2 Climate and Natural Environment

OVERVIEW

This chapter contains information about Victoria's natural environment and climate. It includes contributions from the Department of Geography and Environmental Studies at the University of Melbourne, the Bureau of Meteorology and the Environment Protection Authority.

Physical features

Although Victoria is the second most populous State or Territory in the country, it is ranked sixth in terms of geographic size and accounts for only 3% of Australia's total area.

2.1 AREA OF STATES AND TERRITORIES

State or Territory	Area in square kilometres	Length of coastline in kilometres	Percentage of total area	Percentage of total population (as at 1995)
Western Australia	2 525 500	12 500	32.87	9.5
Queensland	1 727 200	7 400	22.48	18.2
Northern Territory	1 346 200	6 200	17.52	1.0
South Australia	984 000	3 700	12.81	8.2
New South Wales	801 600	1 900	10.43	33.9
Victoria	**227 600**	**1 800**	**2.96**	**24.9**
Tasmania	67 800	3 200	0.88	2.6
Australian Capital Territory	2 400	(a) 35	0.03	1.7
Australia	**7 682 300**	**36 735**	**100.00**	**100.0**

(a) Jervis Bay Territory.

Source: Bureau of Meteorology; ABS unpublished data

Location

Wilson's Promontory, latitude 39° 08' S, longitude 146° 22' 30" E, is the southernmost point of the mainland of Victoria and similarly of the mainland of Australia; the northernmost point is where the western boundary of the State meets the Murray River, latitude 33° 59' S, longitude 140° 58' E; the point furthest east is Cape Howe, situated in latitude 37° 31' S, longitude 149° 58' E. The westerly boundary lies upon the meridian 140°58' E and extends from latitude 33° 59' S to latitude 38° 04' S, a distance of 451 kilometres.

Coastline

The Victorian coastline comprises many types of environments. Broad sandy beaches and impressive cliffs contrast with mangrove-fringed mudflats. Cliffs and beaches occur mostly in areas that receive the main impact from waves generated by the dominant winds from the south-west: for example the ocean coast and north-eastern coast of Port Phillip Bay. In the large embayments – Port Phillip Bay, Western Port Bay and Corner Inlet – and in some estuaries, waters are more protected from the wind and the ocean swells; here, tidal flats of sand or mud, traversed by sinuous channels, may be colonised by salt-tolerant plant communities such as mangroves.

Physiographic divisions

Jenkin and Rowan have classified Victoria's landforms into six main regions, each comprising several sub-regions.

1 Central Victorian Uplands

1.1 East Victorian Uplands, consisting of:

Dissected uplands

Dissected plateaus (Wellington uplands)

High plains (Dargo, Bogong)

1.2 West Victorian Uplands, consisting of:

Dissected uplands (Midlands)

Prominent ridges (Grampians)

Dissected tableland (Dundas Tableland, Merino Tableland)

The Uplands separate the northern flowing streams and rivers which join the Murray, from the south flowing streams and rivers which drain directly to the coast. The Uplands trend east-west, but are separated into eastern and western parts by the Kilmore Gap. The eastern uplands have peaks of up to 2,000 metres, composed of granite, sandstone, limestone and volcanic rocks. The western uplands are much lower and have a smaller area.

At their higher levels, the uplands had a native vegetation of woodland and grassland, with sedges and mosses where drainage was disrupted. At moderate elevations, tall open forests predominated. Such regions are now used for water supply, conservation, forestry, grazing and recreation. At lower elevations, vegetation was scrub, woodland or open forest, depending on rainfall and slope; now they are used for conservation, grazing and some cropping.

2 South Victorian Uplands, consisting of:

Dissected fault blocks (Otway Ranges)

Moderately dissected blocks (Barrabool Hills)

Moderately dissected ridge (Mornington Peninsula)

Dissected fault blocks (South Gippsland Ranges)

Dissected outlier (Wilsons's Promontory)

These are isolated regions in the south of the state. The Otway, Barrabool and South Gippsland hills are sedimentary rocks, in contrast to the granite residual that is Wilson's Promontory. Open forest and woodland dominated the vegetation of these regions. Now they are used for water supply, conservation, forestry, grazing and recreation.

