



VICTORIA'S FUTURE ENVIRONMENT

PROTECTING OUR FUTURE ENVIRONMENT IN A CHANGING CLIMATE

EPA Victoria
40 City Road, Southbank
Victoria 3006

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SUMMARY

Climate change is one of the biggest challenges to Victoria's environment, economy and society. Recognising the importance of this challenge, EPA Victoria has made tackling climate change a corporate objective. This makes sure that we consider the issue of climate change, and our response to it, in our planning and decisions.

Changes in some environmental systems are likely to be unavoidable as a result of climate change. In some cases we will have to rethink what can be protected. Where possible and practical, we need to strengthen the ability of our environment to withstand climate change by reducing stresses on it. Reducing emissions of greenhouse gases and pollution, protecting at-risk ecosystems and species, and appropriately managing the use of environmental resources are examples of what we can do to make our environment more resilient.

We are already seeing how a changing climate can affect what we value in our environment. Ongoing drought conditions have been associated with increased bushfires, reduced air and water quality, and affected ecosystem health, productivity and recreational opportunities.

Responses to climate change are also likely to impact our environment. Examples include the following:

- The use of alternative water sources and strategies to reduce greenhouse gases such as carbon capture and storage need to be managed properly to protect human and environmental health.
- Decentralised energy generation and use of alternative fuels for transport could change the location of air pollution emissions and their composition.

Projections for Victoria include:

- higher temperatures and more hot spells
- less rainfall but more rainfall intensity
- less run-off in almost all areas
- more frequent, longer-lasting droughts
- greater risk of bushfires
- rising sea levels.

In this report we present the findings of the first stage of our research to understand how climate change will impact the way we protect the environment.

Building on research that is being conducted at the state, national and international level, we reviewed the scientific literature, held expert workshops involving Victorian government agencies and leading researchers, and applied our scientific expertise to build a picture of what the impacts on our environment might be in light of climate change projections for Victoria.

We present these impacts here for each of the following environments:

- **Air** – Summer smog, smoke from bushfires and prescribed burning, and windblown dust are likely to increase.
- **Freshwater** – Declining water quantity and quality and the loss of some aquatic systems is leading to a decline and the potential loss of aquatic species.
- **Groundwater** – The impacts are hard to identify because of the long lag times between changes on the surface and impacts on groundwater quality. The most significant impacts are likely to be from increased extraction of groundwater and use of aquifers for water storage.
- **Marine** – Warming oceans, increasing acidity and changing ocean currents and wind patterns off Victoria's coast could lead to changed distribution patterns and decline and loss of some marine species.

While the weight of scientific evidence tells us that our climate is changing, there are still many gaps in our knowledge about the environmental consequences of climate change. As new information arises we will continue to refine our assessment and our strategies.



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HOW WE CONDUCTED THIS RESEARCH

The information we present in this report is based on our review of the literature, discussions at a number of workshops, and preliminary studies, carried out by EPA in partnership with the Monash Sustainability Institute.

We reviewed the current state, national and international scientific literature on the impacts of climate change on aquatic ecosystems and the air environment.

We hosted workshops with Victorian and Australian experts on groundwater, freshwater, marine and air environments.

See Appendix A for a list of organisations that participated in the workshops.

CLIMATE CHANGE PROJECTIONS FOR VICTORIA

Temperature, rainfall and run-off

Victoria's Department of Sustainability and Environment (DSE 2008) has commissioned a range of studies to better understand our likely future environment. Projected changes to 2030 include:

- average annual temperatures increasing by 0.6–1.2 °C in most areas
- more hot days and hot spells when temperatures are high for three to five days in a row
- rainfall decreasing by up to nine per cent, with the greatest decreases in spring and winter
- evaporation increasing by one to five per cent
- A slight increase in rainfall intensity. A one-in-130-year storm event may become a one-in-100-year event (Howe et al. 2005). The largest increases in rainfall intensity are projected along the coastline of Southern Victoria and west of Melbourne (Abbs et al. 2006).
- run-off decreasing by up to 30 per cent in north-east catchments, by five to 45 per cent in north-west catchments and by five to 40 per cent in south-west catchments. East Gippsland is the only catchment that may experience an increase in run-off. Note that the reduction in rainfall to date has resulted in reductions in run-off in parts of the State greater than the current projections for 2030.
- droughts becoming more frequent and lasting longer.

