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Australia's Environment Issues and Trends 2007

Special issue: Water

Australia's Environment: Issues and Trends 2007

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INQUIRIES

- For further information about these and related statistics contact the National Information and Referral Service on 1300 135 070, or refer to contacts listed at the back of this publication.

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Preface

Australia's Environment: Issues and Trends 2007 is the 4th edition in a series that presents a broad selection of environmental statistics and information on topical environmental issues. By drawing on a wide range of ABS statistics and statistics from other official sources, *Australia's Environment: Issues and Trends* describes major aspects of Australia's environment and how these are changing over time. It is designed to assist and encourage informed decision-making, and to meet the information needs of a general readership.

The material presented in *Australia's Environment: Issues and Trends 2007* is organised into two main parts. The first part explores an issue of major environmental concern, and the issue chosen for the 2007 edition is water. The second part covers major trends of relevance to the environment, included under five broad headings: population, human activities, atmosphere, water, and landscape.

The opportunity has been taken to use the most recently available data to update analysis of topics examined in previous editions. The publication does not aim to present data on all environmental issues and other topics will be covered in future editions.

The production of this publication would not have been possible without the contributions of numerous organisations and individuals. The ABS is grateful for this help.

The ABS welcomes readers' suggestions on how the publication could be improved. To comment or to ask for more information, please contact the Director of the Centre of Environment and Energy Statistics.

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General information

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General inquiries about the content and interpretation of statistics in this publication should be addressed to:

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Inquiries about the availability of more recent data from the ABS should be directed to the National Information and Referral Service on 1300 135 070.

There is a wealth of statistical information on the ABS website <http://www.abs.gov.au>.

ABS publications and services

A complete list of ABS publications produced in Canberra and each of the Regional Offices is contained in the ABS *Catalogue of Publications and Products* (cat. no. 1101.0), which is available from any ABS office or on the ABS web site <http://www.abs.gov.au>.

In many cases, the ABS can also provide information which is available on request or which is historical or compiled from a variety of sources. Information of this kind may be obtained through the Information Consultancy Service. Charges are generally made for such information. The ABS also issues a daily release advice on the web site which details products to be released in the week ahead.

Abbreviations

The following abbreviations have been used in this publication.

Australia, states and territories of Australia

Aust.	Australia
NSW	New South Wales
Vic.	Victoria
Qld	Queensland
SA	South Australia
WA	Western Australia
Tas.	Tasmania
NT	Northern Territory
ACT	Australian Capital Territory

Other abbreviations

ABS	Australian Bureau of Statistics
ASR	Aquifer storage recovery
AWR 2005	Australian Water Resources 2005
CFCs	chlorofluorocarbons
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDP	gross domestic product
GHG	greenhouse gas
GVIP	gross value of irrigated production
IUCN	World Conservation Union
OECD	Organisation for Economic Co-operation and Development
NLWRA	National Land and Water Resources Audit
NWC	National Water Commission
NWI	National Water Initiative
PM	particulate matter
PPP	Purchasing Power Parity
RDF	refuse-derived fuel
SD	Statistical Division
SLA	Statistical Local Area
UV	ultraviolet (radiation)

Conversions

One billion = 1,000 million
One gigalitre (GL) = 1,000 megalitres (ML)
One megalitre (ML) = 1,000 kilolitres (kL)
One kilolitre (kL) = 1,000 litres (L)
One micrometre (μm) = 1/1,000 millimetre (mm)
One microgram (μg) = 1/1,000 milligram (mg)
One tonne (t) = 1,000 kilograms (kg)

Symbols and usages

The following symbols and usages mean:

CH_4	methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
°C	degrees Celsius
$	dollars
$m	million dollars
$m GDP	million dollars of gross domestic product
$/cap	dollars per person (per capita)
GJ	gigajoules of energy
GL	gigalitres
ha	hectares
IE	included elsewhere
kL	kilolitres
kL/cap	kilolitres per person
km	kilometres
km^2	square kilometres
mill.	million
mm	millimetres
ML	megalitres
Mt	megatonnes
μg	micrograms
$\mu g/m^3$	micrograms per cubic metre
μm	micrometres (micron)
N_2O	nitrous oxide
nec	not elsewhere classified
no.	number
n.a.	not available
n.p.	not published
nr	no region
p	preliminary – figures or series subject to revision
%	per cent
/cap	per person (per capita)
PJ	petajoules (of energy)
ppm	parts per million
SO_2	sulphur dioxide
SF_6	sulphur hexafluoride
'000	thousand
'000 tonnes	thousand tonnes
'000 ha	thousand hectares
–	nil or rounded to zero

Where figures have been rounded, discrepancies may occur between the sums of the component items and totals.

Introduction

Aims

Many current approaches used when discussing issues on the environment divide environment into component areas of concern, e.g. biodiversity, land, water, air. While this approach is intuitive and useful, and largely mirrors the way in which environmental welfare is publicly administered, its success is partly dependent on the extent to which information can be re-integrated to provide a cohesive picture of Australia's environment and environmental trends. Certainly, when policy makers, environmental practitioners or researchers seek information, their focus is on complex environmental issues which often cut across such areas. For example, to usefully inform on an issue such as salinity, a researcher would need to bring together data relating to soils, agricultural activities, water, biodiversity, and vegetation; and data on drinking and irrigation water may also be relevant. Thus, *Australia's Environment: Issues and Trends* aims to bring together data from a wide range of statistical collections, and to present these data from an issue and trends driven perspective. More specifically, *Australia's Environment: Issues and Trends* aims to:

- Inform decision-making, research and discussion on environmental conditions in Australia, environmental issues of current and ongoing concern, environmental pressures of interest, and changes in these over time – by drawing together up-to-date environmental data and analysis from both ABS and other official sources, and incorporating readily understood commentary about the statistics.

- Support the monitoring and review of progress towards environmental goals, changes in environmental conditions, and levels of environmental pressures and responses – by presenting a range of issues and trends on a regular basis.

Approach

Australia's Environment: Issues and Trends 2007 comprises two main parts, a feature article (the issue) and trends. The first part, a feature article, explores an issue of environmental concern. The issue chosen for this year is water. Articles aim to provide relevant statistical facts surrounding the issue, together with context and explanation through highlighting relevant environmental developments. It is the intention that the topic will change every edition, with some topics refreshed as new data become available. Thus, each edition will remain responsive to contemporary concerns and a more comprehensive picture of Australian environmental conditions will accumulate across editions.

The second part, the trends section, is broken into five discrete areas that encapsulate major environmental indicators of interest to Australians. These are: Population and urban trends, Human activity trends, Atmosphere trends, Water trends, and Landscape trends. The main data sources used in the trends sections are included at the bottom of the tables and graphs or referenced at the bottom of each page.

A key aspect of the publication is its readability. Information is deliberately presented in non-technical language that can be readily understood by the general reader. Statistics are organised to illustrate specific issues and to highlight the meaning behind the data, and the main patterns and exceptions.

Environmental trends and progress

Australia's Environment: Issues and Trends complements the ABS publication, *Measures of Australia's Progress (*MAP, cat. no. 1370.0). MAP presents a suite of indicators for reporting on economic, social and environmental progress and considers the interrelationships between these aspects of life. MAP 2006 used six headline indicators across three headline dimensions to discuss progress in the health of the environment: the natural landscape (biodiversity, land, water), air and atmosphere, and oceans and estuaries. In addition, MAP presents a number of supplementary and other indicators.

It should be noted that there is no definitive set of indicators that encapsulate progress in the environmental domain. Any suite cannot fully reveal the total picture of Australia's environment. *Australia's Environment: Issues and Trends* extends both the breadth and depth of the environmental investigation presented in MAP.

Looking at indicators is useful for the following:

- evaluating conditions and trends
- comparing places and situations
- offering early alert information
- anticipating future conditions and trends
- evaluating conditions in relation to certain policy goals.

The indicators included in *Australia's Environment: Issues and Trends 2007* have been chosen to strike a balance between considerations of approachability, technical precision and the availability and quality of data. The indicators used in this publication have been selected on the basis that, as far as possible, they should be:

- relevant
- supported by timely data of good quality
- available preferably as a time series to see if changes are significant over time
- summary in nature
- preferably capable of disaggregation by, say, geography or population group
- intelligible and easily interpreted by the general reader.

Data gaps and data inconsistency present problems in many areas of environment analysis. For example, water quality is measured in many states and territories, but not on a comparable basis.

Where data have not been kept current or updated in the past five years, generally they have been omitted for this year's publication, but may be re-introduced in a later edition if the data are updated and available as a time series.

Feature Article

Issue: Water

Water is a valuable resource. Apart from drinking water and household use, Australians rely on water as an input to almost every industry in the nation's economy, particularly agriculture.

In the past, Australians have generally thought of water as a free resource. However, drought and water restrictions in many areas of Australia since 2002, together with increasing evidence of the adverse effects of increased water use on river health, is changing the way we regard water. It is now widely recognised that taking too much water out of Australia's rivers and groundwater systems can have detrimental economic and environmental consequences. These can include declines in native animal and plant populations (and possible extinctions) and reduced agricultural production (e.g. caused by reduced availability of water or salinity).

To address these water availability issues, there is a need to balance the different demands. The states and territories, along with the Australian Government, officially recognised the need to improve the efficiency of water use and the health of Australia's river and groundwater systems, with the signing of the National Water Initiative (NWI) in 2004, which was built on the Council of Australian Governments (COAG) framework for water reform signed in 1994. The NWI involves a range of reforms to the water industry, including water trading. To provide a baseline of conditions at the start of the NWI reform process, the National Water Commission (NWC) commissioned an assessment of water resources, Australian Water Resources 2005 (AWR 2005).

There is a lack of accurate, nationwide environmental data on which to base a clear national picture of the state of Australia's water resources.[1] The *Water Act 2007*, is a key mechanism for implementing elements of the Australian Government's National Plan for Water Security including increasing the availability and quality of information on water at the national level. Within existing data limitations, this article looks at some of the nation's major water issues.

- **Availability:** The volume of water available is determined mainly by rainfall, which affects run-off and groundwater supplies. Rainfall is variable and in recent times many parts of Australia have experienced prolonged periods of drought. Population growth also contributes to pressure on water supplies. Water storage in dams and aquifers (underground storage) is important to secure water supplies for human use. However, storage is also an environmental issue, for example, dams disrupt and deplete environmental flows. This can adversely affect flora and fauna downstream.

- **Consumption:** Water consumed for drinking and in our homes and gardens is only a small part of the total water use in Australia (11% of total water consumed in 2004–05). Most of the water consumed in Australia is by the agriculture industry, which accounted for nearly two-thirds (65%) of total water consumed in 2004–05.

- **River health:** Water quality is directly related to river and wetland health. Human activities can exacerbate river health problems such as salinity, turbidity and blue-green algae outbreaks. Reduced water quality and flows can affect the agricultural and tourism industries and damage the plants and animals that rely on the water for food and habitat.

- **Management and conservation:** The recent drought has firmly focused attention on the need to conserve water. One-third of farmers reported water-related management activities in 2004–05. For households, mandatory water restrictions apply in many parts of Australia to limit outdoor water use, and many Australians have been voluntarily conserving water by adopting water saving practices and installing water saving devices.

Oceans and estuaries are outside the scope of the article.

Water in Australia

Water availability – counting the drops

The availability of water determines the quantity of water that society can use for agriculture, recreation, industrial and domestic purposes. Water availability is also critical for ecological processes, which are in turn fundamental for the wellbeing of society.

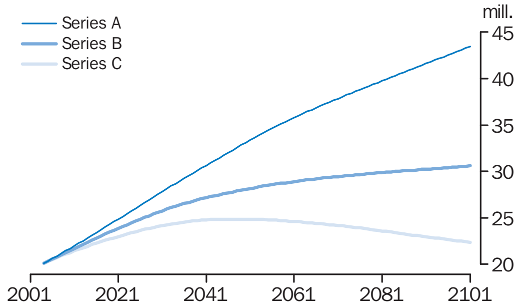
Water is ultimately a renewable resource. Water is constantly exchanged between the oceans, the land and the atmosphere (the hydrologic cycle). For example, water evaporates from oceans and rivers into the atmosphere and then falls as rain, snow, etc. The amount of rain, as well as the rate at which it evaporates, is transpired by plants, or runs off land to fill rivers and aquifers, determines how much water is available.

Water is a scarce resource in many parts of Australia. To secure water supplies, water is stored above ground (for example, in dams) and below ground in aquifers. This is important in Australia because of variable rainfall, both across the continent and from year-to-year.

In recent years, low rainfall in many parts of Australia has led to low water storage levels, causing concern about the adequacy of water supplies.

Population increase, especially in coastal urban areas, is placing further pressure on water supplies.

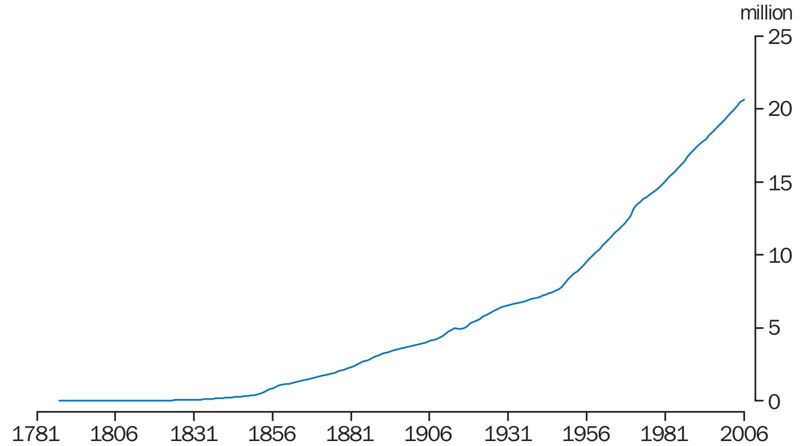
Population projections



Source: ABS, Population Projections, Australia, 2004 to 2101 (cat. no. 3222.0).

Over the decade to June 2006, Australia's population has grown by 2.2 million people or about 12%. Future projections indicate that Australia's population could range between 25 and 33 million people by the year 2051 (depending on various assumptions about future levels of fertility, mortality and overseas migration), thereby placing further pressure on water resources. Predictions are for higher growth rates in all capital cities, compared to regional and rural areas. This will see further concentration of the population in capital cities.

Population growth – 1788 to 2006



Source: ABS, Australian Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, March 2007 (cat. no. 3101.0).

Average annual rainfall and daily temperatures, selected cities

	Rainfall mm	Daily maximum temperature °C	Daily minimum temperature °C
Sydney	1 276.5	22.3	14.4
Melbourne	654.4	20.1	11.2
Brisbane	1 194.0	25.3	15.7
Adelaide	563.0	22.1	12.1
Perth	745.3	24.5	12.5
Hobart	576.4	17.2	8.8
Darwin	1 847.1	32.1	23.4
Canberra	630.0	19.7	6.7
Alice Springs	325.6	28.8	13.2

Averages are for the standard climate normal period (1971–2000) except for Adelaide (1977–2000). Brisbane, Perth, Darwin and Canberra averages are for observations taken at airports, others are at locations in or near the central city.
Source: Bureau of Meteorology, http://www.bom.gov.au, last viewed 3 September 2007.