3 The Murray Basin Plains

3.1 Riverine Plain, consisting of:

Present floodplain of the Murray Valley

Older alluvial plain (Shepparton)

3.2 Mallee Dunefield, consisting of:

Low calcareous dunes (Ouyen)

High siliceous dunes (Big Desert, Sunset)

3.3 Wimmera Plain, consisting of:

Clay plains (Nhill)

Ridges and flats (Goroke)

Low siliceous dunes (Little Desert)

These plains are bounded by the Central Victorian Uplands (in the south) and the Murray River (in the north). The Riverine plains comprise alluvial material, mostly deposited by ancient river systems, and sometimes covered by a wind-blown sandy clay. The Mallee dunefields are east-west trending sand and clay dunes, formed 15,000 to 40,000 years ago, together with some parabolic sandy dunes. The Wimmera plains have calcareous clayey soils; the rivers have anabranches, and there are chains of swamps and small lakes separated by minor sandstone ridges.

These regions were covered by scrub, woodland or grassland, depending on soil and rainfall. Now they are used for conservation and recreation, grazing and – depending on rainfall – some cropping.

4 West Victorian Volcanic Plains, consisting of:

Undulating plain (Western District)

Stony undulating plain (Western District)

These plains, which occupy the regions between Melbourne and Hamilton, originated from lava flows between 6,000 and 6,000,000 years ago. Volcanic hills punctuate the landscape of the basalt plain, which is deeply dissected by some rivers. Originally covered by grassland and woodland, the volcanic plains are now used for cropping and grazing.

5 South Victorian Coast, consisting of:

Ridges and flats (Follett)

Dissected plain (Port Campbell)

Sand and clay plain (Moorabbin)

Fans and terraces (Western Port)

Barrier complexes (Discovery Bay, Gippsland Lakes)

These are areas of marine sediments, ranging from the limestones of Port Campbell and the lower Glenelg through the sand plains around Port Phillip and Western Port Bays, through the coastal barrier complexes of the Gippsland Lakes and Discovery Bay. The limestones of the west make for the vertical cliffs and stacks that are so famous on the Great Ocean Road.

Originally grassland and woodland, the flats and plains are now used for grazing and cropping. On the dune complexes, heaths, shrubs and some woodlands predominated; these regions are now important sites of conservation and recreation.

6 South Victorian Riverine Plains, consisting of:

Present floodplains (Gippsland)

Intermediate terraces (Gippsland)

High terraces and fans (Gippsland)

These Gippsland plains were formed by sediments deposited by such rivers as the Latrobe, Thomson, Mitchell and Snowy. Woodland with tall open forest dominated these regions; they are now used for grazing and cropping. In the west, the plains contained large areas of swamp that have been largely reclaimed.

Rivers

In the west of the state, streams tend to reflect the following characteristics: low run off, high variability of flow from year to year, and peak flows in winter. The Great Divide (Central Victorian Uplands) ensures that streams in the east of the state exhibit higher run off and low variability of flow from year to year, with peak flows in late winter or early spring.

Professor Michael Webber, Department of Geography and Environmental Studies, University of Melbourne.

Other features

Victoria's highest mountain is Mt Bogong, located in the West Victorian Uplands. The longest river is the Goulburn, which runs from Lake Eildon to the Murray east of Echuca. The Goulburn is also the river with the greatest annual flow of water. (The Murray river flows in NSW, as the state boundary is the south bank of the river.) Other important physical features are shown in Table 2.2.