These projections are relative to the period 1980–99.

Bushfires

Victoria is expected to have more Forest Fire Danger Index 'very high' and 'extreme' days by 2020, (DSE 2008). The number of 'extreme' days is projected to increase by five to 40 per cent. Fire seasons are projected to start earlier, end later and be more intense.

Rising sea levels

By 2100, global sea levels are projected to rise by 18–59 centimetres (McInnes, O'Farrell and Sloyan 2007). The rise in sea levels off the east coast of Australia is expected to be above the global average (McInnes, O'Farrell and Sloyan 2007).



Climate shift

‘The future climate of Victorian regions is projected to resemble the warmer, drier present-day climates of regions further north’ (DSE 2008).

In 2070	Temperature may be similar to	Rainfall may be similar to
Melbourne	Echuca	Seymour
Warrnambool	Horsham	Hamilton
Hamilton	Horsham	Ararat
Horsham	Wentworth (NSW)	Nhill
Bendigo	Ouyen	Charlton
Beechworth	Bonegilla	Charlton
Orbost	Nowra (NSW)	Bairnsdale
Wonthaggi	Seymour	Tooradin
Benalla	Hay	Rutherglen
Mildura	Wilcannia (NSW)	Wilcannia (NSW)

OUR AIR ENVIRONMENT

The quality of the air that we breathe affects the health and wellbeing of all Victorians. In Melbourne, air pollution has been linked to the number of hospital admissions, particularly for respiratory conditions and cardiovascular disease.

Victorians have seen significantly improved air quality since the 1980s, largely due to the introduction of motor vehicle emission control technologies, industry emission standards and controls on backyard burning. Compared to similar urban centres, Melbourne’s air quality is now good. Melbourne’s air quality is similar to that of Sydney and Brisbane and, in general, better than in larger overseas cities such as London and Los Angeles (EPA 2007). This is a reflection of Melbourne’s favourable meteorology, relatively few major industrial emission sources, relatively dispersed urban population and distance to other major cities. Continuing to maintain and improve Victoria’s air quality will be a challenge as the population continues to grow and the climate changes.

Potential impacts of climate change

Climate change, and people’s response to climate change, may have both positive and negative impacts on our air quality. Projected changes include:

- air emissions from natural sources, such as vegetation, and human-made sources, such as petrol, increasing with increasing temperatures (DEFRA 2007).
- In the Port Phillip region, high-pressure systems may become more frequent (Monash Sustainability Institute 2008). These weather systems cause stable air conditions, which lead to a build-up of pollutants (Dobbins 1979). The result is a brown-hazed horizon that remains until it is dispersed by wind or rain. We may get more days like this in future.
- Drying of land and loss of vegetation is expected to increase sources of dust. In urban areas, loss of vegetation may increase pollution levels, as vegetation typically acts as a ‘filter’ by absorbing some air pollutants.
- An increased risk of bushfires and planned burning (carried out to manage the risk) is expected to lead to more days when people are impacted by smoke.
- Actions we may take to reduce greenhouse gases could increase or decrease air pollution. For example, changes to energy generation (such as increased use of renewable or decentralised generation) could change the location of air pollution emissions. The use of alternative fuels for transport could change the composition of air pollution. Motor vehicles are responsible for about half of Melbourne’s air pollution in summer, so any changes to transport patterns or vehicle and fuel types are likely to affect air quality.

We expect that the greatest impact on air quality will be associated with summer smog and particles from dust and fires. However, EPA will continue to review impacts on current and emerging air pollutants.

More summer smog days

Sometimes winds cause pollutants to be recirculated around the Port Phillip region. As the smog levels build, polluted air from Melbourne can be returned to the city, typically on a sea breeze. In strong sunlight, photochemical reactions can create high levels of ozone, the main component of summer smog.

In future, increases in temperature and other climatic changes could mean more smog may form in urban areas. A preliminary analysis conducted by EPA found that if air emissions were kept at current levels the expected temperature increase from climate change is likely to increase peak ozone levels in Melbourne over the next 50 years, with the potential for more breaches of objectives that have been set to protect human health. EPA is planning to conduct further analysis into the significance of this finding by considering the impact that future air emission scenarios will have on the frequency of summer smog events.