From drought to flooding rains

The major driver of water availability in Australia is rainfall.

Australia's long-term annual average rainfall is 472 millimetres (mm), the lowest of all the continents (except Antarctica).[2]

A notable feature of Australia's climate is the high variability of its rainfall. Australia's climatic zones range from high rainfall tropical regions in the north through desert regions in the interior to the temperate regions of the south. Rainfall in Australia varies not only from region-to-region but also from year-to-year and from season-to-season.

The average total rainfall throughout Australia for 2006 was 493 mm, slightly more than the long-term average of 472 mm. However, this average was a combination of well-above average totals across the more sparsely populated areas of northern and inland Western Australia, and well-below average totals recorded in the south-east and far south-west where the majority of Australia's population and agricultural production is concentrated.

The well-below average totals continued into 2007, particularly in the agriculturally important Murray-Darling Basin. October 2007 marked the sixth anniversary of lower-than-average rainfall totals – the November 2001 to October 2007 period was the Basin's equal driest six-year period on record. Accompanying high temperatures exacerbated the impact of this low rainfall.[3]

El Niño

The variability in seasonal and yearly rainfall experienced on the Australian continent is related to the climate phenomenon known as El Niño-Southern Oscillation (ENSO). El Niño is well known in Australia since it is often associated with reduced winter and spring rainfall, especially in eastern Australia, which can lead to drought conditions and increased bushfire risk. It was also the dominant cause of the drought experienced throughout south-eastern Australia in 2006.[4]

El Niño refers to a warming of surface water over the central and eastern tropical Pacific Ocean. Associated with this warming are changes in the atmosphere (measured by the Southern Oscillation Index which measures the air pressure difference between Tahiti and Darwin) that affect weather patterns across much of the Pacific Basin, including Australia.

La Niña, the opposite of El Niño, is often associated with above-average rainfall and flooding. By continuously measuring changes in air pressure, sea surface temperatures, and other variables, meteorologists are able to predict El Niño and La Niña events.

El Niño events have been affecting the Pacific Basin for thousands of years, usually occurring about every four to seven years and lasting for about 12–18 months. However, in recent years El Niño events have been happening more frequently, occurring in 1986–87, 1991–1992, 1994, 1997–98, 2002–03 and 2006.[5]

Run-off

In most parts of Australia, only a small proportion of rainfall finds its way into rivers, lakes, dams and aquifers. Australia's Murray-Darling Basin, for example, is one of the largest catchments in the world, but it is also one of the driest. The average annual flow of the Murray-Darling would pass through the Amazon River in less than a day.[6]

Variable rainfall, high evaporation (especially in inland Australia) and mountains that are not high by world standards, have led to low surface water flows. Consequently, discharge of Australia's rivers into the sea is by far the lowest of any of the continents, excluding Antarctica.[7]

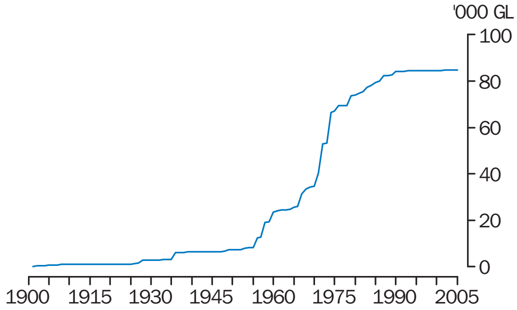
However, where annual rainfall is relatively high, including parts of Tasmania and northern Australia, run-off is also high.

Dams

Dams have been built in Australia since the late-1800s to provide a reliable water resource for irrigation, urban water needs and hydro-electric power generation.

At the start of the 20th century the combined storage capacity of all large dams was 250 GL, increasing to 9,540 GL by 1950 and to 83,853 GL in 2005.

Total storage capacity of large dams



Source: ABS, Water Account, Australia, 2004–05 (cat. no. 4610.0).

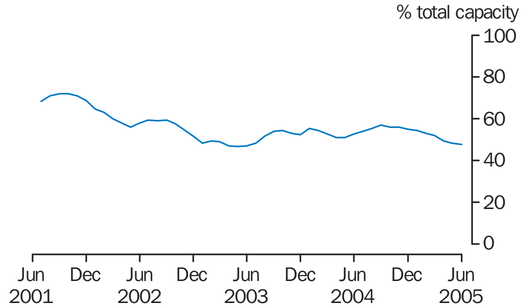
Australia has about 500 large dams. A large dam is defined as having a height of greater than 15 metres (m), or as greater than 10 m but meeting other size criteria.[8]

Australia has the highest per capita water storage capacity in the world, more than 4 million litres per person.[9]

However, storage levels in many dams have continuously declined in the period from 2001 to 2006 as a result of reduced inflows due to the drought and continued water extractions.

Drought conditions were reflected in an 18% fall in the water stored in large dams between 2002 and 2005. On 1 July 2002, storage levels were at 48,683 GL, falling to 39,959 GL by 30 June 2005.

Large dam storage levels



Source: ABS, Water Account, Australia, 2004–05 (cat. no. 4610.0).

Despite rainfall in the first half of 2007, at the end of August 2007 many dams were yet to return to their pre-drought levels according to major metropolitan water providers. Sydney's dam storage levels had recovered to more than half full in August 2007, but those in Canberra, Melbourne and Perth remained less than half full. As a consequence, water restrictions remained in place in all capital cities (except Darwin and Hobart) and in many regional areas into the second half of 2007.

Farm dams have been estimated to hold nearly 10% of total water stored in Australia.[10] Farm dams intercept run-off before it reaches rivers and streams, which can reduce the flow of water in waterways. Estimates from Victoria suggest that up to 70% of water in farms dams is lost to evaporation.[11]

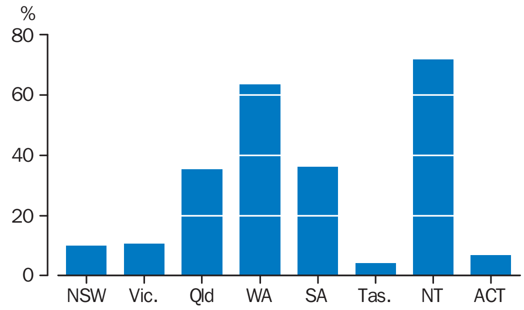
Groundwater

While surface water supplies in dams and reservoirs are usually the main focus when assessing water availability, Australia also has significant groundwater reserves.

Groundwater is water contained underground in geological formations, made up of porous rocks or soils, known as aquifers. Surface water (in rivers) and groundwater can be interconnected as water seeps through riverbeds and percolates down to become groundwater. They can also be interconnected as groundwater surfaces in wetlands or streams due to the removal of deep-rooted (usually native) vegetation.

About 80% of total water consumed in Australia is surface water and about 20% is groundwater. However, national estimates for the ratio of groundwater to surface water consumption have not been updated since 1996–97.

Groundwater as percentage of total water use, by state, 1996–97



adapted from: National Land and Water Resources Audit 2001, Australian Water Resources Assessment 2000, Land and Water Australia, Canberra.

Some areas have a high dependence on groundwater, such as Western Australia and the Northern Territory, where well over half of the consumption is supplied from groundwater sources. Groundwater quality can vary considerably, particularly with regard to the amount of dissolved salt (salinity) that affects its suitability for human consumption and agricultural use.

The Great Artesian Basin is Australia's biggest source of groundwater. It extends for 1.7 million km^2 under Australia including parts of South Australia, New South Wales, Queensland and the Northern Territory. It contains 64.9 million GL of water and is the world's largest artesian groundwater basin.[12]

Aquifer storage and recovery

Aquifer storage has many potential advantages over surface water storages such as dams and reservoirs. Aquifers can store large quantities of water without losses from evaporation and with reduced risk of contamination, both of which are problems associated with surface water storages.

Aquifer storage and recovery (ASR) is a human modification of the groundwater recharge system that has been occurring naturally for millions of years. Natural groundwater recharge occurs by filtration of rainwater through the soil profile, past the vegetation root zone and down to permeable rocks known as aquifers. ASR involves gravity feeding or injecting water into a suitable underground aquifer for storage and later reuse.

ASR can be a way to artificially recharge depleted underground water supplies. For example, during high rainfall periods, excess stormwater, filtered and cleaned (by the wetlands) can be pumped into the aquifer. During dry periods, the water is recovered from the aquifer, when needed to irrigate sporting fields and turf areas.

In South Australia, ASR trials have used stormwater filtered and cleansed at the Kaurna Park wetlands and stored in aquifers, for use in irrigation. In Western Australia, an ASR project for a groundwater aquifer in Cottesloe will filter stormwater to replenish the aquifer.

ASR avoids the impacts that dams have on ecological systems (such as disruption and depletion of environmental flows and restricting movements of fish along waterways). However, if it involves depleting groundwater reserves, it can be as ecologically damaging as the depletion of surface water in rivers, through reducing the supply or quality of water to wetlands and surface waters on which large numbers of species rely.

Desalination

Desalination is seen by some as the way to drought-proof Australia's cities, at least those in coastal areas. Desalination plants remove the salt from seawater or brackish water to make it suitable for drinking. Worldwide, more than 23 GL of desalinated water is produced each day.[13] Most of this is in the Middle East and North Africa, with 100% of the water in Kuwait and Qatar sourced from desalination plants.

At Kwinana, near Perth, a desalination plant started production in late 2006, providing 130 ML a day, about one-fifth of Perth's water use. This plant uses the reverse osmosis method that has a synthetic membrane that allows water molecules to pass through, but not salts.

Desalination is a relatively expensive way to produce drinking water. However, over the past decade improved technologies have reduced the cost of desalination from between \$3.00 to \$5.00 a cubic metre (m^3) to between \$0.46 to \$0.80/m^3, depending on local conditions.[14]

Energy consumed per kilolitre of potable water produced

Water supply option	Energy use in kilowatt hours per kilolitre(kWh/kL)
Reverse osmosis of seawater (seawater desalination)	3.0–5.0
Brackish reverse osmosis (stillwater desalination)	0.7–1.2
Municipal wastewater reclamation	0.8–1.0
Conventional water treatment	0.4–0.6

Source: Issues encountered in advancing Australia's water recycling schemes, viewed 3 September 2007. <http://www.aph.gov.au/library/pubs/rb/2005-06/06rb02.pdf>.

It is also relatively expensive in terms of energy use and has associated environmental costs such as greenhouse gas emissions. The process also produces a brine waste product that has potentially hazardous effects on the marine environment.

Controversy surrounds the use of renewable energy (such as wind or solar power) to reduce the greenhouse gas emissions associated with desalination, particularly if the desalination plant draws power from the electricity grid. If renewable energy feeds into the electricity grid, the network effectively combines all electricity from all generators so it is not possible to direct the renewable energy flows to a particular user, such as a desalination plant. Further, if the renewable energy would otherwise have been used to supply other users, then for any new desalination plant to meaningfully claim it is powered by renewable energy, additional renewable energy must be generated, equal to the electricity consumption of the plant over time.[15]

Recycling

Recycling water is regarded as a less expensive and more environmentally friendly alternative to desalination. Recycled water is used overseas and the scientific evidence overwhelmingly shows it is safe to drink. However, there is a perception that the Australian public is reluctant to allow recycled water directly into the drinking water system because of health concerns. This perception was reinforced when, in 2006, 62% of Toowoomba residents voted against a proposal to source 25% of the city's water from recycled effluent.

Status of large-scale desalination projects, selected urban centres

Urban centre	Population (mill.)	Desalination status
Sydney	4.3	Planned desalination plant to provide up to 250 ML a day by 2010
Melbourne	3.7	Study into planned desalination plant near Wonthaggi, to provide 150 GL a year by 2012 (a third of Melbourne's water)
Brisbane & Gold Coast	2.8	Approval for desalination plant at Tugan in south-east Qld to provide 120 ML a day
Perth	1.5	Desalination plant at Kwinana providing 130 ML a day, with another 130ML a day plant proposed
Adelaide	1.1	Planned desalination plant to provide 50 GL a year by 2012

Adapted from: Knights et al, 2006, viewed September 2007, <http://www.ceem.unsw.edu.au/content/userDocs/OzWaterpaperIMRP_000.pdf>. ABS, Regional Population Growth, 2005–06 (cat. no. 3218.0).

Water consumption – conflicting demands, balancing needs

The most recent data on water consumption in Australia shows a fall of 14% between 2000–01 and 2004–05 to 18,767 GL, largely due to the effects of the recent drought in many parts of the country.

The graph below shows the biggest fall in water consumption was in agriculture. Reduced rainfall meant less water available for irrigation, prompting farmers to reduce their area of planting. The table opposite shows that agriculture was the highest water consumer in every state and territory.

Western Australia saw relatively high water consumption by the mining industry reflecting the high level of mining in that state. Tasmania saw high consumption by the manufacturing industry mainly due to wood and paper manufacturing.

For most industries, water use and water consumption are the same, however, consumption will be different for some industries, specifically the Water supply, sewerage and drainage service industry, and Mining and Manufacturing industries where in-stream water use and water supply volumes are high.

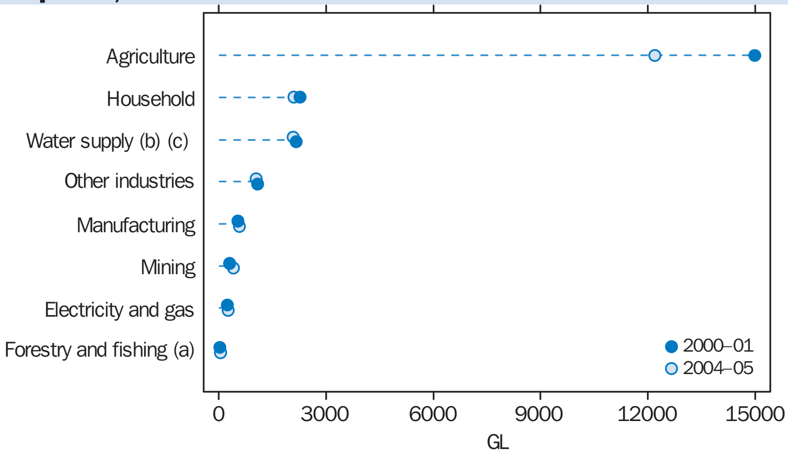
Water consumption is equal to the sum of distributed water from water suppliers and self-extracted water use and reuse water, less in-stream use and distributed water to the environment.