2.2 SELECTED PHYSICAL FEATURES, VICTORIA

Mountain	*Height (metres)*	*River*	*Length (Km)*
Bogong	1 986	Goulburn	566
Feathertop	1 922	Glenelg	457
Nelse North	1 883	Loddon	381
Fainter South	1 877	Mitta Mitta	286
Loch	1 874	Hopkins	281

Climate

The major topographical determinant of Victoria's climate is the Great Dividing Range, running east-west across the State, and rising to approximately 2,000 metres in the eastern half. This acts as a barrier to the moist south-east and south-west winds and together with its proximity to the coast, causes the south of the State to receive more rain than the north.

To the south of Victoria, except for Tasmania and its islands, there is no land for 3,000 kilometres. This vast area of ocean has a moderating influence on Victoria's climate in winter. Snow, which is a common winter occurrence at similar latitudes on the eastern seaboard of the great land masses of the northern hemisphere, is rare in Victoria below elevations of 600 metres. To the north of Victoria, the land mass of Australia becomes very hot in the summer, and on several days at this time of year the temperature over the State may rise to between 35°C and 40°C, often with a strong northerly wind.

Across Victoria, the average number of days of rain (0.2mm or more in 24 hours) in a year varies considerably. In the Otway Ranges there are over 200 days of rain, compared with an average of 100 wet days a year experienced in regions approximately 160 kilometres inland from the coast. Average rainfall ranges from 250mm for the driest parts of the Mallee to 2,600mm at Falls Creek in the Alps. The distribution of rainfall in Victoria by districts is shown in Table 2.3.

2.3 RAINFALL IN DISTRICTS, VICTORIA

	Year						
District	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*Average (a)*
				mm			
North Mallee	273	300	475	364	178	348	309
South Mallee	294	319	564	412	184	373	355
North Wimmera	313	408	567	440	222	431	412
South Wimmera	460	562	763	558	355	510	507
Lower North	376	401	625	531	268	427	434
Upper North	437	500	704	648	306	570	517
Lower Northeast	925	794	1 129	1 092	610	1 065	785
Upper Northeast	1 237	1 334	1 117	1 514	940	1 245	1 111
East Gippsland	862	782	1 049	681	724	890	780
West Gippsland	975	1 033	972	1 055	864	952	917
East Central	923	1 061	1 171	1 111	764	969	895
West Central	675	634	811	718	454	752	615
North Central	782	803	1 030	910	496	750	731
Western Plains	622	642	866	707	493	642	632
West Coast	854	955	1 043	797	742	830	780
Melbourne Suburban	727	833	909	900	537	870	n.a.

(a) Average for 83 years 1913 to 1995.

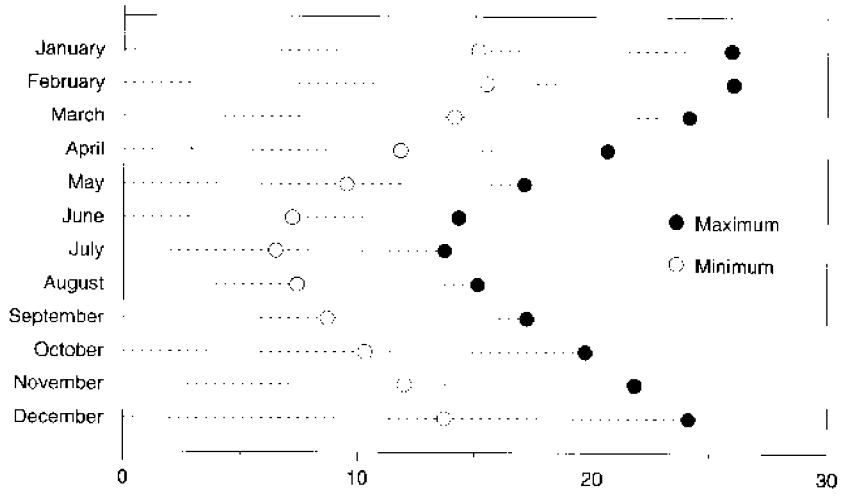
Source: Bureau of Meteorology

Melbourne's weather

Melbourne's climate is temperate and variable, and moderate rainfall is received in most months. In summer, daytime temperatures average in the mid to high 20s. In autumn and spring, daytime temperatures average near 20°C, while in winter, temperatures average in the low to mid teens.