More particles in the air

Particles in the air are emitted from industrial processes, motor vehicles, domestic fuel burning and industrial and domestic incineration. Bushfires, windblown dust and, to a small extent, the oceans are all natural sources of particles. Particles result from all sorts of combustion.

Victoria is predicted to become hotter and drier. As a result, particles from bushfires, fuel reduction burns and windblown dust are expected to be emitted more frequently, impacting air quality.

The increased use of motor vehicle fuels that emit less greenhouse gas is desirable and likely in future. Changes in dominant motor vehicle fuels used will impact particle levels. Increased use of diesel fuel may increase emissions of particles from motor vehicles, while the use of biodiesel may help to reduce levels, as it emits fewer particles than standard diesel (Beer et al. 2007, Sharma et al. 2008). The effect on air quality from changing fuel use will depend on the actual mix of fuels used.



Figure 1: Melbourne's CBD affected by bushfire smoke during December 2006.

More frequent bushfires and fuel reduction burns means Victorians will be impacted by smoke more often.

Photo by Mario Borg, courtesy of *The Age*.

Bushfires and air quality

Between December 2006 and February 2007 over 1.2 million hectares were burnt in one of the most severe bushfires ever recorded in Victoria. High levels of air pollution were recorded across Victoria, including Melbourne.

- North-east Victoria had very poor visibility due to smoke. Visibility in Wangaratta was reduced to 400 metres. Visibility in Melbourne was less than three kilometres.
- Particle levels from smoke were high on 17 days at Wangaratta and 15 days in Melbourne.
- Geelong recorded its highest ever smog level. In the Latrobe Valley high smog levels were reported for the first time since EPA began monitoring in 1979.

In response to an increasing threat of bushfires EPA will provide advice about air quality in regions affected by fires based on monitoring data and visual assessment. Together with the Department of Human Services, EPA has developed a system to categorise air quality measurements and provide advice on possible impacts on people's health. See

www.epa.vic.gov.au/air/bushfires/default.asp and www.health.vic.gov.au/environment/emergency_mgmnt

OUR FRESHWATER ENVIRONMENT

Victoria has extensive aquatic systems made up of a diverse range of ecosystems including rivers, estuaries, oceans, bays, lakes and wetlands.

EPA helps to protect Victoria's water environments through setting up environmental quality objectives for the protection of the water environment. These quality objectives have been established to protect the things we value such as recreation, ecosystems and water for industry and human consumption.

Potential impacts of climate change

Drying aquatic habitat, isolated pools, declining water quality, loss of aquatic species

Climate projections of increased temperatures, reduced run-off, more frequent and intense droughts, and extreme events such as very hot days and floods are expected to impact our freshwater environment. Projected changes include:

- an increasing number of Victoria's rivers and streams becoming isolated, drying pools of water for many months of the year. These isolated pools will become vital as refuges for many aquatic species and for their continued survival.
- permanent headwater and lowland streams becoming seasonal or intermittent and ephemeral streams (ephemeral streams only flow for short periods during or after rain) (Lake 2006)
- some wetlands drying out for long periods (Lake 2006; Brock et al. 2003)
- drying and increasing salinity of permanent salt lakes, such as Bullen Merri and Gnotuk. There may be long periods when seasonal lakes will dry (Timms 2005). The filling of some lakes could become a rare event.
- in limited cases, improved water quality in some aquatic systems because less run-off means fewer pollutants entering the system
- in some cases, reduced water quality from a lack of water, with less dissolved oxygen and higher salinity levels
- an increased chance of algal blooms (Melbourne Water 2007; Poff, Brinson & Day 2002)
- impacts to the survival, growth, maturation and reproduction of aquatic plants and animals. Some aquatic species may be lost and replaced by other species (Brock et al. 2003), especially if egg and seed banks are lost.
- loss of some alpine species because they have limited options to adapt (McGregor et al. 1995). They may be replaced by exotic and non-alpine species.
- changing composition of riparian growth to species that favour the changed conditions
- Mangroves and estuarine fauna spreading southward (McLeod, Salm 2006, Clark et al. 2000).



Figure 2: Wimmera River, autumn 2005 (top) and autumn 2007 (bottom).

Reduced rainfall is expected to cause many Victorian rivers to remain dry for long periods.

