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, Bureau of Meteorology and 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 (table 2.1).

2.1 AREA OF STATES AND TERRITORIES

State or Territory	Square kilometre area, 1996(a)	Percentage of total area(a)	Length of coastline in kilometres(a)	Percentage of total population (as at 30 June 1997)(b)
Western Australia	2 529 880	32.89	20 781	9.7
Queensland	1 730 650	22.50	13 347	18.4
Northern Territory	1 349 130	17.54	10 953	1.0
South Australia	983 480	12.78	5 067	7.9
New South Wales	800 640	10.41	2 137	33.9
Victoria	**227 420**	**2.96**	**2 512**	**24.8**
Tasmania	68 400	0.89	4 882	2.6
Australian Capital Territory	2 360	0.03	0	1.7
Australia	*7 692 030*	*100.00*	*59 679*	*100.00*

(a) Excludes Jervis Bay (57 km of coastline), Christmas Island and Cocos (Keeling) Island Territories (total area 225.1 sq. km). (b) Includes estimates for Jervis Bay, Christmas Island and Cocos (Keeling) Island Territories.

Source: AUSLIG 100K Coastline database, 1993; Bureau of Meteorology; Regional Population Growth, Australia (Cat no. 3218.0; Unpublished data, 1996 Census of Population & Housing.

Location

Wilson's Promontory, latitude 39°08'S, longitude 146°22'30"E, is the southernmost point of mainland Victoria and similarly of mainland 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 at longitude 140°58'E and extends from latitude 33°59'S to latitude 38°04'S, a distance of 451 kilometres.

Victoria's longest river is the Goulburn, which runs from Lake Eildon to the Murray east of Echuca (table 2.2). The Goulburn is also the river with the greatest annual flow of water. (The Murray River flows in New South Wales, as the State boundary is the south bank of the river.)

2.2 SELECTED PHYSICAL FEATURES

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

Source: E.S. Hills, The Physiography of Victoria, Whitcombe and Tombs, Melbourne, 4th edit.

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 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 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 in a year varies considerably. In the Otway Ranges there are over 200 days of rain, compared with an average 100 wet days a year experienced in regions approximately 160 kilometres inland from the coast. Average rainfall ranges from 250 millimetres for the driest parts of the Mallee to 2,600 millimetres at Falls Creek in the Alps. District rainfall in Victoria is shown in table 2.3.

2.3 RAINFALL IN DISTRICTS(a)

	Year						
	1992	1993	1994	1995	1996	1997	Average(b)
District	mm	mm	mm	mm	mm	mm	mm
North Mallee	490	374	177	355	308	241	322
South Mallee	500	411	175	333	376	243	366
North Wimmera	588	448	221	432	431	292	404
South Wimmera	770	604	336	488	580	390	515
Lower North	604	541	268	462	425	284	438
Upper North	689	645	288	572	556	376	524
Lower Northeast	1 096	1 083	574	986	1 014	547	796
Upper Northeast	1 451	1 526	754	1 225	1 384	799	1 084
East Gippsland	983	771	698	862	747	551	790
West Gippsland	874	931	785	959	904	592	910
East Central	1 027	1 041	593	1 028	997	534	868
West Central	832	794	429	711	643	419	622
North Central	935	922	458	780	850	514	766
Western Plains	812	699	454	636	626	441	628
West Coast	983	794	687	762	838	633	778

(a) Figures in this table have been revised to reflect Bureau of Meteorology methodology which uses a new scientific averaging technique across the whole rainfall area rather than the previous method of averaging selected rainfall stations within the rainfall area. For this reason tables published in previous years cannot be compared with this revised data. (b) Average for 84 years 1913 to 1997.

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 from 25°C to 29°C. In autumn and spring, they average near 20°C; while in winter, they average from 13°C to 15°C (table 2.4).

Situated about 60 kilometres from 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 north eastern suburb of Watsonia has an average summer maximum of 26.1°C.

2.4 AVERAGE MONTHLY TEMPERATURE IN MELBOURNE

	Maximum	Minimum
	°C	°C
January	25.9	15.1
February	26.0	15.5
March	24.1	14.1
April	20.6	11.8
May	17.1	9.5
June	14.3	7.2
July	13.7	6.5
August	15.1	7.4
September	17.2	8.7
October	19.7	10.3
November	21.8	12.0
December	24.1	11.0

Source: Bureau of Meteorology.