Top three water consuming sectors, by state, 2004–05

State	Top Water Using Sector/Industry	Consumption (GL)	Percentage of total %
NSW/ACT	Agriculture	4 134	69
	Water Suppliers	637	11
	Households	604	10
Vic.	Agriculture	3 281	66
	Water Suppliers	793	16
	Households	405	8
Qld	Agriculture	2 916	67
	Households	493	11
	Water Suppliers	426	10
SA	Agriculture	1 020	75
	Households	144	11
	Manufacturing	55	4
WA	Agriculture	535	36
	Households	362	24
	Mining	183	12
Tas.	Agriculture	258	59
	Households	69	16
	Manufacturing	49	11
NT	Agriculture	47	33
	Households	31	22
	Other Industries	30	21

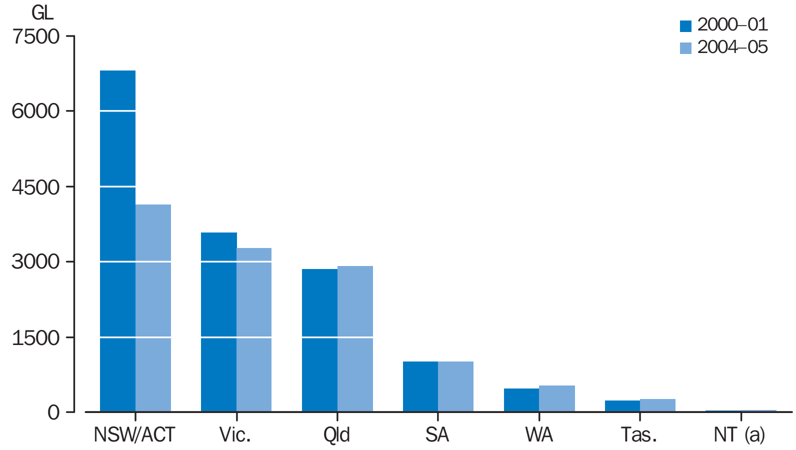
Note: 'Water Suppliers' include sewerage and drainage services.
Source: ABS, Water Account Australia, 2004–05, (cat.. no. 4610.0).

Water consumption, Australia



(a) Includes services to agriculture, hunting and trapping
(b) Includes sewerage and drainage services
(c) Includes water losses
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Water consumption – agriculture



Note: NT values too small to show.
Source: ABS, Water Account Australia, 2004–05 (cat.. no. 4610.0).

Water consumption – agriculture

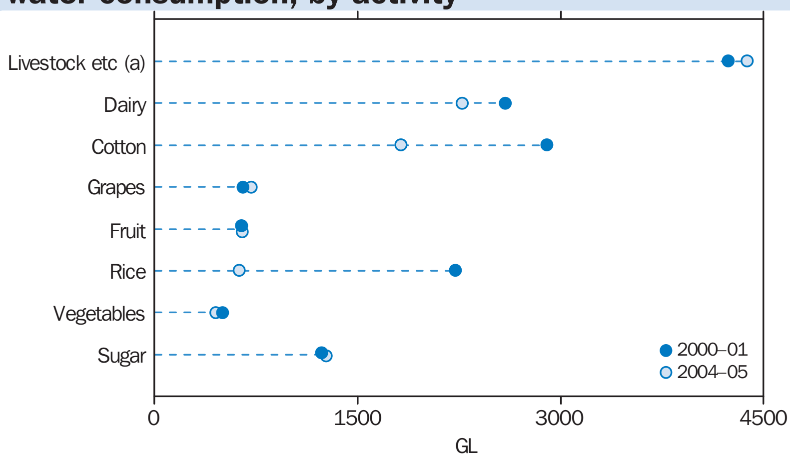
Agriculture accounts for nearly two-thirds (65%) of Australia's total water consumption. The amount of water consumed by agriculture was 12,191 GL in 2004–05, nearly one-fifth less (19%) than in 2000–01 when it was 14,989 GL.

Within the agriculture industry, the category "livestock, pasture, grains and other agriculture" had the highest water consumption, 4,374 GL (36%). This can be broken down into livestock (1,035 GL), pasture (1,928 GL) and grains (1,162 GL). Dairy farming consumed 2,276 GL or 19% of total water consumption, cotton consumed 1,822 GL (or 15%) and sugar 1,269 GL (or 10%).

The largest percentage fall in water consumption from 2000–01 to 2004–05 was in rice (72%) from 2,222 GL to 631 GL. Cotton fell 37% in the period from 2,896 GL to 1,822 GL. This was a result of dry conditions in New South Wales and a reduction in the irrigated area of these crops because of reduced water allocations due to the drought.

Consumption of water by agriculture was greatest in New South Wales, which accounted for more than a third (34%) of total agricultural water consumption. Next was Victoria (27%) and then Queensland (24%). New South Wales combined with the Australian Capital Territory (ACT) had the largest fall in agricultural water consumption from 2000–01 to 2004–05 (6,795 GL to 4,134 GL). Of this, the ACT accounted for only about 1 GL.

Agriculture water consumption, by activity



(a) Includes livestock, pasture, grains and other agriculture (excluding dairy farming).
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Irrigation on Australian farms

Nearly all of the water used for agricultural production in 2004–05 (91%) was for irrigation of crops and pastures. The rest was for other agricultural uses, such as drinking water for stock and dairy/piggery cleaning.

More than a quarter (27%) of Australian farms use irrigation. In 2004–05, a total of 35,244 farms applied a total of 10,085 GL of water to 2.4 million hectares. This area represents less than 1% of agricultural land used for pasture and crops in Australia.

Farms that irrigated generated, on average, 55% more output per farm in 2003–04 than farms that did not irrigate – although the average land area of irrigated farms was less than that of non-irrigated farms.

The gross value of irrigated production (GVIP) in Australia was estimated at $9.1 billion in 2004–05, around one-quarter (23%) of the gross value of all agricultural production. GVIP is measured as the volume of irrigated commodities produced, valued at wholesale prices.

Data from 2003–04 show that more than half (52%) of GVIP came from irrigated horticulture, with irrigated pastures and irrigated broadacre crops each contributing around one-quarter. Horticultural crops include fruit trees, nut trees, berries, vegetables and grape vines.

In 2003–04, irrigated broadacre crops accounted for nearly half (45%) of Australia's irrigation water use and 42% of the irrigated area. Broadacre includes mainly annual crops such as rice, cereals, sugar and cotton.

Within the irrigated broadacre crops group, cereal crops was the largest cropping activity in terms of irrigated area, however the activities that have increased most since the early 1980s, both in terms of irrigation water use and area cultivated, are cotton, rice and sugar.

Irrigation activity

	2003–04	2004–05
Percentage of agricultural establishments irrigating	31.0	27.1
Volume applied (GL)	10 442	10 085
Application rate (ML/ha) (a)	4.3	4.2

(a) Averaged across all irrigated pastures and crops.
Source: ABS, Water Use on Australian Farms, 2004–05 (cat. no. 4618.0).

The value of irrigated broadacre production was lower in 2003–04 than in earlier years, primarily reflecting lower income from rice and cotton growing. The drought contributed to a sharp reduction in the area harvested of both cotton and rice in 2002–03 and 2003–04.

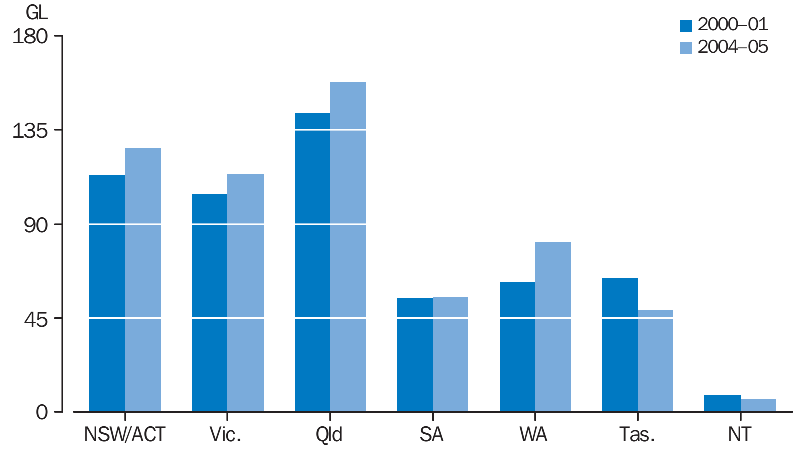
Nationally, the most common source of irrigation water was surface water, such as rivers and dams, reported by three-quarters of irrigating farm establishments. Recycled or re-used water from off-farm sources accounted for about 2% of water used by agriculture.

Irrigation activity by crop type, 2003–04

	Farms undertaking this activity	Farms irrigating this activity	Farms irrigating this activity as a percentage of all farms with this activity	Farms with this activity as the main irrigated activity as a percentage of all farms with this activity (b)
	no.	no.	%	%
Pastures	103 364	16 943	16	88
Broadacre crops	55 656	12 507	22	78
Horticultural crops	20 480	17 032	83	91
Total (a)	130 526	40 400	31	

(a) The total number of farms is less than the sum of the number of farms engaged in each activity because many farms have more than one activity.
(b) The main irrigated activity is defined as that irrigated activity which occupied the largest area of irrigated land on the farm.
Sources: ABS, Characteristics of Australia's Irrigated Farms, 2000–01 to 2003–04 (cat. no. 4623.0).

Water consumption – manufacturing, by state



Source: ABS, Water Account, Australia, 2004–05 (cat. no. 4610.0).

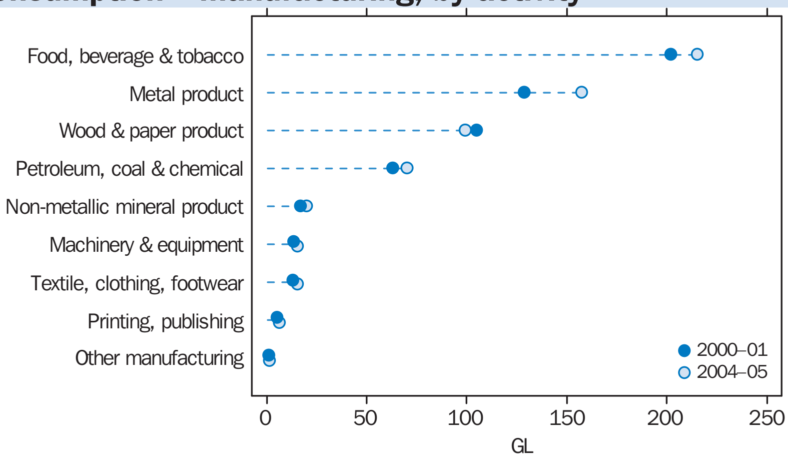
Water consumption – manufacturing

In 2004–05, the manufacturing industry consumed 589 GL (or 3% of Australia's total water consumption). This was 7% higher than the water consumed by manufacturing in 2000–01 (549 GL).

All states and territories, except Tasmania and the Northern Territory, increased their total manufacturing water consumption from 2000–01 to 2004–05. The state or territory with the highest manufacturing water consumption was Queensland (158 GL), followed by New South Wales and the Australian Capital Territory combined (127 GL), and then Victoria (114 GL).

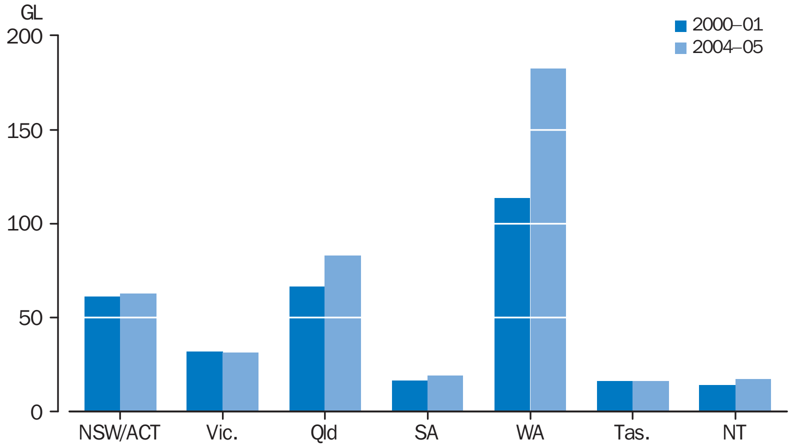
Within the manufacturing sector, the largest volume of water was used by manufacturers of Food, beverage and tobacco (215 GL), followed by Metal products (146 GL) and then Wood and paper products (99 GL).

Water consumption – manufacturing, by activity



Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Water consumption – mining, by state

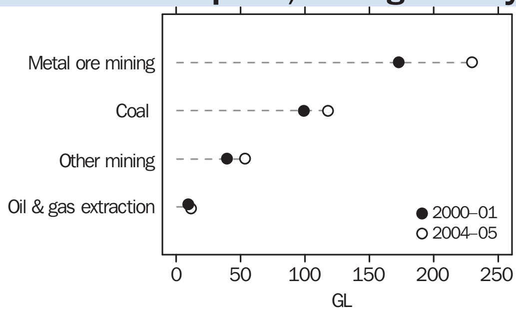


Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Water consumption – mining

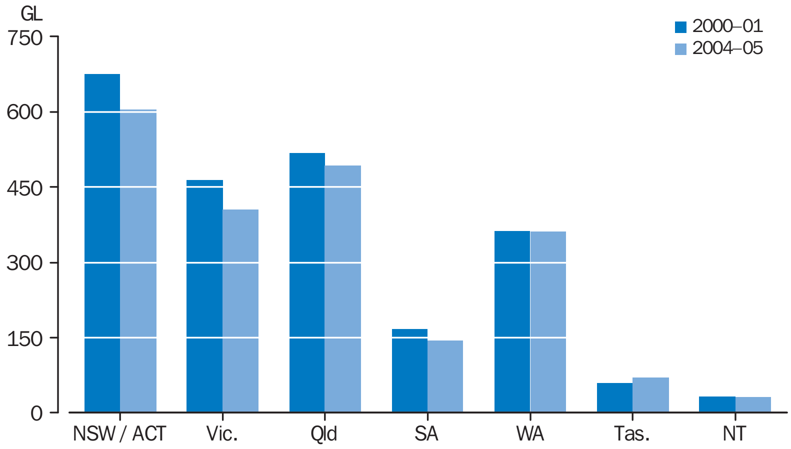
Water consumption by the mining industry rose by nearly one-third (29%) from 2000–01 to 2004–05, reflecting increased activity in the resources sector (the "mining boom"). In 2004–05, total water consumption by the mining industry was 413 GL (or 2% of total water use in Australia) compared to 321 GL in 2000–01. Western Australia had the highest mining water consumption (183 GL), followed by Queensland (83 GL). New South Wales (combined with the Australian Capital Territory) consumed 63 GL.