Isolated pools will become vital as refuges for many aquatic species

Dry conditions in Victoria have caused some rivers that once flowed all year round to flow intermittently. Many have stopped flowing and have become a series of isolated pools. These isolated pools are critical refuges that enable animals (and some plants) to survive the dry times and from which whole river systems can recover when conditions improve. Protection of these refugia has been identified as a key priority in protecting river resilience during drought.

Victorian natural resource managers and scientific experts have identified a gap in the information and knowledge required to identify and manage these kinds of refuges.

EPA Victoria, in collaboration with other government and scientific experts, has initiated work to identify what makes a 'good' refuge in times of drought. The tools and information from this study can be used by natural resource managers to improve the resilience of our river environment.



Figure 3: Lower Wimmera River, 2005, 2006 and 2007 (top to bottom).

Climate change is expected to reduce many rivers to isolated pools. These pools are vital for the continued survival of aquatic species during times of drought.

The health of streams is likely to decrease

The Wimmera basin is situated in the north-west of Victoria and contains the Wimmera River. The basin is large (approximately 2.4 million hectares), with a broad range of land uses, ranging from national parks (Grampians and Little Desert) to large areas under wheat. The region has been experiencing severe drought since 1997, with storage levels typically below 10 per cent. In recent years there have been few allocations of water for agricultural use or to meet environmental needs.

From the spring of 2004 to the spring 2005 EPA and Wimmera Catchment Management Authority assessed the condition of streams in the basin (EPA 2008).

The study found that:

- many sites could not be assessed because they remained dry for the whole period
- many sites, especially in the lower reaches, were in poor health from lack of flow or an absence of water over the summer-to-autumn period
- flow diversions in the middle reaches of the Wimmera River increased the effects of the drought in the lower Wimmera
- common problems that caused poor water quality were high salinity levels, low dissolved oxygen levels, poor riparian condition and land degradation.

More recent assessments indicate that the ongoing drought has continued to reduce the overall health of streams in the basin. The pipelining of the Wimmera Mallee Stock and Domestic System will improve the efficiency of water use by reducing losses. Once this is completed, some of the savings have been allocated to improving the environmental health of the river (Our Water Our Future 2008).

Sediment slugs and algal blooms after bushfires

Projected increases in the frequency and intensity of bushfires are expected to have negative impacts on aquatic systems. Although there is an immediate impact of a fire on a stream, extreme storm events shortly after a bushfire can cause further damage to already climate-stressed systems (EPA 2006).

Bushfire impacts on stream ecosystems, in both the short and long term, include the following:

- Sedimentation – Loss of vegetation coupled with changes in soil structure can lead to a build-up of loose sediment and ash that can be rapidly washed into streams during heavy rains (a sediment ‘slug’). These sediments scour and smother the in-stream habitat, reduce the amount of dissolved oxygen and light penetration, and clog the gills of fish.
- Algal blooms – When greater amounts of sediment enter the waterways, the concentrations of nutrients in the system increases. Higher levels of nitrogen and phosphorus, coupled with less shade, can lead to excessive plant and algal growth.



Figure 4: A sediment slug in the Ovens River at Whorouly following bushfires in 2003.

Heavy rains soon after bushfires can cause sediment slugs that scour and smother the in-stream habitat, reduce the amount of dissolved oxygen and light penetration, and clog the gills of fish.

Loss of tidal wetlands from rising sea levels

Due to rising sea levels, sea water is expected to intrude into coastal freshwater wetlands. Some coastal freshwater wetlands could be lost (Roessig et al. 2004; Western Coastal Board 2005).

Victoria’s Western District lakes are drying, becoming more saline and losing aquatic life

Many lakes in western Victoria are showing significant signs of stress from an unprecedented period of low rainfall. A number of these lakes are internationally significant wetlands because of their ecological, cultural, recreational and scientific values. EPA Victoria has monitored 28 lakes in western Victoria to assess their condition.

A number of iconic lakes in western Victoria, including Lake Corangamite, are similar in salinity level to the Dead Sea. This level of salinity has not occurred in living memory. Some lakes have very little aquatic life.

Climate change and reduced rainfall are likely to lead to a loss of some lakes. A better understanding of what may happen to the lakes is important for environmental managers and the community to help plan for potential changes. EPA, in collaboration with CSIRO and Latrobe University, are conducting modelling to examine the impacts of climate change on water levels and water quality in the lakes of western Victoria.

