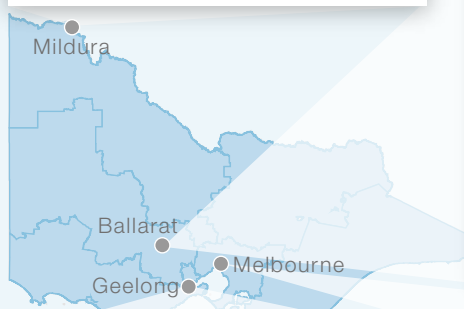
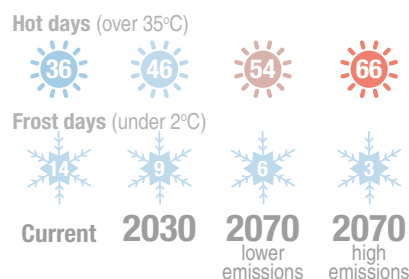
Extreme temperatures are likely to increase at a similar rate to average temperature. There will be a substantial increase in the temperature reached on hot days. There will be more hot days (greater than 35°C), and warm spells will last longer.

There will be fewer frosts ***

The number of frost-risk days will decrease throughout Victoria, with some areas more affected than others.

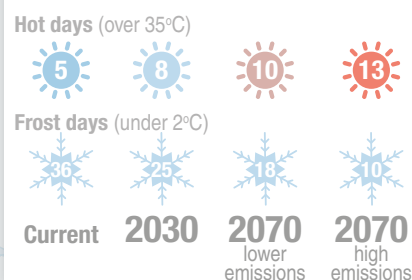
FUTURE CLIMATE MILDURA

Average number of days per year



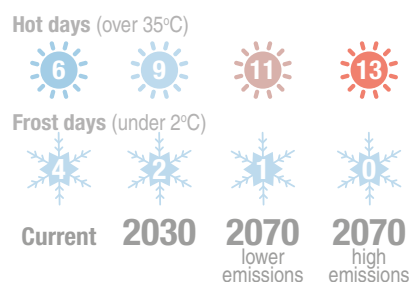
FUTURE CLIMATE BALLARAT

Average number of days per year



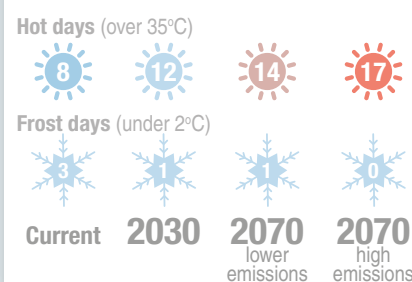
FUTURE CLIMATE GEELONG

Average number of days per year



FUTURE CLIMATE MELBOURNE

Average number of days per year





RAINFALL

Natural climate variability will dominate any projected changes in the near future ***

In the near future (2030), year to year changes in rainfall will dominate trends caused by greenhouse gases. Recent research partly links the observed cool season rainfall reductions to climate change.

Frequency and intensity of extreme rainfall events are projected to rise ***

Despite an overall trend of declining rainfall, more of the rain that does fall will be in increasingly extreme downpours. This is likely to lead to an increase in the incidence of flooding events, particularly in urbanised and small catchments.

Time spent in drought is projected to increase over the course of the century **



Barwon South West, Greater Melbourne and Gippsland regions

There is projected to be less rainfall in winter and spring ***

By the middle of the century, and under high emissions, winter rainfall reductions will become evident against natural variability.

Changes to summer and autumn rainfall are possible but not clear, although there is a tendency for a decrease in autumn.



Grampians, Loddon Mallee and Hume regions

By 2070 there is projected to be less rainfall in the cool season * but no rainfall changes in the warm season ****

Overall, rainfall is likely to decrease, with the greatest decreases expected in spring and winter.

Conditions outside these projections are also possible, from either natural variability (such as extended drought) or climate changes that are outside the range we currently estimate.



MARINE AND COAST

Sea level will continue to rise ****

By 2030 the projected sea level rise for studied coastal locations is 0.08 to 0.20 m above the 1986–2005 level.

By 2070, sea level is projected to rise 0.20 to 0.48 m at studied coastal locations under lower emissions and 0.25 to 0.59 m under high emissions. However, depending how much the Antarctic ice sheet melts, these levels may be higher.

Height of extreme sea level events will also increase ****

The ocean will get warmer and more acidic ****

Sea surface temperature is projected to increase in the range of 1.1 to 2.5°C by 2070 under high emissions. The sea will also become more acidic, with acidification proportional to emissions growth.



FIRE WEATHER

Fire weather is projected to be harsher in the future ***

Fire weather is a measure of fuel dryness and hot, dry, windy conditions. An increase in frequency of very high and extreme fire danger days is projected.

More detailed information on these and other climate variables is available at www.climatechange.vic.gov.au



VICTORIA 2050

In 2050, under high emissions, the climate of Melbourne will be more like Adelaide now; Hamilton and Colac will be more like Melbourne; Bendigo will be more like Shepparton; Shepparton will be more like Griffith; and Wangaratta and Benalla will be more like Dubbo.

To find out what the climate will be like in the future where you live, use the Climate Analogues tool on the Climate Change in Australia website at www.climatechangeinaustralia.gov.au.

The tool matches projected rainfall and maximum temperature with the current climate experienced in another location for 20-year periods centred on 2030, 2050 and 2090.



ARE YOU CLIMATE-READY?

There are many resources available to help you get climate-ready.

A full list of links to projects mentioned in this brochure is available at www.climatechange.vic.gov.au.

There are similar brochures for Victoria's regions, available at www.climatechange.vic.gov.au.

To find out more about what the Victorian Government is doing to make the state more climate-ready, or for more information about Victorian Government climate policy, visit www.climatechange.vic.gov.au.

Information about the impacts of climate change on water availability and supply is available from the Victorian Climate Initiative website at www.cawcr.gov.au/projects/vicci/.

Information about the changes in our climate since the beginning of last century and trends we're seeing now is available from the Bureau of Meteorology website at www.bom.gov.au.

Information about the future climate and its impacts, and adaptation strategies, is available from the Climate Change in Australia website, produced by CSIRO and the Bureau of Meteorology, at www.climatechangeinaustralia.gov.au.

Climate-ready Victoria: Victoria. November 2015.

Climate change projections in this publication have been generated by CSIRO on behalf of the Victorian Government, and are based on national projections released by CSIRO and the Bureau of Meteorology. The Bureau of Meteorology has kindly supplied data on climatic trends. CSIRO has reviewed this publication.

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Photo credits: Rob Blackburn, Baw Baw Shire Council, City of Greater Geelong