Water consumption, mining activity



Source: ABS, Water Account Australia, 2004–05, (cat. no. 4610.0)

Water consumption – households, by state



Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Water consumption – households

Household water consumption fell by 7% from 2000–01 to 2004–05. Water consumption by Australian households was 2,108 GL in 2004–05, accounting for 11% of total water consumed. This compares with 2,278 GL in 2000–01, which was 10% of total consumption.

The decrease may be attributed, in part, to mandatory water restrictions in most states and territories since 2002, which have mostly focussed on the use of water outside the house. During this period, many Australians also have been voluntarily conserving water by adopting water saving practices and installing water saving devices, such as dual flush toilets.

How healthy are our rivers?

Water use for agriculture, industry and households has had a significant effect on the nation's rivers. Water resource development, such as dams and weirs, have altered the availability and quality of water in many rivers and led to an overall decline in river health.

Australia has the highest per capita water storage capacity in the world, with most of this water used for irrigation. Most of the water is held in a few very large dams, the 10 largest comprising about half the total capacity. As a result, many Australian river systems suffer from substantial reductions in the volume of river flows and altered flow patterns.[16]

This can cause damage to plant and animal communities that rely on the river for their food and habitat. In addition, river health problems such as salinity, blue-green algae outbreaks and turbidity, which all occur naturally, are exacerbated by human activities that alter the river flow and water quality. Excessive nutrients have contributed to severe algal bloom outbreaks. Irrigation and clearing for agriculture have worsened salinity problems on land and in inland waters, and turbidity and sedimentation in waterways. They have also contributed to the reduction in the quality of water by removing the water storage capacity of the surrounding vegetation and the bank stability provided by its roots.

Altered river flows can have serious implications for the plants and animals that rely on the water for their food and habitat. To give just a few examples:

- dams and weirs prevent some native fish species from moving between spawning, nursery and adult habitats, thereby reducing their reproduction and growth leading to population declines. For example, natural populations of golden perch have disappeared from the River Murray above the Hume Dam due to river fragmentation.[17]
- floods and high flows are important parts of a river's natural flow pattern, but dams trap a proportion of natural high flows, which reduces or eliminates downstream flooding. The Barmah-Millewa Forest is the world's largest river red gum forest and is recognised as a Ramsar wetland of international importance. River red gums require frequent flooding to regenerate and grow. Without adequate flooding in the near future, the result is likely to be a significant loss of river red gum communities on the lower River Murray floodplain.[18]
- releases of very cold water from the bottom of dams can depress water temperatures to the level at which some large native fish species are unable to breed.

Reduced water quality, in turn, affects the wider community, including agricultural producers and people involved in the recreation and tourism industries (e.g. boating, fishing, swimming) who rely on healthy rivers for their livelihood.

Water quality and river health

Water quality is directly related to river and wetland health. Many factors are involved in water quality, which can vary from place-to-place and from time-to-time, even within a particular river system. There is no single, national, widely-accepted method used to assess river health.

Current approaches rely either on assessments of individual biota groups (e.g. invertebrates, fish and algae), on assessments of physical river condition, or combinations of various biological, physical and chemical assessments.

The Australian Water Resources 2005 (AWR 2005) assessment included a Framework for the Assessment of River and Wetland Health (FARWH) based on six key components that represent ecological integrity and function, including water quality and soils, catchment and hydrological disturbance, aquatic biota, fringing vegetation and physical form. For more information about FARWH, see page 73 in the Trends section.

Selected water quality indicators

Indicator	Potential impacts from changes
Turbidity	♦ Increased water surface temperature due to changes in light penetration
	♦ Increased sedimentation can cause changes in breeding patterns of bottom gravel dwelling organisms
	♦ Suspended particles can cause suffocation in some fish, adversely affect fishing, aquaculture and tourism
	♦ Increased cost of treating affected water
Nutrients	♦ Excess leads to excessive plant growth which chokes waterways
	♦ Increased nitrogen increases algal growth and 'nuisance plants'
	♦ Reduction in light penetration smothers habitats of bottom gravel dwelling animals
	♦ Decreased dissolved oxygen due to weed mat die off
	♦ Increased occurrence of blue-green algal blooms
Temperature	♦ An increase or decrease affects fish breeding (spawning)
	♦ Changes in algae occurrences
Salinity	♦ Increased physiological stress on organisms leading to population declines in native aquatic animals
	♦ Growth inhibition of aquatic plants
	♦ Adverse effects on riverbank vegetation, bank erosion
	♦ Reduced suitability of river water for irrigation
	♦ Increased costs for treating drinking water

Source: National Land and Water Resources Audit, Australian Catchment, River and Estuary Assessment, 2002.

In order to assess water quality, it is necessary to know the intended use of the water. Water used for hydro-electric power generation or industrial uses does not require high standards of purity.

However, water for drinking, fishing and animal and plant habitat does need to be of high quality. The maintenance of estuarine and marine water quality is equally important but is beyond the scope of this article.

The most common chemical indicators used to assess water quality in rivers are salinity, turbidity, nutrients (nitrogen and phosphorus) and acidity/alkalinity (pH). Potential impacts of such indicators are shown in the table above.

Significant gaps in the coverage of water quality monitoring preclude a comprehensive assessment of all Australia's river systems.

Salinity

Salinity occurs naturally in Australia, but the clearing of native vegetation and use of water for irrigated agriculture, domestic and other uses, has caused the salt stored beneath the ground to come to the surface in many areas.

There are two forms of salinity, dryland and irrigation salinity. Dryland salinity is the predominant type and occurs when salts are brought to the soil surface, primarily through the replacement of deep-rooted native vegetation with shallow-rooted annual crops and pastures that use less water, causing the water table to rise, bringing salt with it. Irrigation salinity is associated with excessive irrigation.

Estimated current annual costs of salinity include $130 million in lost agricultural production, $100 million infrastructure damage and at least $40 million in loss of environmental assets.[19] Rising salinity also threatens biodiversity.

Area affected by dryland and irrigation salinity, comparison of ABS survey results with other estimates

State	PMSEIC 1999	NLWRA 2001	ABS 2002
	Area of salinity affected land (a)	Area at risk of salinity (b)	Areas showing signs of salinity (c)
	'000 ha	'000 ha	'000 ha
NSW/ACT	120	181	124
Vic.	120	670	139
Qld	10	n.a.	106
SA	402	390	*350
WA	1 802	4 363	1 241
Tas	20	54	6
NT	–	–	2
Australia	**2 476**	**5 658**	**1 969**

* denotes relative standard error (RSE) of this estimate is greater than 25% but less than 50%, therefore use with caution.
(a) Determined by experts – Prime Minister's Science, Engineering and Innovation Council (PMSEIC) 1999 – includes non-agricultural land.
(b) Estimated from water table heights by the National Land and Water Resources Audit (NLWRA) 2001.
(c) Reported by farmers.
Source: ABS, Salinity on Australian Farms, 2002 (cat. no. 4615.0).

The area of land affected by salinity in Australia, according to two different surveys (PMSEIC and ABS shown in the table above), shows results varying from a minimum of 1,969,000 hectares (ha) to a maximum of 2,476,000 ha. UP to 5,658,000 ha was assessed by the NLWRA as being at risk of salinity. Salinity is also a major water quality issue in 24 (32%) of 74 assessed river basins (NLWRA).

Restoring flows

In the interest of maintaining the health of rivers, a number of states and territories have begun to plan to allocate and provide water to the environment – generally known as "environmental flows".

Environmental flows recognise the needs of rivers for an amount of water to maintain ecological health for the protection of the environment and sustainability of water resources.

The ABS *Water Account Australia, 2004–05* presented information on water released for the purpose of the environment in accordance with specific environmental regulations. This has been termed environmental provisions, in recognition that it does not represent all environmental flows, but only the volume of water released by water suppliers. Other methods of providing water to the environment include placing limits and rules on licences for water extraction and strategic management of flows and water quality.

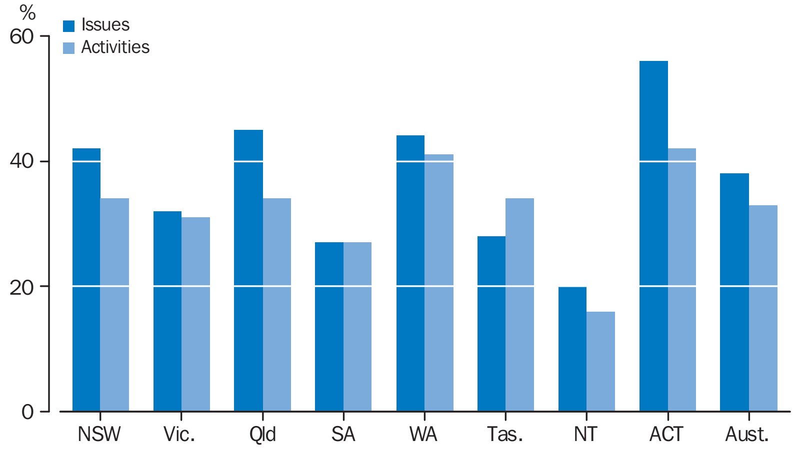
In 2004–05, 1,005 GL of water was supplied to the environment by water providers. This is an increase of 119% across Australia since 2000–01. States with large increases were Queensland, Victoria and Tasmania.

Environmental provisions

	NSW/ACT	Vic	QLD	SA	WA	Tas	NT	Aust.
	GL	GL	GL	GL	GL	GL	GL	GL
2000–01	200.5	253.2	4.5	0.9	–	0.4	–	459.4
2004–05	127.2	373.9	383.6	0.7	–	118.7	1.1	1 005.3

– Nil or rounded to zero (including null cells)
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Farms identifying water issues and water activities, 2004–05



Financial expenditure by the agriculture industry for water management, 2004–05

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
Total expenditure ($million)	128	51	85	18	25	5	1	–	314
Average expenditure per farm ($)	9 474	5 189	9 241	4 836	5 095	3 833	18 474	3 405	7 351

Source: ABS, Natural Resource Management on Australian Farms, 2004–05 (cat. no. 4620.0).

Water management – making every drop count

Agricultural water management practices

In 2004–05, a third of all farms carried out water-related management activities, spending a total of $314 million in that year.

The most commonly reported water management activities were: earthworks, drains and water pumping; tree and shrub maintenance; and removing stock from waterways.

Water issues included surface and groundwater availability, excess nutrients, clarity, toxicity and other water issues. Of these, water availability was the most frequently reported water issue by farmers.

The drought affecting south-eastern Australia during 2004–05 was especially evident in New South Wales and Queensland where nearly three-quarters (73%) of farmers reported surface water availability as a major issue. This compares with 63.1% for Australia as a whole.

In Queensland, groundwater availability was also a major issue (45.5%).

Water trading – managing the resource

Until the 1990s, supplies of irrigation water were considered to be plentiful, and expansion of irrigated agriculture was encouraged through large-scale developments such as the Murrumbidgee and Murray Irrigation Schemes in the 1930s and the Snowy Mountains Scheme in the 1970s. However, the last decade has seen increased demand for water associated with general population and economic growth and concerns about the environmental impacts of higher consumptive water use. Together with six years of widespread drought in southern and eastern Australia, this has prompted significant developments in the use and management of Australia's irrigation water resources.

In response to concerns about water scarcity, Australia is one of a small number of countries that has instituted markets for trading water. The NWC regards water trading as fundamental to water reform because it will help governments, water users and communities to better value and use the nation's water resources.[20]

If farmers have sufficient water entitlements, they can choose to sell their water or use it on their crops. Being able to buy and sell

Water trading, 2004–05

	Permanent water trades		Temporary water trades	
	no.	GL	no.	GL
NSW	164	41.3	2 042	382.6
Vic.	702	57.4	9 323	444.3
Qld	168	20.3	1 874	194.2
SA	364	33.4	446	49.5
WA	218	62.8	8	8.6
Tas.	232	37.6	111	5.6
NT	–	–	–	–
ACT	–	–	–	–
Australia	**1 802**	**247.6**	**13 456**	**1 052.8**

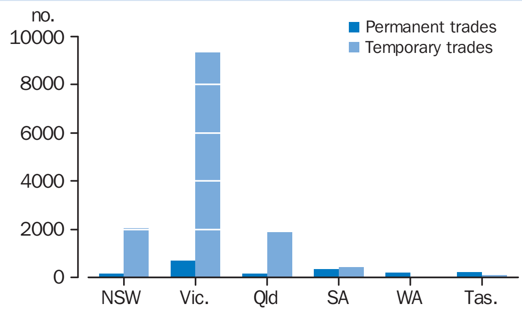
nil or rounded to zero (including null cells)
Note: Total for Australia cannot be calculated by taking the sum of the states and territories as this would double count interstate trades.
Source: ABS, Water Account, 2004–05 (cat. no. 4610.0).

water, assists agricultural producers in obtaining sufficient water for their crops. Water trade has directly facilitated at least some of the change over recent decades in the activity mix of irrigated agriculture. For example, in Victoria, water has been traded on a permanent basis away from sheep and cattle grazing towards dairy farming.[21]

Trading can occur on a temporary or permanent basis. Temporary transfers, where water entitlements are leased for a specified period of time (usually one year), are the most commonly used method of trading water in Australia. This market depends mainly on how much rain has fallen and how hot the season has been.

The advantage of temporary transfers includes the ability to increase and decrease water allocations as needed, rather than the significant financial investment usually involved in buying on a permanent basis. In 2004–05, there were 1,802 permanent and 13,456 temporary water trades involving 247.6 GL of water traded permanently and 1,052.8 GL traded temporarily.

Water trading, 2004–05



Note: WA and Tas. temporary trade figures too small to show.
Source: ABS, Water Account, 2004–05 (cat. no. 4610.0).

Victoria had the highest number of permanent and temporary water trades (702 and 9,323 respectively). Victoria also had the largest volume of water temporarily traded in Australia (444.3 GL). Western Australia had the highest volume of water traded permanently (62.8 GL).

As the data show, water trading is far from being a well-utilised and fully functioning mechanism for ensuring more efficient water use. [22] However, with the drought conditions that have affected many parts of Australia over the past six years, water trading has allowed many farms to survive despite low seasonal water allocations. Although water trading is not a panacea, the persistent dry conditions have highlighted the importance of an effective water market.[23]

Limiting the extent of water trading and water reform is the complexity of current water property rights. States and territories largely have the responsibility for water and catchment management, but each one has different approaches to defining environmental needs and acceptable levels of river and wetland health. This is further complicated when a river crosses state boundaries, such as in the Murray-Darling Basin which includes New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory, impeding progress in the development of a national water market. Australia's experience with trying to establish and implement a uniform rail gauge, which took more than a century after Federation, highlights the difficulties that can be involved in achieving national consistency.[24]

Water trading on irrigated farms

While farms of all sizes engaged in trading irrigation water, trade has not been a frequent event for most farms.

Around 43% of irrigated pasture farms, 36% of irrigated broadacre farms and 27% of irrigated horticulture farms participated in some form of trade, temporary or permanent over the three years to 1 July 2003.