Situated about 60 kilometres from the open ocean, the city has a climate midway between maritime and continental, although the extensive landlocked Port Phillip Bay has a moderating effect on temperatures in bayside areas. To illustrate, the bayside suburb of Black Rock has an average summer maximum temperature of 24.3°C. By contrast, the outer northeastern suburb of Watsonia has an average summer maximum of 26.1°C.

AVERAGE MONTHLY MINIMUM AND MAXIMUM TEMPERATURE IN MELBOURNE DURING EACH MONTH (°C)



Source: Bureau of Meteorology

The hottest months in Melbourne are normally January and February, when the average maximum temperature is 26°C. The hottest day on record in Melbourne was 13 January 1939, when the temperature reached 45.6°C. In Melbourne, the average number of days per year with maximum temperatures over 30°C is approximately twenty-nine and the overnight temperature remains above 20°C on about four nights per year.

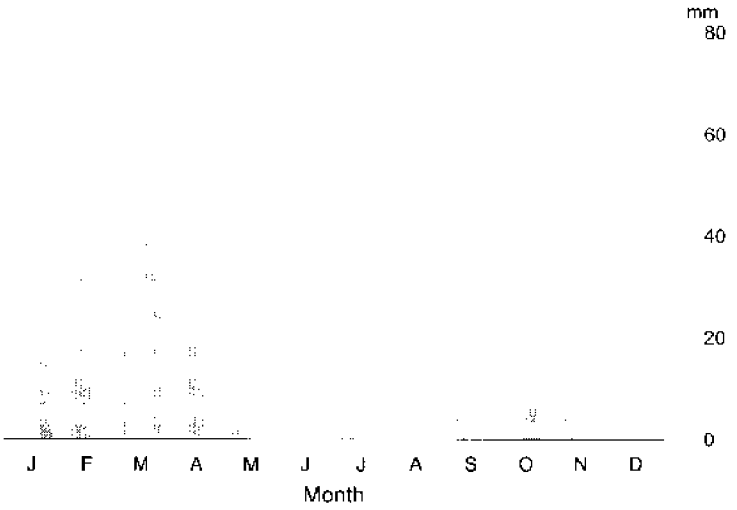
Nights are coldest at places a considerable distance from the sea, and away from the city where heat retention by buildings, roads, and pavements may maintain the air at a slightly higher temperature. This 'heat island' effect, which is the consequence of asphalt and concrete absorbing daytime warmth and radiating it back into the environment during the night, is largely confined to the Central Business District (CBD). In the CBD minimum temperatures are now mostly between 1°C and 2°C above those of most metropolitan locations.

The frequency of very low air temperatures varies widely across the Melbourne metropolitan area. For example, there are approximately ten annual occurrences of 2°C or less around the Bay, but the frequency increases to over twenty in the outer suburbs and to more than thirty a year in the more frost susceptible areas.

In Melbourne, rainfall is fairly evenly distributed throughout the year, averaging about 55mm per month with an annual average rainfall of 639mm, falling over 143 days. Spring is slightly wetter than other seasons. Although the total amount of rain received is about the same for winter and summer, it falls on twice as many days in winter than it does in summer.

The eastern suburbs are significantly wetter than the western suburbs. For example, Scoresby has an average annual rainfall of 901mm, in contrast to Laverton's 569mm. The relatively low rainfall to the west of the city is due to a combination of the 'rain shadow' effects of the Otway Ranges and the ranges in the Ballarat region. The relatively high rainfall to the east of the city is due to moisture in the predominant westerly wind stream condensing as the stream approaches the foothills of the Dandenong Ranges.