More fish are likely to die

Fish deaths were once again an unfortunate feature of the 2007–08 and 2008–09 summers in Victoria. Low water levels in our lakes, creeks and rivers, due to continued drought conditions, resulted in warm water with high salinity and low oxygen levels.

Ongoing drought conditions at Lake Boga and Lake Colac resulted in two major fish-death events. Around 400 tonnes of fish were relocated from Barongarook Creek and the lake itself to reduce the impact of low water levels on the fish population. Some fish deaths still occurred over summer. More than 10,000 fish, mainly carp, died at Lake Boga. While various agencies were able to partially clean up the dead fish, the smell had a significant impact on the local community.

Climate change and continued drought conditions across Victoria will probably increase the likelihood of similar fish-death events. The Victorian Government is preparing for these events by continuing to collect data on water quality and quantity. This helps us improve predictions of fish deaths, plan our responses and focus on the areas that are most important for protection.

OUR GROUNDWATER ENVIRONMENT

Groundwater is an important resource in Victoria. Groundwater is a valuable source of water for human uses and for rivers, streams and vegetation.

We have a legislated role to protect groundwater in the state of Victoria. We aim to keep it at a level of quality where it can:

- keep ecosystems alive
- supply water to people, agriculture and industry
- be used for recreation
- not damage buildings and structures through contamination.

Groundwater presents a different protection challenge than surface water. Changes to groundwater quality depend on the scale of the groundwater system. Changes to local systems can take a few years; changes to regional system can take many years (up to tens of thousands of years). This means that changes that occur on the surface may not be evident in the groundwater until well into the future.

Potential impacts of climate change

Mobilisation of contaminants, changed use patterns, impacted water quality

Climate change could impact groundwater quality and, therefore, its beneficial uses as follows:

- Increased levels of carbon dioxide in the atmosphere could change the pH of rainfall; this, combined with changes in evaporation-rainfall relationships, could change the amount of salt in the water that passes through the soil before becoming groundwater. A range of contaminants could be mobilised as the soil chemistry changes.
- The water quality of waterways and wetlands that feed aquifers could change.
- Rising sea levels could cause seawater to move into coastal aquifers.
- Feed sources in urban areas could change. For example, as we repair leaking water infrastructure, create wetlands, water our gardens less and increase our use of greywater, we may be affecting the quality and quantity of water flowing into underground aquifers.
- As we increasingly manage aquifer recharge – for example, by storing stormwater in underground aquifers in urban areas – depending on the source of water, we may cause localised changes in groundwater quality. In many cases, we may improve local groundwater quality, but in high-quality aquifers it is more likely that there will be issues associated with other introduced contaminants.
- As we increase the rate at which we extract groundwater, we can change the quality of the remaining water. When water is removed from an

aquifer, surrounding water from within (or external to) the aquifer can flow in and replace the removed water. This means that quality of the water in the aquifer becomes like the quality of the surrounding water. For example, saline water may replace fresh water that has been removed from an aquifer near the coast.

Less groundwater available to sustain surface water ecosystems

Groundwater can be an important source of water for surface water ecosystems. Declining groundwater levels will impact ecosystems that depend on groundwater for survival.

Surface water quality impacted by groundwater quality

Groundwater is an important source of base water flow for some streams. Less rainfall and surface run-off into rivers and streams means that surface flow may be dominated by groundwater sources. This could impact the quality of surface water (for example, by increasing salinity).

Environment protection and alternative water sources

Reduced water availability has resulted in people using alternative water sources such as bore water, recycled water, greywater, desalinated water and stormwater. Handled correctly, these alternative sources can supply water for irrigation, environmental purposes and industrial uses and could be highly useful to Victoria's economy and environment. However, the water sources need to be managed properly to protect our health and our environment.

EPA and the Department of Human Services are working together to establish appropriate frameworks for use of alternative water sources to make sure that Victoria has a safe and sustainable water supply.

Declining groundwater levels can impact water quality

Ongoing drought and declining groundwater quality has limited the use of groundwater for irrigation in the Werribee district (Southern Rural Water 2007). The Werribee Irrigation District is an important area for vegetable market gardens, located very close to Melbourne.