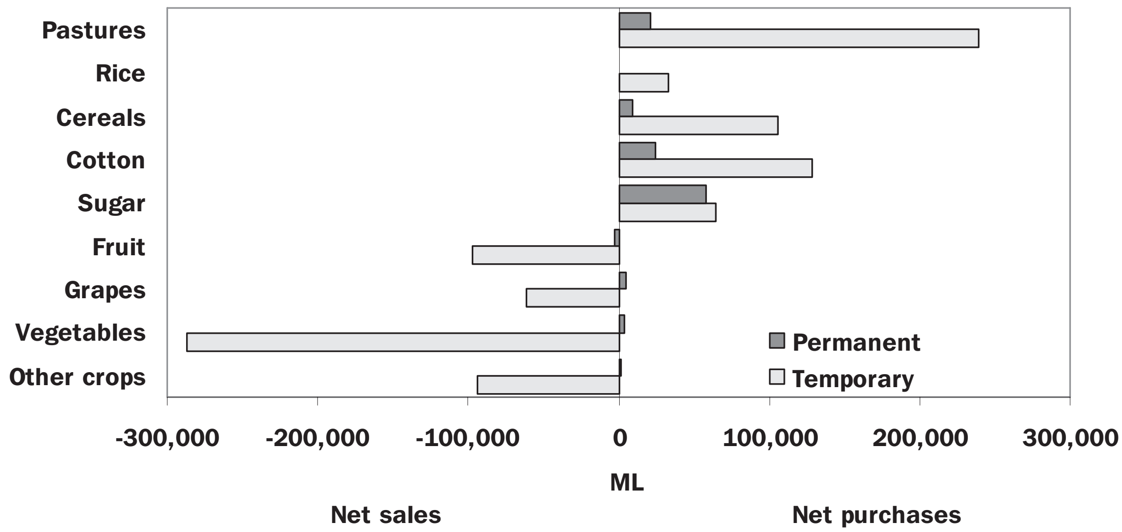
Broadacre activities include mainly annual crops such as rice, cereals, sugar, cotton, and soybeans. Horticulture includes fruit and nut trees, berries, vegetables and grape vines. However, few farms engaged in trade on a regular basis. Only 13% of irrigated pasture farms, 11% of irrigated broadacre farms and 10% of irrigated horticulture farms traded water in every year.

Most trade in irrigation water was on a temporary basis. In 2002–03, horticultural establishments were the main sellers, while farms with irrigated pastures and irrigated broadacre activities were the main buyers.

Following the drought in 2002–03, the temporary water market comprised a comparatively high number of small irrigated pasture farms selling relatively low quantities of irrigation water. Overall, temporary purchases were highest for large farms with pastures, cereals (excluding rice) or cotton as their main irrigated activity. Temporary trade by irrigated horticultural farms in 2002–03 was characterised by net sales of water by fruit and grape growers and large vegetable farms.

Consistent with earlier years of water trade in Australia, comparatively little trade on a permanent basis occurred in 2002–03. The largest net purchases on a permanent basis were by larger farms with irrigated sugar, cotton or pastures.

Balance of water trade, by irrigated activity, 2002–03 (a)



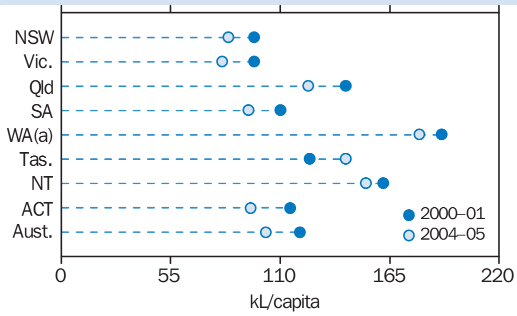
(a) Net trades do not add to zero due to sampling errors and unaccounted trades with non-irrigated agricultural establishments and with non-agricultural water users and suppliers and within sectors.
Sources: ABS, Characteristics of Australia's Irrigated Farms, 2000–01 to 2003–04 (cat. no. 4623.0).

Household water conservation

Over the period 2000–01 to 2004–05, household water use per person decreased everywhere in Australia, except in Tasmania. Household water use includes water used for human consumption, such as drinking or cooking, and for cleaning or outdoors, such as for gardens and in swimming pools.

The decrease reflects in part, water restrictions in most states and territories since 2002 as well as voluntary conservation of water by households.

Household water consumption per person



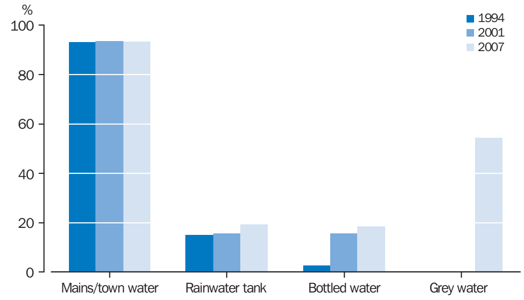
(a) Includes unlicensed water use from garden bores.
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

To encourage reductions in household water use, a number of state and territory governments offer incentives to households to conserve water. This has involved schemes that require or reward the installation of water-saving devices such as dual flush toilets.

Australia also introduced the first scheme of its kind in the world for water efficiency labelling of appliances. The Water Efficiency Labelling Scheme requires mandatory water efficiency labels on all shower heads, washing machines, toilets, dishwashers, urinals and some types of taps.

In 2007, more than three-quarters of all households (81%) had at least one dual flush toilet. Water-efficient shower heads were installed in more than half (55%) of households in 2007 (up from 22% in 1994).

Sources of water for households



Note: Grey water as a source of water not collected before 2007.
Source: ABS, Environmental Issues: People's Views and Practices, March 2007, (cat. no.4602.0).

While mains/town water was overwhelmingly the main source of water for Australian households, with 93% connected in March 2007, grey water was the second most common source. Grey water is water re-used from waste water sourced from the shower/bath, laundry and kitchen.

More than half (55%) of all households reported grey water as a source in 2007. Grey water was more common as a source of water outside capital cities than within them, in every state except Queensland. In Queensland, 63% of households in Brisbane reported grey water as a source of water, but only 46% of households outside of Brisbane reported it as a source.

Rainwater tanks

In 2007, nearly one-fifth (19%) of all households sourced water from a rainwater tank, up from 16% in 2001.

In capital cities, more than one in ten households (11%) sourced water from a rainwater tank. This compared with more than more than one-third of households (34%) outside capital cities. In the capital cities, the most commonly reported reason for installing a rainwater tank was to save water. In areas outside the capital cities, the most commonly reported reason was that the dwelling was not connected to mains/town water.

Case study
The Murray-Darling Basin

The Murray-Darling Basin dominates irrigation in Australia, accounting for more than 70% of irrigation water use in Australia.

The Basin covers approximately one-seventh (14%) of the total area of Australia. It extends over three-quarters of New South Wales, more than half of Victoria, significant portions of Queensland and South Australia, and the whole of the Australian Capital Territory. The major rivers are the Darling River in the north of the Basin and the River Murray in the south. The Murrumbidgee and Goulburn rivers are major tributaries of the River Murray that support large irrigation schemes.

Key features of the Basin are its high evaporation rate and large annual variability in rainfall. The Murray-Darling Basin receives only 6% of Australia's annual run-off. In the last 100 years, construction of major water storages on the River Murray and Darling River and their tributaries has supported large irrigation developments. The Basin provides about 70% of all water used for agriculture across the nation and accounts for 40% of Australia's gross value of agricultural production. It supports a quarter of the nation's cattle herd, half of the sheep flock and half of the cropland.

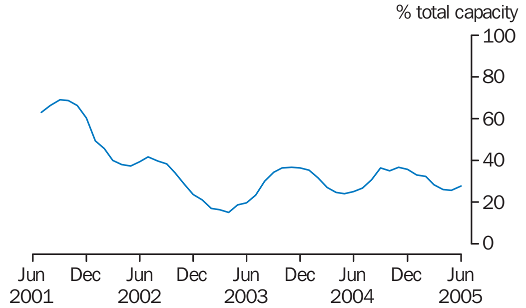
The total volume of water storage capacity of large dams in the Basin is more than 24,000 GL. This comprises nearly one-third (29%) of Australia's large dam storage capacity. The water stored in these dams is predominantly used for irrigated agriculture, but also for hydro-electricity generation, households, manufacturing and mining uses.

In addition to large dams, many farm dams exist in the Murray-Darling Basin. Hillslope farm dams have been estimated to be able to store up to 2,200 GL in the Basin and can act as a significant interceptor of run-off, potentially reducing stream flow.[25] Reduced stream flow in the rivers can affect the health of many plants and animals that live in or near the river as well as water availability to downstream users.

The AWR 2005 provided a snapshot of Australia's river and wetland health using the key findings of the Murray-Darling Basin Assessment of River Condition, conducted in 2000 including:

- 10% of river length was identified as severely impaired, having lost at least 50% of the types of aquatic invertebrates expected to occur there.
- More than 95% of the river length assessed in the Murray-Darling Basin had an environmental condition that was degraded and 30% was substantially modified from the original condition.
- All reaches and catchments in the Basin had disturbed catchments and modified water quality.
- Many parts of the Basin were threatened by multiple stresses, principally land use changes, damaged riparian vegetation, poor water quality and modified hydrology.

Large dam storage levels in the Murray-Darling Basin



Source: ABS, Water Account, Australia, 2004–05 (cat. no. 4610.0).

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[8] ANCOLD (Australian National Committee on Large Dams) <http://www.ancold.org.au/dam_register.html>, viewed September 2007.

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[22] R. Roberts, N. Mitchell and J. Douglas, 2006, *Water and Australia's future economic growth*, <http://www.treasury.gov.au/documents/1087/PDF/05_Water.pdf>, viewed September 2007.

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Trends

Population and urban trends

Australia's estimated resident population was 20.9 million at March 2007, based on the first releases of 2006 Census data. As the population continues to increase, both in numbers and in affluence, there is more pressure on the environment.

This section looks at a number of trends which are drivers of environmental change, including population growth, the age and household structure of the population, where people are living and moving to, gross domestic product (GDP) and changes in people's expenditure.

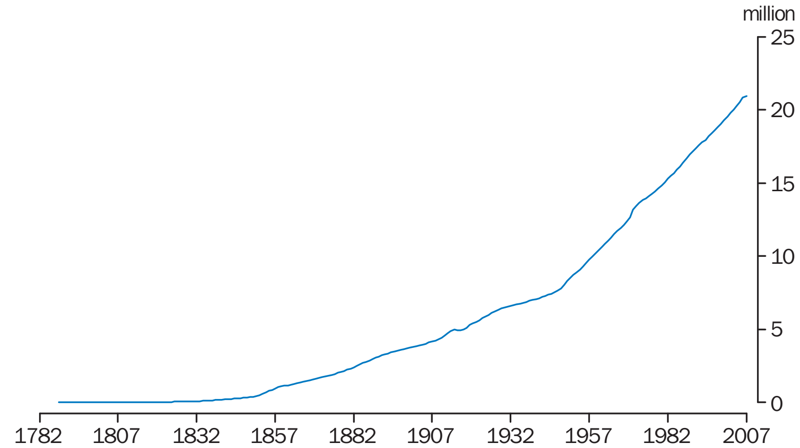
- **Population growth** occurs as a result of natural increase (defined as the number of births less the number of deaths) and migration patterns. Trends in natural increase and migration patterns have resulted in uneven population growth and distribution across Australian states and territories. Despite the large land area of Australia, the majority of the population is located in two widely-separated coastal regions. Where people live has environmental implications for air quality, and land and water degradation. The movement of people from rural and remote areas to cities and coastal areas has resulted in relatively high rates of land clearing for urban development. Urban expansion has caused loss of habitat for native plants and animals, reducing their numbers and geographical spread. It has also placed additional pressure on resources such as water and sewerage services. In turn, loss of vegetation cover contributes to land degradation problems including dryland salinity, weed invasion and soil erosion.

  Increased waste generation and energy use are associated with an increase in population and affluence. Environmental issues associated with waste disposal include emission and leaching of pollutants (including greenhouse gas emissions), the requirement of land for landfill sites, and littering and health problems from hazardous waste. Australia's energy use is largely based on non-renewable fossil fuels, such as coal and oil, that create greenhouse gas emissions.

- **Growth in the economy** (as measured by GDP) is a key determinant of employment and, therefore, of the economic wellbeing of households. However, economic activity often has associated environmental costs. For example, economic activity, especially among the more energy-intensive industries, is associated with the creation of greenhouse gas emissions. Another example of environmental costs associated with economic activity is in the agriculture industry where the use of irrigation can reduce water flows and quality in rivers, thereby affecting riverine flora and fauna and human health. On the other hand, higher incomes can provide resources to address environmental issues. There is a debate about how to balance economic progress, often measured by gross domestic product (GDP), against the need to maintain resources for future generations – getting this balance right is often referred to as environmental sustainability. Depletion-adjusted GDP is a way of incorporating the depletion/damage to environmental assets that is associated with economic activity.

Population

Population growth



Note: 2007 figure is at March 2007.
Source: ABS, Australian Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, March Quarter 2007 (cat. no. 3101.0).

Australia's preliminary estimated resident population was 20.9 million at March 2007, based on the first release of 2006 Census data.

Since Federation in 1901, Australia's population has increased by 16.9 million. The graph above shows the growth in Australia's population since European settlement in 1788.

The growth of Australia's population has two components: natural increase (the number of births minus the number of deaths) and net overseas migration (net permanent and long-term migration). For state and territory estimates net interstate migration is also included.

The potential economic impacts of an ageing population make fertility rates of particular interest to policy makers and demographers. Since 1961, Australia's total fertility rate (TFR) declined from 3.55 babies per woman to the historic low of 1.73 in 2001. Since then the fertility rate has trended upwards to 1.81 babies per woman in 2006, with the largest increases in fertility occurring in the most advantaged areas of Australia.