AVERAGE RAINFALL IN MELBOURNE DURING EACH MONTH



Source: Bureau of Meteorology

Thunderstorms are more frequent during late spring and summer, when there is adequate surface heating to provide energy for convection, than at other times of the year. In February 1972, 78mm fell in one hour during a thunderstorm. Hail is observed more often during winter and spring.

The wind varies from day to night and from season to season. Wind speed is usually lowest during the night and early hours of the morning prior to sunrise. It increases during the course of the day as heating of the earth's surface induces turbulence in the wind stream. Examples of the daily variation are the sea breeze, which brings relief on many hot days, and the valley or katabatic breeze, which brings cold air from inland Victoria down valleys during the night and early morning towards Melbourne. These breezes are responsible for winds being more often from the north during winter, particularly during the morning and from the south during summer, particularly during the afternoon. There is a marked tendency for the strongest winds to occur during the late winter and early spring months.

Duststorms and tornados are rare. However, on February 8, 1983, a duststorm reduced visibility in the city to 100 metres.

2.4 AVERAGE MEASUREMENTS OF CLIMATIC ELEMENTS, MELBOURNE

Meteorological element	*Spring*	*Summer*	*Autumn*	*Winter*
Atmospheric pressure (hectopascals)	1 018.2	1 013.6	1 018.7	1 018.9
Maximum temperature of air in shade (°C)	19.6	25.1	20.6	14.4
Minimum temperature of air in shade (°C)	10.3	13.7	11.8	7.0
Relative humidity at 9 a.m. (per cent, saturation=100)	64	61	72	78
Rainfall (mm)	175	154	164	149
Number of days of rain	40	25	34	44
Amount of evaporation (mm) (a)	346	563	269	135
Daily amount of cloudiness (scale 0 to 8) (b)	4.9	4.2	4.8	5.2
Daily hours of sunshine (c)	6.5	8.4	5.6	4.5
Number of days of fog	1.4	0.6	5.7	10.1

(a) Measured by Class A Pan (records commenced 1967).

(b) Scale: 0 = clear, 8 = overcast.

(c) Measured at Laverton (records commenced 1968).

Source: Bureau of Meteorology

Environment

Recognition is increasing of the interdependency between people and the environment. The health of the environment not only affects the quality of life experienced by people; it also determines the availability of the basic resources – air, water and land – which are essential for life.

In June 1994, an ABS survey collected information about peoples' concern for environmental problems and their views on environmental protection and economic growth. In Victoria, 67% of people expressed concern about environmental problems. Air and ocean pollution, destruction of trees/ecosystems and freshwater pollution were the environmental problems which raised the greatest concern. Environmental protection and economic growth were ranked as being equally important by 71% of people.

Air

In 1975 the Environment Protection Authority (EPA) began monitoring air quality in Victoria. The major pollutants monitored were ozone, sulphur dioxide, nitrogen oxides, carbon monoxide, air-borne particles, hydrocarbons and lead.

Melbourne's air quality rates well by international standards for cities of similar size. The Victorian air quality objectives provide a framework for monitoring. In 1995–96 in Melbourne, these objectives were exceeded on 43 days, 12 for ozone and 31 for visibility. Breaches are usually associated with particular weather patterns which are characterised by a temperature inversion and slow moving air mass, creating ideal conditions to allow the build-up of pollutants.

Problems are generally confined to photochemical smog – of which ozone is the main component – in summer, and fine particles in autumn and winter. Motor vehicle emissions are a major contributor to each problem, although fuel reduction burning and poorly designed and operated solid fuel combustion equipment contribute significantly in some areas. In 1995–96 in Melbourne 15 smog alert days were declared.

Since the reduction of lead in petrol in the late 1970s, lead level in air concentrations have shown a steady decrease. This downward trend was enhanced after the introduction of unleaded petrol in 1985. The reduction of lead in petrol is a contributing factor to the reduction of blood lead levels in Victorian children, which have roughly halved since 1979.