The hottest months in Melbourne are normally January and February, when the average maximum temperature is 26ºC (table 2.5). The hottest day on record in Melbourne was 13 January 1939, when the temperature reached 45.6ºC.

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 a consequence of asphalt and concrete absorbing daytime warmth and radiating it back into the environment during night, is largely confined to the Central Business District (CBD). In the CBD, minimum temperatures are now mostly between 1ºC and 2ºC 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 10 annual occurrences of 2ºC or less around the Bay, but the frequency increases to over 20 in outer suburbs and to more than 30 a year in the more frost susceptible areas.

2.5 TEMPERATURE—Melbourne

	Air temperature daily readings			Extreme air temperature				Extreme temperature	
				Highest max.		Lowest min.		Lowest terrestrial	
	Mean max.	Mean min.	Mean	Value	Date of occurrence	Value	Date of occurence	Value	Date of occurrence
	°C	°C	°C	°C	—	°C	—	°C	—
Jan	25.9	15.1	20.5	45.6	13/1/1939	5.6	28/1/1895	–1.0	28/1/1885
Feb	26.0	15.5	20.7	43.2	8/2/1983	4.6	24/2/1924	–0.6	6/2/1891
Mar	24.1	14.1	19.1	41.7	11/2/1940	2.8	17/3/1884	–1.7	(a)
Apr	20.6	11.8	16.2	34.9	5/4/1938	1.6	24/4/1888	–3.9	23/4/1897
May	17.1	9.5	13.3	28.7	7/5/1905	–1.2	29/5/1916	–6.1	26/5/1916
Jun	14.3	7.2	10.7	22.4	2/6/1957	–2.2	11/6/1866	–6.7	30/6/1929
Jul	13.7	6.5	10.1	23.1	30/7/1975	–2.8	21/7/1869	–6.4	12/7/1903
Aug	15.1	7.4	11.3	26.5	29/8/1982	–2.1	11/8/1863	–5.9	14/8/1902
Sep	17.2	8.7	12.9	31.4	28/9/1928	–0.6	3/9/1940	–5.1	8/9/1918
Oct	19.7	10.3	15.0	36.9	24/10/1914	0.1	3/10/1871	–4.0	22/10/1918
Nov	21.8	12.0	16.9	40.9	27/11/1894	2.4	2/11/1896	–4.1	2/11/1896
Dec	24.1	13.7	18.9	43.7	15/12/1976	4.4	4/12/1870	0.7	1/12/1904
Averages	20.0	11.0	15.5	. .	. .	. .	. .	. .	. .
Extremes	. .	. .	. .	45.6	13/1/1939	–6.7	30/6/1829	–6.7	30/6/1829
	no.	no.	no.	no.	—	no.	—	no.	—
Years of record	30	30	30	142	. .	142	. .	137	. .

(a) 17/1884 and 20/1897.

Source: Bureau of Meteorology.

In Melbourne, rainfall is fairly evenly distributed throughout the year, averaging about 55 millimetres per month with an annual average rainfall of 639 millimetres, falling over 143 days (table 2.6). 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.

2.6 HUMIDITY, RAINFALL AND FOG—Melbourne

	Relative humidity		Rainfall								Fog
					Greatest monthly		Least monthly		Greatest in one day		
Month	9 am mean	3 pm mean	Mean monthly	Mean days	Amount	Year of occurrence	Amount	Year of occurrence	Amount	Date of occurrence	Mean days
	%	%	mm	no.	mm		mm		mm		no.
Jan	62	44	47.1	7.9	176	1963	(a)	1932	108	29/1/1963	0.0
Feb	65	45	45.8	6.8	238	1972	(a)	1965	87	26/2/1946	0.3
Mar	66	47	43.5	9.4	191	1911	4	1934	90	5/3/1919	0.4
Apr	71	52	52.7	10.7	195	1960	—	1923	80	23/4/1960	1.1
May	77	59	67.8	14.5	142	1942	4	1934	51	15/5/1974	1.7
Jun	81	63	42.5	13.2	117	1991	8	1858	44	22/6/1904	2.3
Jul	79	61	48.8	14.8	178	1891	9	1979	74	12/7/1891	2.2
Aug	74	57	57.4	15.9	111	1939	12	1903	54	17/8/1881	1.2
Sep	67	52	53.0	14.0	201	1916	13	1907	59	23/9/1916	0.8
Oct	63	50	65.2	13.9	193	1869	7	1914	61	21/10/1953	0.5
Nov	63	47	56.9	11.8	206	1954	6	1895	73	21/11/1954	0.9
Dec	62	45	58.1	10.4	197	1993	2	1972	100	4/12/1954	0.2
Totals	. .	. .	638.8	143.3	. .	. . .	. .	. . .	. .	. .	11.1
Averages	69	52	. .	. .	. .	. .	. .	. .	. .	. .	. .
Extremes	. .	. .	. .	. .	967	1916	332	1967	108	29/1/1963	. .
	no.	no.	no.	no.	no.		no.		no.		no.
Years of record	30	30	30	30	142	. .	142	. .	142	. .	30

(a) Less than 1 mm.