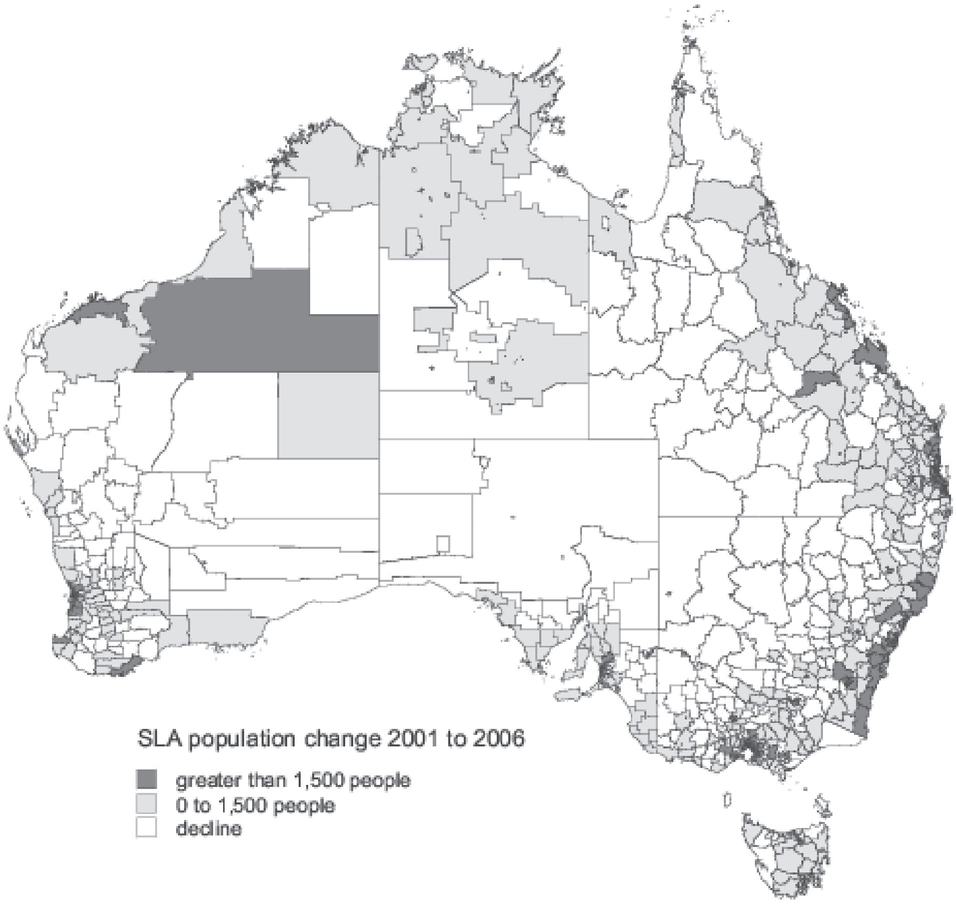
Sustained periods of fertility well below the replacement level of 2.1 babies per woman are one of the drivers of population ageing. The decline in the TFR has been closely associated with the tendency for women to have their babies at older ages. The median age of all women who gave birth in 1995 was 29.1 years; by 2006 this had increased to 30.8 years. This is the highest median age on record. Delaying childbearing reduces the remaining length of time in which women can have babies, generally leading to fewer babies per woman and an increased level of childlessness.[1]

Depending on assumptions about future levels of fertility, mortality and overseas migration, future projections indicate that Australia's population could range between 25 and 33 million people by the year 2051.

1. Weston, R 2004, 'Having children or not', *Family Matters*, no. 69, pp.4-9.

Population

Population change, Statistical Local Area



Source: ABS, Regional Population Growth, 2005–06 (cat. no. 3218.0).

All states and territories experienced population growth in the five years to June 2006. The three most populous states recorded the largest population growth in the five-year period to June 2006. Queensland experienced the largest growth (462,600 people), followed by Victoria (323,600) and New South Wales (242,000).

Capital city Statistical Divisions (SDs) were home to over 13 million people, around two-thirds (64%) of Australia's population.

In the five years to June 2006, Melbourne SD recorded the largest growth of all capital cities, increasing by 272,700 people. Brisbane SD recorded the second largest growth, increasing by 191,300 people, followed by Sydney SD (up 156,100) and Perth SD (up 126,500).

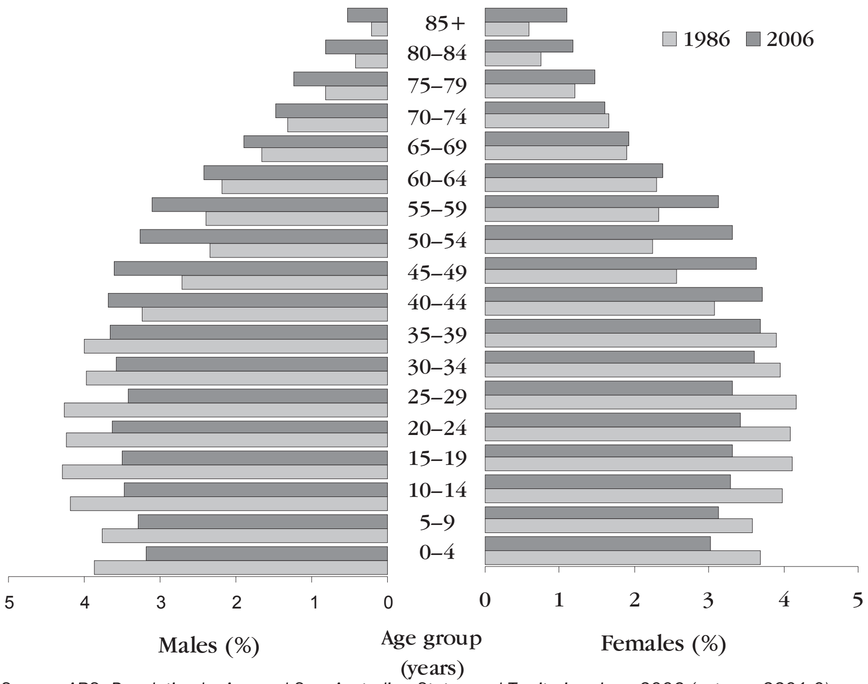
The fastest growing capital city from June 2001 to June 2006 was Brisbane SD, with an average annual growth rate of 2.2%. Next was Perth SD at 1.8% a year.

Capital city growth outpaced growth in the state balances (i.e. the rest of the state) in all states and territories except Queensland and South Australia in the five years to June 2006. However, growth in the balance of New South Wales almost equalled that of Sydney SD.

Generally, outside capital cities, coastal Australia experienced the strongest growth. Many Queensland coastal areas saw large growth in the five year period. Urban coastal development causes loss of habitat for native flora and fauna and places pressure on resources such as water supply.

Population

Population age and sex structure



Source: ABS, Population by Age and Sex, Australian States and Territories, June 2006 (cat. no. 3201.0).

The age structure of Australia's population has changed significantly over the past century.

The graph above shows the proportions of the population by age and sex in 1986 and estimated figures for 2006, illustrating the ageing of Australia's population.

Between 30 June 1986 and 30 June 2006, the proportion of the population aged 0–14 years decreased by 3.8 percentage points from 23.1% to 19.3%. During the same period, the proportion of the population aged 15–64 years increased from 66.4% to 67.4%.

The ageing of Australia's population changes consumption patterns, influencing the quantity and quality of resources used and waste generated by the community. For example, expenditure on personal travel is increasing and transport is associated with the production of greenhouse gas emissions.

In 2006, the age with the most number of people in Australia was 35 years, with 324,200 people. This corresponds to children born during the baby boom echo in the early 1970s. The year 1971–72 had the most number of births recorded in Australia.

The balance between men and women has also changed. In 1901, there were 110 men for every 100 women (in part due to the relatively high proportion of Australian immigrants who were male). This balance has changed. In 2006, there were 98.8 men for every 100 women.

Population

Selected population indicators, 2006

	Major Cities	Inner Regional	Outer Regional	Remote	Very Remote	Australia
Population ('000 persons)	13 636	4 359	2 097	328	182	20 602
Share of total population (%)	66.2	21.2	10.2	1.6	0.9	100.0
Area ('000 km^2)	14	220	803	1 021	5 646	7 704
Population density (persons/km^2)	950.2	19.8	2.6	0.3	–	2.7
People living in same state/territory between 1996 and 2001 (%)	96	96	96	94	91	95

Note: Population estimates for 2006 are preliminary.
Source: ABS Regional Population Growth, Australia, 2005–06, (cat. no. 3218.0). Bureau of Transport and Regional Economics, About Australia's Regions, 2007.

Population growth by state/territory and remoteness area, 2001 to 2006

State/Territory	Major Cities	Inner Regional	Outer Regional	Remote	Very Remote	Total
	%	%	%	%	%	%
NSW	4	4	1	-2	-2	4
Vic.	6	8	3	-3	nr[(a)]	6
Qld	12	13	9	4	1	12
SA	3	8	0	3	-9	3
WA	8	18	1	-2	4	8
Tas.	nr[(a)]	4	3	0	-6	4
NT	nr[(a)]	nr[(a)]	7	1	2	5
ACT	3	-2	nr[(a)]	nr[(a)]	nr[(a)]	3
Aust.	**6**	**8**	**4**	**1**	**1**	**6**

Note: Estimates for 2006 are preliminary. Figures are total percentage growth over the period 2001–2006.
(a) For the purpose of the ABS Remoteness Structure, there are no regions in this category for this state or territory.
Source: ABS Regional Population Growth, Australia, 2005–06 (cat. no. 3218.0). Bureau of Transport and Regional Economics, About Australia's Regions, 2007.

The major cities of Australia were home to 13.6 million people or two-thirds of Australia's population in 2006. In contrast, just 506,000 people, or 2.5% of the total population lived in remote or very remote areas of Australia.

The tables above show population growth and decline from both natural increase and people moving into cities and coastal areas, and out of rural and remote areas. The movement of people to coastal areas is linked to a number of factors, including tourism development and retirees relocating. The concentration of people in coastal areas of south-eastern Australia has resulted in relatively high rates of land clearing for urban development. This has caused loss of habitat for native plants and animals, reducing their numbers and geographical spread. Urban developments also need landfill sites and water and sewerage services, all of which can affect the environment.

Regions of greatest development are:

- Hervey Bay to Byron Bay (south Qld to north NSW)
- Newcastle to Wollongong (NSW)
- Port Phillip region (Vic.)
- City of Wanneroo to City of Mandurah (north Perth to south Perth).[1]

1. *2006 Australian State of the Environment Committee,* Australia State of the Environment 2006, *Department of the Environment and Heritage, Canberra.*

Population

Population, states and territories

30 June	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	**Aust. (a)**
	'000	'000	'000	'000	'000	'000	'000	'000	**'000**
1957	3 625.0	2 656.3	1 413.1	873.2	687.6	326.1	21.1	37.9	**9 640.1**
1967	4 295.2	3 274.3	1 700.0	1 109.8	879.2	375.2	61.8	103.5	**11 799.1**
1977	5 001.9	3 837.4	2 129.8	1 286.1	1 204.4	415.0	103.9	213.7	**14 192.2**
1987	5 616.7	4 210.1	2 675.1	1 392.8	1 392.8	449.2	158.2	265.5	**16 263.9**
1997	6 277.0	4 597.2	3 394.7	1 481.4	1 795.0	473.6	186.9	309.0	**18 517.6**
2001	6 606.0	4 833.6	3 671.8	1 516.7	1 913.8	472.3	198.4	320.8	**19 535.1**
2002	6 651.3	4 893.2	3 764.9	1 525.9	1 937.0	474.9	199.4	324.2	**19 773.3**
2003	6 691.3	4 953.3	3 857.6	1 536.3	1 967.3	480.8	200.7	326.1	**20 015.8**
2004	6 731.2	5 015.7	3 947.0	1 545.0	1 998.1	484.7	203.9	328.2	**20 257.1**
2005	6 787.9	5 087.2	4 045.1	1 559.6	2 036.8	488.5	208.5	332.5	**20 548.4**
2006 (b)	6 855.2	5 165.4	4 132.0	1 575.7	2 081.0	491.7	212.6	336.5	**20 852.4**
2007 (b)(c)	6 875.7	5 188.1	4 162.0	1 581.4	2 094.5	492.7	213.8	338.1	**20 948.9**

(a) From September quarter 1993, includes Other Territories comprising Jervis Bay Territory, Christmas Island and the Cocos (Keeling) Islands. Prior to September quarter 1993, the ACT included Jervis Bay Territory, and Christmas Island and the Cocos (Keeling) Islands were not included.
(b) Estimated resident population for September 2006 onwards is preliminary.
(c) Estimated resident population for March 2007.
Source: ABS, Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, March Quarter 2007 (cat. no. 3101.0).

The proportion of Australia's population resident in each state and territory has changed over time.

Between 1957 and March 2007, the proportion of the Australian population living in New South Wales fell (from 37.6% to 32.8%). Other states that have experienced decreases are Victoria (27.6% to 24.8%), South Australia (9.1% to 7.5%) and Tasmania (3.4% to 2.4%).

The proportion of the population living in other states has increased: Queensland (14.7% to 19.9%), Western Australia (7.1% to 10.0%), the Northern Territory (0.2% to 1.0%), and the Australian Capital Territory (0.4% to 1.6%).

Queensland's average annual growth rate over the five years to June 2006 was the fastest in Australia, at 2.4%.

Households

Household and dwelling characteristics, 2003–04

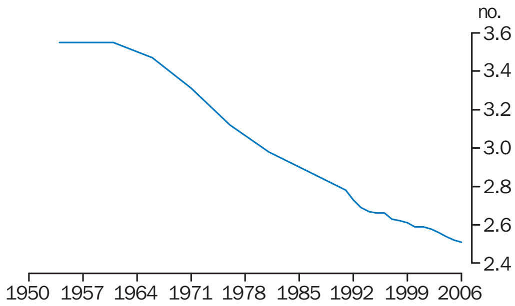
	One bedroom	Two bedrooms	Three bedrooms	Four or more bedrooms	Total households (a)	
	'000	'000	'000	'000	'000	% of total
One person	277.7	676.9	825.9	163.5	1 962.1	25.4
Two persons	75.8	620.4	1 397.6	529.0	2 625.3	33.9
Three persons	8.7	136.3	686.6	375.5	1 207.1	15.6
Four persons	n.p.	63.2	620.2	538.6	1 223.0	15.8
Five or more persons	n.p.	9.0	239.3	468.9	718.4	9.3
Total households	**364.2**	**1 505.9**	**3 769.6**	**2 075.4**	**7 735.8**	**100.0**

(a) Includes bedsitters and dwellings with zero bedrooms.
Source: ABS data available on request, Survey of Income and Housing, 2003–04.

Australian households have changed considerably in number, size and composition over the past 90 years. Households are becoming smaller on average. Average household size fell from 4.5 people per household in 1911 to 3.6 people per household in 1954 and 2.6 people per household in 2001. It is projected to fall to 2.5 in 2006.

Much of this decline can be attributed to reductions in completed family size and the increase in numbers of one- and two-person households. The number of one-person households has grown largely as a result of population ageing combined with longer life expectancy of women over men.

Average household size



Note: Graph shows number of people per household. Figures for 2002 to 2006 are projections based on the 2001 Census, Series II *Household and Family Projections, Australia, 2001 to 2026 (cat. no. 3236.0).*
Source: ABS data available on request, Household Estimates; Australian Demographic Statistics (cat. no. 3101.0); Census of Population and Housing, 1954–1981.

Population ageing, increased childlessness among couples and an increase in the number of one-parent families have contributed to the increase in the number of two-person households.