Water

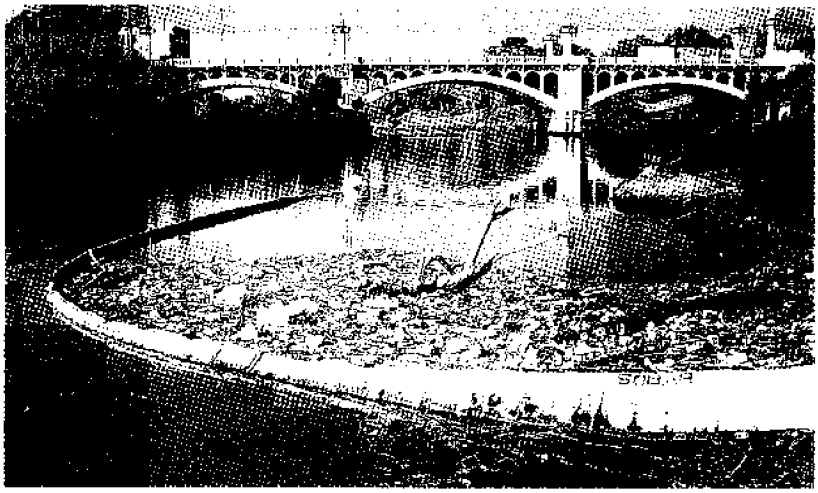
Good quality water is essential to maintain human life and protect natural ecosystems. As all people live in catchments, their activities have a direct impact on the water quality of streams and rivers and coastal waters. In Australia, a high proportion of people live in coastal urban centres. As a result, considerable pressure is exerted on coastal waters from urban run-off and recreational demands. Groundwater is important in supporting many aquatic ecosystems and wetlands. In addition, many communities rely on good quality groundwater for drinking, agricultural and industrial use.

Water pollution can be divided into two main types. The first is point-source pollution, in which the pollutant's source is localised and identifiable, e.g. the discharge drains of industrial or sewerage treatment plants. The second is diffuse water pollution, where the pollutant is derived from activities across a large area, for example, inputs of sediment associated with land use practises. The EPA facilitates the monitoring, and where necessary monitors, the quality of inland, coastal and groundwaters and works with industry, agricultural and community groups to address key problems.

The impact of point-source pollution in Victoria has steadily decreased as a result of education, licensing and waste minimisation programs. However,

diffuse water pollution remains a significant concern. In Victoria, problems of this nature include high levels of nutrients, turbidity and salinity which adversely affect the quality of our waterways.

The major nutrients of concern are nitrogen and phosphorous. These are found in urban and rural run-off, erosion, sewage and animal faeces. Algal blooms, which can result in fouling of waterways, depletion of oxygen levels and the production of toxins, are one of the major problems caused by high nutrient levels. Nutrients are of particular concern in waterways across the State. The Victorian Nutrient Management Strategy released by the Victorian government in March 1995 provides a policy and planning framework to help local communities manage nutrient levels.



The Yarra River is a major feature of Melbourne. The quality of water in the Yarra is an important reflection on environmental management with the catchment. High turbidity, litter, suspended solids and *E.coli* are major concerns in the Yarra River Catchment. Urban development and areas of poor land management, including areas subject to erosion, affect the quality of run-off in this catchment.

Coastal and marine ecosystems are highly valued and sensitive environments, subject to intense commercial and recreational activities. The water quality around Victoria's coast is generally good with the exception of some areas where inputs from urban drainage and treated sewerage effluent affect water quality. Even at these locations, conditions are generally within acceptable limits. However, there is growing concern about the introduction of exotic plant and animal species such as, the giant kelp (Undaria Pinnatifida) and the fanworm (Sabella Spallanzanii), via ballast water or attached to the hulls of ships.