Many farmers have licences to extract groundwater from the Deutgam aquifer for irrigation. During 2006-07, despite water allocations of only 25 per cent, water levels in the aquifer declined and salinity levels increased to the point where the water could no longer be used. It is suspected that the low groundwater levels allowed seawater to infiltrate the aquifer, causing the salinity rise. As a result a total ban on bore water extraction was put in place. The ban is in place until the aquifer water level recovers to the point where seawater can no longer infiltrate.

OUR MARINE ENVIRONMENT

Our bays and oceans provide immense social, economic and environmental value to Victoria. EPA helps to protect the marine environment for uses such as recreation and commercial fishing, while providing habitat for marine species.

How climate change is projected to affect our ocean, bays and inlets

Increased sea surface temperature, altered wind patterns and currents, increased ocean acidity

In addition to the climate change projections for Victoria discussed previously, projections for Victoria's ocean, bays and inlets include:

- sea surface temperatures increasing by 0.3–0.6 °C (McInnes et al. 2007)
- the East Australian Current strengthening and bringing warmer water further south (McInnes et al. 2007)
- westerly winds strengthening and shifting southward (McInnes, Macadam 2007), resulting in changes in average wind speed off the Victorian coast
- changes in the East Australian Current and westerly winds altering patterns of upwelling, or creating new ones, depending on local underwater topography and oceanography. Upwelling brings cold, nutrient-rich waters to the ocean surface and is important for the growth of marine plants and animals.
- ocean acidity in the Australian region increasing due to increasing levels of carbon dioxide in the atmosphere (McInnes et al. 2007). This would make it difficult for some marine species to make shells (McInnes et al. 2007). Marine organisms make shells out of calcium carbonate. If ocean acidity is too high calcium carbonate dissolves. Ocean acidity projections show that the areas where marine organisms can form shells may decrease in size.
- increasing ocean acidity increasing the availability of toxic trace elements such as copper (Kester 1986) and reducing nitrification in marine bacteria (Huesemann, Skillman & Crecelius 2002).

Marine species replaced by those that favour altered conditions

Fishing and pollution already have a strong impact on the health of our marine ecosystems. Climate change is expected to have the following additional impacts:

- Algal blooms may occur more frequently, due to warmer ocean temperatures (Boyd, Doney 2002).
- Distribution and reproductive patterns of marine organisms may change due to warmer ocean temperatures, changed ocean currents and increasing ocean acidity.

- Current phytoplankton species may be replaced by those that favour warmer water (CSIRO 2006). Populations may reduce in some regions and increase in others.
- Species that form shells may be lost, impacting species higher up the food chain.
- Jellyfish blooms may occur more frequently (CSIRO 2006).
- Seagrass beds in Western Port Bay may decline or be lost due to the increased number of extremely hot days (CSIRO 2006).
- Port Phillip Bay may become saltier due to reduced freshwater inflows, longer flushing times and increased evaporation.
- Less freshwater is expected to enter marine systems due to less catchment run-off. This could have a positive effect by reducing the amount of land pollution entering marine waters.

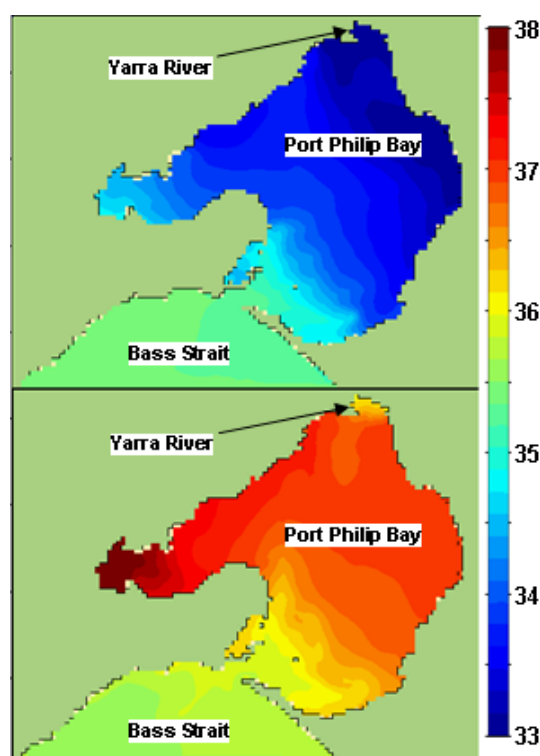


Figure 5: A schematic of Port Phillip Bay showing measured salinity in parts per thousand in 1994, top, and 2007, bottom.