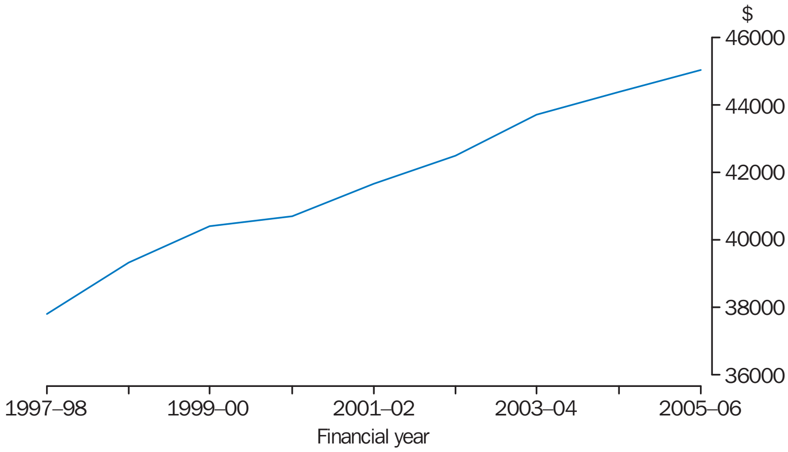
However, the size of the houses or apartments (dwellings) that people live in, is increasing (as indicated by the number of bedrooms). The proportion of dwellings with four or more bedrooms increased from 17% to 27% between 1976 and 2006, and the average number of bedrooms per dwelling rose from 2.8 to 3.0.

About 85% of lone person households lived in dwellings with two or more bedrooms and more than three-quarters of 2-person households (77%) had three or more bedrooms.

Dwelling characteristics have an impact on the environment in terms of the amount of energy needed to heat and/or cool them and the amount of resources used to build or renovate them. Other things being equal, a larger house will consume more energy than a smaller one, although factors such as solar orientation can alter this equation.

Economic growth

Gross domestic product per capita



Note: Chain volume measure; reference year 2004–05
Source: ABS, Australian System of National Accounts, 2005–06 (cat. no. 5204.0)

The performance of the economy is represented in the national accounts by such measures as growth in gross domestic product (GDP). GDP is a measure of the overall value of economic production in Australia in a given period. Growth in the economy is a key determinant of employment and, therefore, economic wellbeing of households. The volume measure of GDP is an indicator of real growth in Australian production. Between 1997–98 and 2005–06, Australia's real GDP grew by 31%.

GDP per capita is also a measure of the performance of the economy and takes growth in the population into account. Between 1997–98 and 2005–06, Australia's GDP per capita grew by 19% in volume terms.

Economic activity is often associated with depletion and/or degradation of natural resources. For example, the degradation of water quality due to land clearing for agricultural production or urban development, can adversely affect native plants and animals in freshwater ecosystems.

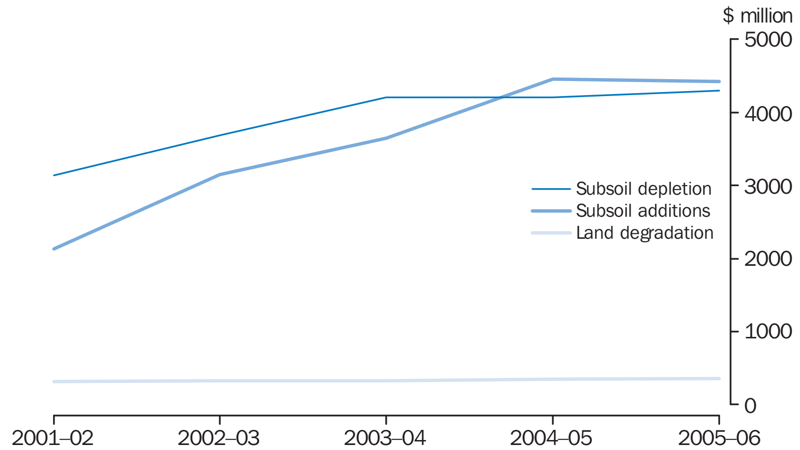
Similarly, air quality can be linked to the generation of income. Economic activity, particularly among the more energy-intensive industries relying on coal-generated electricity, generate air pollution that affect human health and the environment.

Decoupling indicators have emerged as a way to measure whether economic growth is occurring without corresponding pressures on the environment. Decoupling has been described as breaking the link between economic growth and environmental degradation. An example of decoupling is when a developed nation experiences economic growth without an equivalent increase in its greenhouse gas emissions. Decoupling indicators are one way to make an assessment of whether levels of growth are sustainable in the longer term. Appendix A contains more information about decoupling indicators.

Economic growth

Depletion-adjusted gross domestic product

	2001–02	2002–03	2003–04	2004–05	2005–06
	$ million	$ million	$ million	$ million	$ million
GDP	735 714	781 675	840 285	896 568	965 969
Depletion-adjusted GDP (a)	734 397	780 810	839 391	896 481	965 735
Subsoil depletion	3 137	3 685	4 206	4 199	4 295
plus Land degradation	314	322	331	345	362
less Subsoil additions	2 133	3 142	3 642	4 456	4 423
equals Net depletion	1 317	865	894	87	234



(a) Estimates are experimental, therefore use with caution.

Source: ABS, Australian System of National Accounts, Data available on request.

While gross domestic product (GDP) reflects the value added arising from the use of environmental assets, it does not reflect the economic costs of depleting and degrading those assets.

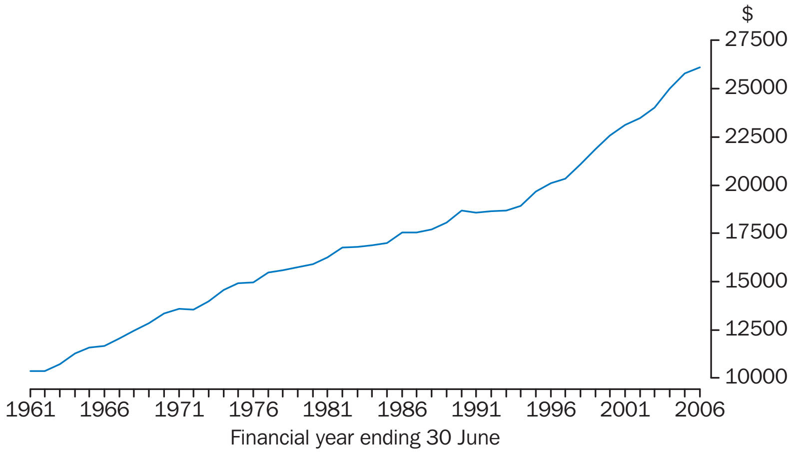
A depletion-adjusted GDP attempts to incorporate the environmental damage and depletion associated with economic activity. This is achieved by deducting depletion and degradation from the conventional GDP measure, then adding in any new discoveries or reappraisals of subsoil assets. At this stage, the estimates are still experimental and should therefore be regarded as indicative only.

Degradation of environmental assets occurs when the value of the stock is reduced through a decline in quality. For example, land degradation can result from land clearance and deforestation; agricultural depletion of soil nutrients, poor irrigation practices and pollution.

Depletion of environmental assets occurs when the value of the stock is reduced through use in a productive activity. For example, the extraction and use of subsoil assets through mining activity depletes the total stock of these assets available for future use.

Consumption

Real household final consumption expenditure per person



Note: Volume measure; reference year 2004-05.
Source: ABS, Australian System of National Accounts, 2005-06 (cat. no. 5204.0); Australian Historical Population Statistics, 2006 (cat. no. 3105.0.65.001); Australian Demographic Statistics, September 2006 (cat. no. 3101.0).

Expressed in real terms (at. 2004–05 prices), household final consumption expenditure per capita rose from $10,400 in 1960–61 to $26,100 in 2005–06.

Growth in real household final consumption expenditure per capita was particularly strong between 1992–93 and 2005–06. After rising by 1.9% a year between 1960–61 and 1992–93, real household final consumption expenditure per capita increased by 2.6% a year between 1992–93 and 2005–06.

During 2005–06, nearly half (46%) of all household final consumption expenditure was accounted for by rent and other dwelling services, food, catering and transport. This expenditure was 51% greater in 2005–06 ($4,551) than it had been in 1985–86 ($3,020). This equates to an average annual rate of increase of 2.1%.

Generally, an increase in the volume (i.e. the quantity and/or quality) of goods and services consumed by people is regarded as progress.[1] However, reduced consumption of certain goods and services can indicate progress towards social and environmental goals such as improved health and cleaner air.

There has been strong growth in the volume of communication services consumed by Australians over recent decades. From a low base in 1985–86, per person real household final consumption expenditure on these services more than quadrupled by 2005–06 (an increase of 341% of 7.7% each year on average). Much of this growth is related to the emergence and popularity of new communication technologies. In February 1996, only 24% of households owned or paid for a mobile phone. The proportion of households who had access to a mobile phone jumped to 72% (when averaged across 2002). An increase in mobile phone usage and turnover is an issue for waste generation and disposal.[2]

1. ABS, *Australian Social Trends 2007,* cat. no. 4102.0, Canberra, p.158.
2. ABS, *Australian Social Trends 2007,* cat. no. 4102.0, Canberra, p.161.

Human activity trends

Population increase, especially in coastal urban areas, is placing increasing pressure on the natural environment through habitat loss, waste disposal and pollution. This is exacerbated by increasing consumption of energy, land, water and other products dependent on natural resources.

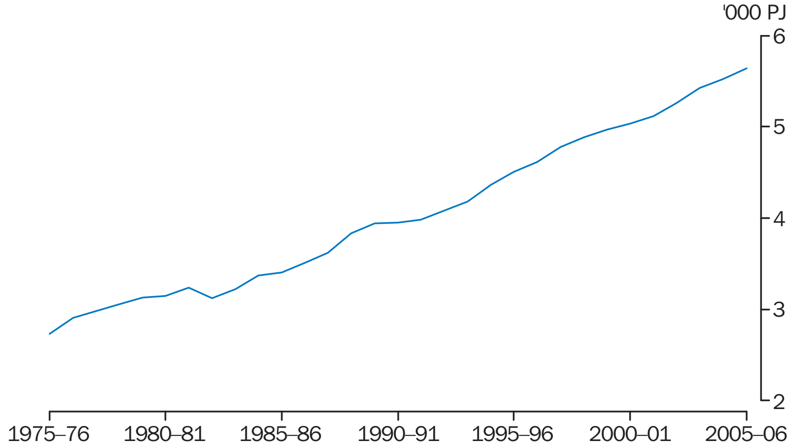
There have been developments in recent years towards better management of natural resources, such as increased recycling of some materials, improved efficiency in the use of energy by households and reduced use of water by households on a per household basis (see Water trends section). Nevertheless, many problems remain, most as a result of the very high level of material and energy consumption which continues to increase at a high rate. This section focuses on energy and waste and the main trends in these areas that can have environmental impacts.

- **Energy** is a vital input into all sectors of the economy. As well as supplying the power on which industry and households depend, the production and supply of energy provides employment, investment and export opportunities, all of which contribute substantially to the welfare and standard of living of Australians. Energy sources are divided into two groups – renewable (energy sources for which the supply is essentially inexhaustible) and non-renewable (energy sources with a finite supply). Renewable energy sources include solar, wind, hydro-electricity, geothermal and biomass. However, most of Australia's energy comes from non-renewable sources, which include the fossil fuels of oil, natural gas and coal. The amount and type of energy used by households has considerable implications for the environment, including depletion of natural resources, greenhouse gas generation and air pollution.

- **Waste** is one of the by-products generated by human activities. Australia's growth in income and wealth has created a massive increase in the disposal of redundant goods, with an associated increase in waste diversity, toxicity and complexity. The extent and nature of environmental or health threats from waste depends on the type of waste and the way it is managed.

Energy

Total energy use



Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update', 2007, Table F1.

In 2005–06, Australia's total domestic energy use was 5,641 petajoules (PJ). Over the 30 year period from 1975–76 to 2005–06, total energy use in Australia rose by 107%, up from 2,731 PJ in 1975–76.

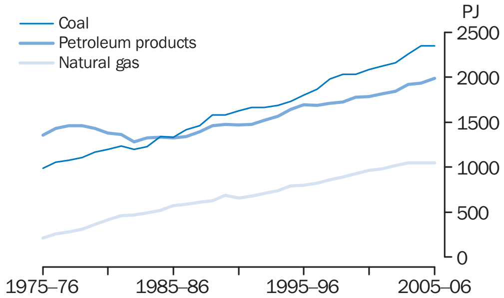
The annual average rate of growth in energy use peaked in 1988–89 at 5.8%. Since this time, energy use has been growing at between 2% and 4% annually. Total energy consumption between 1989–90 and 2005–06 increased by almost 50%.

Until the early 1990s, the rate of growth of total energy use generally matched the rate of growth in gross domestic product (GDP). However, energy consumption has tended to grow more slowly than GDP since that time.

The decline in 'energy intensity' of the Australian economy has been attributed to two main factors. One is an increase in energy efficiency due to technological advancements and fuel substitution. The other is the rapid growth of less energy intensive sectors, such as the services sector, in contrast to lower rates of growth in more energy intensive sectors such as manufacturing and mining.

Of the 5,641 PJ used nationally, the state or territory with the highest energy use was New South Wales (27%), followed by Victoria (26%), Queensland (23%) and Western Australia (14%). Those with the lowest use were South Australia (6%), Tasmania (2%) and the Northern Territory (2%).

Energy use by selected fuel source

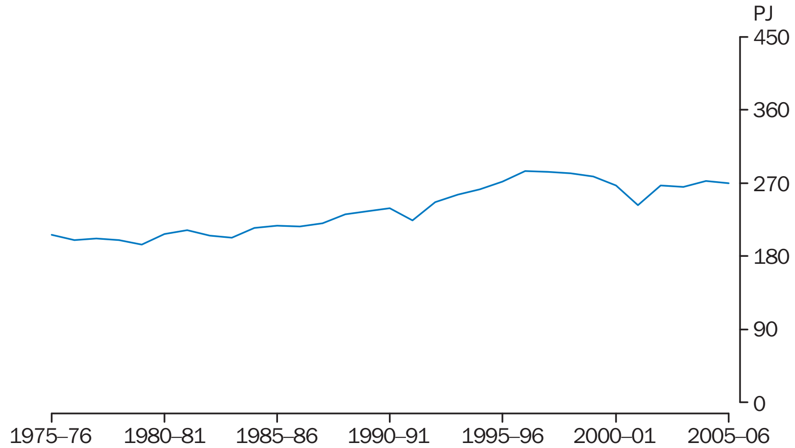


Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update', 2007, Table C.

The mix of fuels used to provide energy has changed little in the last five years. In 2005–06, black and brown coal accounted for 41.6% of primary energy consumption. Petroleum products (e.g. automotive gasoline, aviation turbine fuel, fuel oil and diesel) and natural gas accounted for 35.2% and 18.5% respectively. Renewable energy sources such as wind, hydroelectricity and solar energy represented about 5% of primary energy consumption.