Land

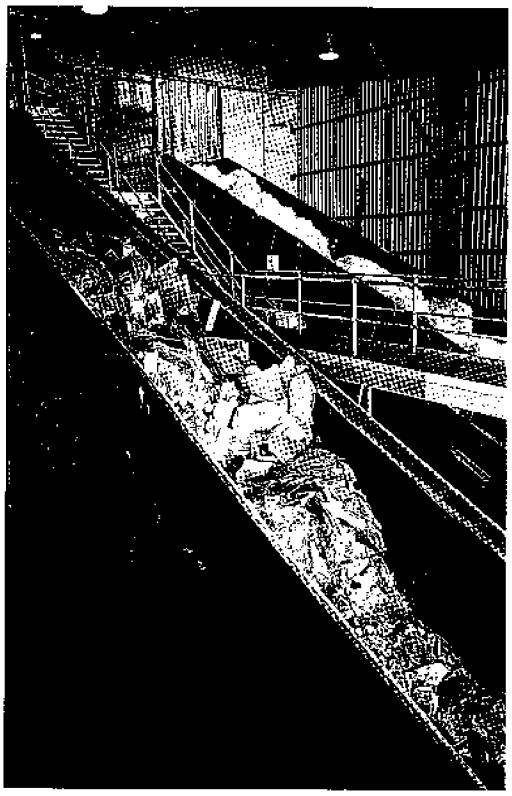
Land is a vital element of the environment. It provides the base for food production, recreational grounds, homes and industrial and commercial developments. Land use practises are important in maintaining and improving the quality of the environment whilst also meeting the economic and social needs of the community.

As land use changes, an increasing number of contaminated sites are being identified. Sites which are found to threaten the health of people using them or which have off-site impacts are monitored by the EPA, which maintains a register of sites which may be subject to clean up under EPA direction.

In Victoria, at December 1996 there were 13 such sites registered. The EPA also maintains records of sites which are contaminated but do not present a risk to health or the environment with the current or proposed use of the site. These sites are not listed on the Priority Sites Register, however contamination assessments are retained by EPA and supplied to the relevant planning authority for future reference.

Deforestation and agricultural practices can have a significant impact on the environment, contributing to soil salinity, erosion and to turbidity, through siltation, in our waterways. Education and revegetation programs are being implemented along with changes to agricultural practices to address these problems. For further information on the forestry industry refer to Chapter 14.

Areas of the natural environment in Victoria are protected under the National Parks Act as National, State, Wilderness, Marine or Coastal Parks. In Victoria at June 1995, there were 32 National Parks, 3 Wilderness Parks, 32 State Parks, 6 Marine and Coastal Parks or Reserves and over 40 other Parks and Reserves. These Parks covered a total of 2,948,988 ha and represented 13% of the State's area and almost 34% of the Victoria's public land.



Waste management

Governments in Australia are committed to reducing waste by 50% in the decade to the year 2000. Local government is responsible for waste management services such as garbage collection and local recycling programs. The EPA is working with local councils and other bodies to promote waste reduction and improve the scope and efficiency of kerbside recycling collections, whilst maintaining their financial viability by promoting the development of competitive markets for recycled products. By developing these measures, pressure on landfills will be reduced and higher levels of recoverable materials will be available for reuse or recycling.

Improvements are also being made to the planning and management of landfill sites in Victoria through rationalisation of waste management across the State. All municipalities will participate in regional waste management groups responsible for regional waste planning before the end of the 1996–97 financial year.

Two agencies, the Recycling and Resource Recovery Council and the Waste Management Council, which have been responsible for waste management issues in Melbourne, Bendigo, Ballarat and Geelong have merged to become Eco Recycle Victoria with a state-wide ambit. The landfill levy has been extended to all licensed landfills.

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Bureau of Meteorology

Environment Protection Authority

Department of Conservation and Natural Resources, Annual Report 1994–95

Photographs

Mitchell River: Courtesy of Tourism Victoria

Wilsons Promontory: Courtesy of Tourism Victoria

Litter boom, Yarra River

Paper recycling: Courtesy of the Environmental Protection Authority