The combination of evaporation and less freshwater inflow has caused water in Port Phillip Bay to become saltier and denser than in Bass Strait. Increasing water density in Port Phillip Bay changes circulation patterns, reduces water exchange with Bass Strait and, in certain areas, affects the dilution and dispersion of pollution from point sources. Modelling indicates that climate change is likely to worsen these conditions in future.



Understanding dynamics of discharges into a climate change impacted Port Phillip Bay

Port Phillip Bay is a large semi-enclosed bay constrained by a small entrance and neighbouring sand banks. In combination, they restrict ocean water from entering the bay. This causes long flushing times of a year or more. Long flushing times mean that any discharge into the bay remains in the bay for a long time.

More than 10 years of drought in Victoria has reduced the amount of freshwater entering the bay. The combination of evaporation and less freshwater inflow has caused the water to become saltier and denser than the ocean. Modelling has indicated that increasing the density of water in Port Phillip Bay changes circulation patterns, reduces water exchange with Bass Strait and, in certain areas, affects the dilution and dispersion of pollution from point sources.

Climate change is expected to cause these conditions to increase. Understanding vulnerable areas and sustainable limits for all discharges into a climate change-impacted Port Phillip Bay is important as part of continuing to protect the bay.

NEXT STEPS FOR EPA

This report presents the findings of the first stage of EPA's research to understand how climate change will impact the way we protect the environment into the future. We will use this information to build our knowledge and develop environment protection strategies.

Reduce the stress on our environment

Where possible and practical, we need to strengthen the ability of our environment to withstand climate change by reducing stresses on it. Reducing emissions of greenhouse gases, reducing pollution, protecting at-risk ecosystems and species, and appropriately managing the use of environmental resources are examples of what we can do to make our environment more resilient.

Get ready to adapt to impacts

Climate change could make changes in some environmental systems unavoidable. In some cases we may have to rethink what can be protected. For example, we may not be able to protect all of Victoria's rivers and lakes from drying, but in some cases it may be possible to intervene and protect our most valuable environmental assets. Water in some lakes and rivers could be maintained by pumping water from other areas. Some isolated pools could be maintained and protected as refuges for plants and animals during times of low rainfall.

Where we cannot intervene we may have to adapt to the changes. For example, we will not be able to prevent air pollution from future dust storms and bushfires, but we could reduce the impacts they have by, as a community, taking precautions to limit our exposure.

For more information, visit www.epa.vic.gov.au/air.

Reduce greenhouse gases

Reducing greenhouse gases to slow down and limit climate change is critical to preventing the most severe impacts.

The Victorian Government has a number of programs to help business and the community use less energy and reduce greenhouse gas emissions.

For more information about what you can do to reduce greenhouse gases or adapt to climate change refer to:

- www.climatechange.vic.gov.au
- www.epa.vic.gov.au
- www.sustainability.vic.gov.au

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APPENDIX A: WORKSHOP PARTICIPANTS

As part of our research for this report, we ran 'water' workshops in collaboration with the Victorian Department of Primary Industries (Fisheries) and Goulburn Broken Catchment Management Authority.

Participants included representatives from:

- Goulburn Murray Water
- Goulburn Broken Catchment Management Authority
- Department of Sustainability and Environment
- Department of Primary Industries
- Murray Darling Freshwater Research Centre, Monash University
- Parks Victoria
- Institute of Geosciences
- Royal Melbourne Institute of Technology
- URS
- Southern Rural Water
- GHD
- SKM
- ASR Consulting.

As part of our research for this report, we ran an 'air' workshop in collaboration with Monash University (Sustainability Institute).

Participants included representatives from:

- CSIRO (Centre for Australian Weather and Climate Change Research group)
- Monash University (Sustainability Institute),
- NSW Department Environment and Climate (Atmospheric Research)
- Parks Victoria (Fire and Emergency Services),
- Department of Transport (Transport Energy)
- Victorian Department of Sustainability and Environment (Climate Change Adaptation and Transport)
- Department of Primary Industries, (Climate Change Research Program, Energy and Earth Resources Policy)
- Department of Human Services (Environmental Health).