Source: Bureau of Meteorology.

The eastern suburbs are significantly wetter than the western suburbs. For example, Scoresby has an average annual rainfall of 901 millimetres, in contrast to Laverton's 569 millimetres. The relatively low rainfall to the west of the city is due to a combination of 'rain shadow' effects of the Otway Ranges and 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.

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, 78 millimetres 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 day as heating of the earth's surface induces turbulence in the wind stream. Examples of 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 late winter and early spring months. Dust storms and tornados are rare. However, on 8 February 1983, a dust storm reduced visibility in the city to 100 metres.

Environment

Recognition is increasing of the interdependency between people and 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 1998, an Australian Bureau of Statistics survey collected information about people's views on environmental problems and protection. In Victoria, 71% of people expressed concern about environmental problems, less than the 75% who expressed concern when the survey was first conducted in May 1992. Air pollution remains the environmental problem of greatest concern (32.1%), followed by destruction of trees/ecosystems (22.5%) and freshwater pollution (21.1%).

Air

The Environment Protection Authority (EPA) began monitoring air quality in Victoria in the early 1970s. The major pollutants monitored were ozone, sulphur dioxide, nitrogen oxides, carbon monoxide, airborne particles, hydrocarbons and lead.

Melbourne's air quality rates well by international standards for cities of similar size. 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 solid fuel combustion are also significant contributors to particle pollution during autumn and winter.

Lead level in air concentrations have shown a steady decrease. This downward trend is a result of a phased reduction of lead in petrol and introduction of unleaded petrol in 1985. These combined actions have been 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, 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. Ground water is important in supporting many aquatic ecosystems and wetlands. In addition, many communities rely on good quality ground water for drinking, agricultural and industrial use.

Water pollution can be divided into two main types. The first is point-source pollution, in which the source is localised and identifiable, e.g. discharge drains of industrial or sewage 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 of the quality of inland, coastal and ground waters, 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 production of toxins, are some of the major problems caused by high nutrient levels. Nutrients are of particular concern in waterways across the State. The Victorian Nutrient Management Strategy 1995 provides a policy and planning framework to help catchment groups develop management plans to reduce 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 within the catchment. High turbidity, litter, suspended solids and E.coli (*Esherichia coli*) are major concerns in the Yarra River Catchment. Urban development, paved surfaces 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 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, industrial and commercial developments. Land-use practices are important in maintaining and improving the quality of the environment whilst also meeting the economic and social needs of the community.

As a consequence of changing land use, an increasing number of contaminated sites are being identified; in particular, the redevelopment of inner urban industrial areas to residential use. Sites that 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 that may be subject to clean-up under EPA direction. In Victoria, at July 1998 there were 12 such sites registered.

The EPA also maintains records of sites that are known to be contaminated but do not present a risk to health or the environment under the current or proposed use of the site. These sites are not listed on the Priority Sites Register. However site contamination assessments (statutory environmental audit reports) are retained by EPA, and statements of the suitability of land for the existing or proposed land use are 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 redress these problems.

Waste management

Governments in Australia are committed to reducing waste through avoidance, reuse and recycling. Local government is responsible for provision of domestic waste management services such as garbage collection, and also provides local recycling programs. The EPA is working with local councils and other bodies to promote waste reduction, and in conjunction with EcoRecyle Victoria to improve the efficiency of kerbside recycling collections.

Improvements are also being made to the planning and management of landfill sites in Victoria through rationalisation of waste management across the State. As from May 1997, all municipalities are members of regional waste management groups responsible for regional waste planning and coordination.

Two agencies, the Recycling and Resource Recovery Council and the Waste Management Council, which were responsible for some waste management issues in Melbourne, Bendigo, Ballarat and Geelong, have been succeeded by EcoRecycle Victoria with a Statewide ambit. The landfill levy has been extended to all licensed landfills across Victoria.

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