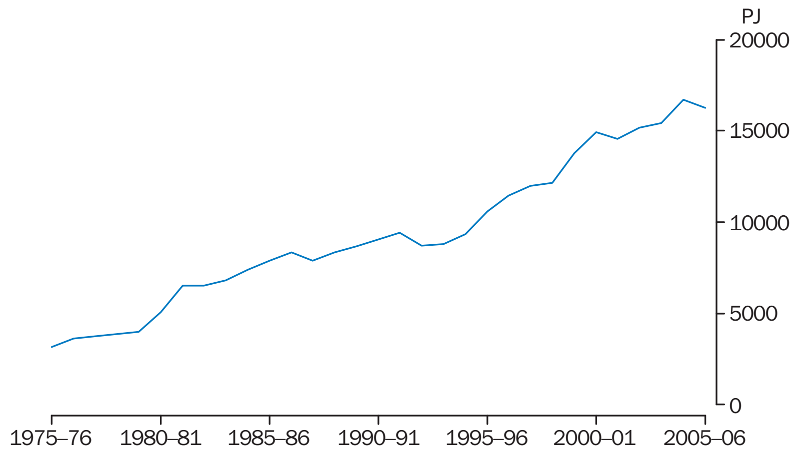
Energy

Production of renewable fuels



Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update', 2007, Table A: Australian energy supply and disposal.

Production of non-renewable fuels



Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics – Australian Energy Update', 2007, Table A: Australian energy supply and disposal.

In 2005–06, Australia's total primary energy production was estimated at 16,524 PJ. Of this, black coal accounted for 50% (8,194 PJ), followed by uranium (28% and 4,666 PJ), natural gas (10% and 1,672 PJ) and crude oil (5% and 900 PJ).

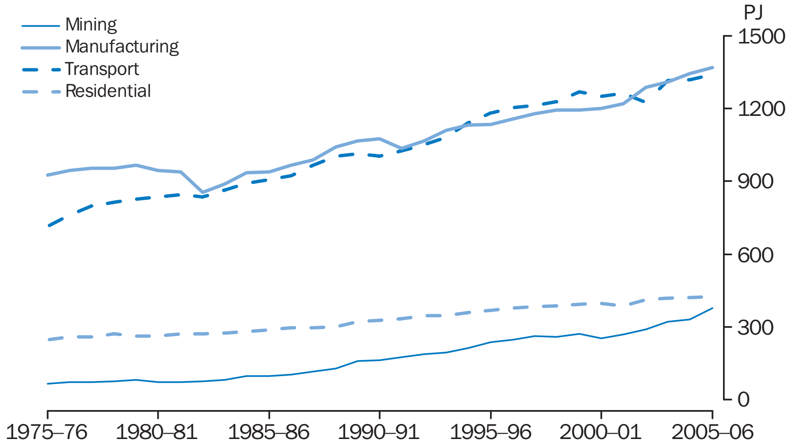
Over the 30 year period from 1975–76 to 2005–06, the production of non-renewable fuels has continually shown an upward trend, increasing from 3,158 PJ in 1975–76 to 16,254 PJ in 2005–06 (up 415%).

Growth in the production of renewable energy fuels increased by 31% but from a small base of just 206 PJ in 1975–76 to 270 PJ in 2005–06.

In the nine years to 2005–06, hydroelectricity output has fallen by nearly 7%, since water flow available for hydroelectricity generators has been restricted due to continued dry conditions mainly in New South Wales, Victoria and Tasmania.

Energy

Energy consumption by selected sector



	2000–01	2005–06	Per cent change
	PJ	PJ	%
Agriculture	85.5	92.8	8.5
Mining	253.9	379.6	49.5
Manufacturing	1 198.6	1 368.5	14.2
Construction	28.2	26.3	-6.7
Transport(a)	1 249.1	1 340.1	7.3
Commercial(b)	235.4	249.5	6.0
Residential	398.0	423.6	6.4
Other(c)	77.6	79.2	2.1
Total	**3 526.3**	**3 959.6**	**12.3**

Note: Excludes electricity generation. Percentages may not be exact due to rounding. Consumption as depicted above is a net concept, in order to avoid double counting, the energy consumed in producing energy products for consumption in other sectors does not count toward the total energy consumption of the producing sector.
(a) Includes all transport use, including household motor vehicle use.
(b) Includes wholesale and retail trade, communications, finance and insurance, property and business services, government administration and defence, education, health and community services, cultural and recreational services, and person and other services, along with water, sewerage and drainage.
(c) Includes lubricants and greases, bitumen and solvents, as well as energy consumption in the gas production and distribution industries.
Source: Australian Bureau of Agricultural and Resource Economics, 'Australian Energy Statistics - Australian Energy Update', 2007, Table B.

In 2005–06, consumption of energy by Australian households and industries (but excluding electricity generation), was 3,959.6 petajoules (PJ). This was an increase of 12.3% since 2000–01.

Mining experienced a 49.5% increase in energy consumption from 253.9 PJ to 379.6 PJ between 2000–01 and 2005–06.

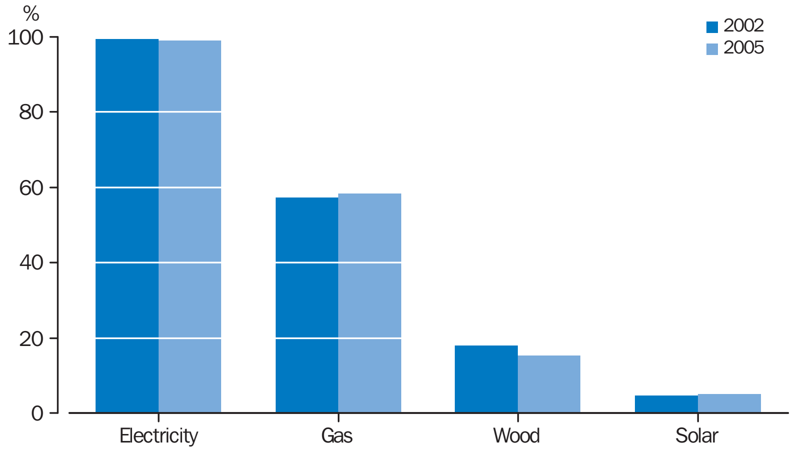
The transport sector (including household transport) was the largest consumer of energy, consuming 1,340.1 PJ in 2005–06. Road transport accounted for about three-quarters of this total, with the remaining contributors being air transport, water transport and rail transport.

The manufacturing sector was the second highest consumer of energy (1,368.5 PJ in 2005–06).

The transport and manufacturing sectors together accounted for more than two-thirds (68%) of total energy consumption. The residential sector accounted for 11% of total energy consumption, while the mining sector accounted for 10%.

Energy

Household energy use by type



Source: ABS, Environmental Issues: People's Views and Practices, 2005 (cat. no. 4602.0)

Almost all households in Australia (99%) use electricity for power and/or heating. In March 2005, electricity was the primary energy source for household cooking and hot water systems throughout Australia. However, electricity and gas were almost equally preferred for room heating.

Gas is the second most important source of energy for Australian households and was used in more than half of households (58%) in March 2005, particularly in the gas producing areas of Victoria and Western Australia.

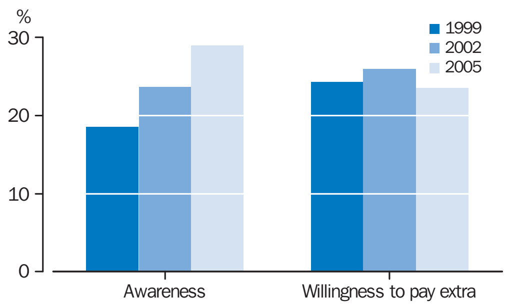
Solar energy is primarily used by households for heating water. It was used by 4% of Australian households for this purpose in 2005. The Northern Territory had the largest proportion of households (42% in 2005) using solar energy to heat water.

The amount and type of energy used by households has considerable implications for the environment, including depletion of natural resources, greenhouse gas generation and air pollution.

Green Power generally refers to the electricity generated from renewable energy resources like solar, wind, biomass, wave and tidal power, hydroelectricity and geothermal. Green Power schemes enable consumers to pay a premium for electricity generated from renewable sources.

The schemes have been operating in Australia for the past eight years in New South Wales, Victoria, Queensland, Western Australia, South Australia and the Australian Capital Territory. As of March 2005, there were 132,262 households belonging to a Green Power scheme.[1]

Household awareness of Green Power awareness and willingness to pay extra



Source: ABS, Environmental Issues: People's Views and Practices, 2005 (cat. no. 4602.0)

The graph demonstrates that although households were more aware of Green Power schemes in 2005 than previous years, they were less willing to pay extra for green power than previously.

1. National Green Power Accreditation Program, <http://www.greenpower.gov.au/admin/file/content13/c6/2005Q1Reportfinal.pdf>, last viewed 17 September 2007.

Waste

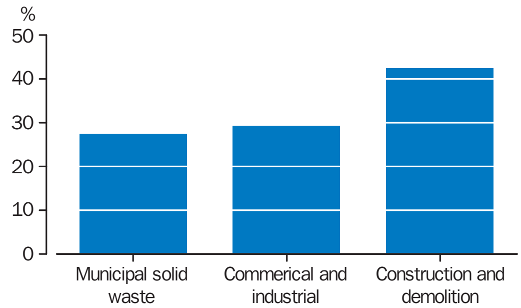
Waste generation, selected indictors

	1996–97 tonnes	2002–03 tonnes	Percentage change from 1996–97 to 2002–03
Waste to landfill	21 220 500	17 423 000	-18
Waste recycled	1 528 000	14 959 000	879
Waste generation	22 748 500	32 382 000	42
Waste to landfill per person	1.15	0.87	-24
Waste to landfill per $m GDP	41.76	23.47	-44
Waste generation per person	1.23	1.62	32
Waste generation per $m GDP	44.77	44.07	-2
Recycling per person	0.08	0.75	838
Recycling per $m GDP	3	20.37	579

Source: Department of the Environment and Heritage, February 2006, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Australians generated approximately 32.4 million tonnes of solid waste or approximately 1,629 kilograms of waste per person in 2002–03.

Solid waste generation by source, Australia(a), 2002–03



(a) Excludes Tasmania and the Northern Territory.
Source: Productivity Commission, 2006, Waste Management, Report no. 38, Canberra.

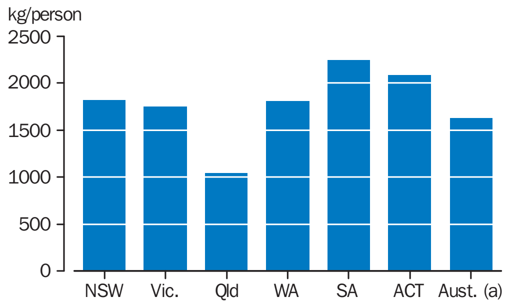
Of this amount, 27% came from municipal sources, 29% from the commercial and industrial sector, and 42% from the construction and demolition sector. Municipal waste includes domestic waste and other council waste (e.g. beach, parks and gardens, streets).

Growth in the amount of waste generated per person in Australia has been driven by a number of economic and demographic factors. A consequence of Australia's fast-growing, materially intensive economy is the production of large quantities of waste. International evidence suggests that economic growth contributes to growth in waste generation per person.[1]

Some of the growth in waste generation, especially in per person terms, has been driven by changes in population demographics. Australians are tending to live in smaller household groups, with an associated increase in the ownership of more durable goods per person and an increase in the consumption of smaller-serve goods that have higher packaging-to-product ratios.[2]

In general, the data show an increase in waste generation per person, but a decline in waste to landfill achieved through a significant increase in recycling.

Solid waste per person, Australia(a), 2002–03

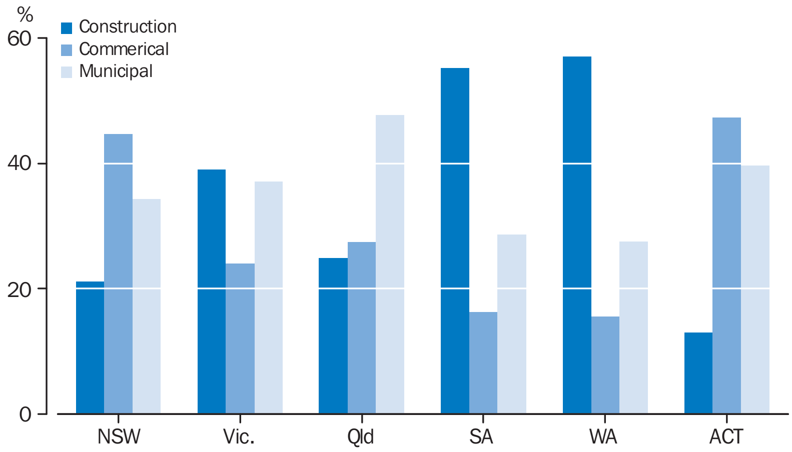


(a) Excludes Tasmania and the Northern Territory.
Source: Productivity Commission, 2006, Waste Management, Report no. 38, Canberra.

1. *Productivity Commission, 2006, Waste Management, Report no. 38,* Canberra, p.20.
2. ABS, *Measures of Australia's Progress, 2006,* (cat. no. 1370.0) Canberra, p.84.

Waste

Solid waste disposed to landfill by source, 2002–03



Source: Department of the Environment and Heritage, 2005, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Australia has a strong dependence on landfill for waste management with more than half (54%) of all solid waste, some 17 million tonnes, deposited in 2002–03. [1] It is estimated that 70% of municipal waste, 56% of commercial and industrial waste, and 43% of construction and demolition waste went into landfill in 2002–03.

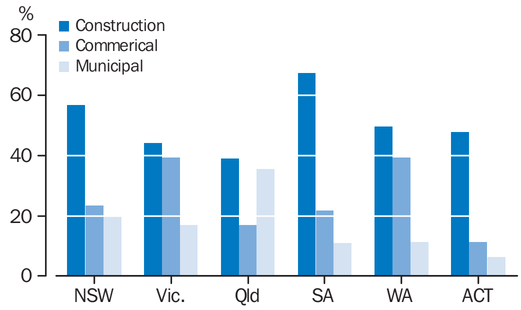
Of the total amount of waste deposited in landfill in each state or territory, commercial and industrial was the largest component in New South Wales (45%) and the Australian Capital Territory (47%); whereas construction and demolition waste was the largest component in Victoria (39%), Western Australia (57%) and South Australia (55%).

The chief environmental concerns associated with modern landfills are emissions of greenhouse gases, particularly methane, and the possible long-term pollution of the environment through leaching of heavy metals, household chemicals, consumer electronic products and earlier generation rechargeable batteries, such as ni-cads.

Recycling of waste materials reduces the volume of waste disposed in landfills. The amount of waste recycled in Australia has increased both in absolute terms and as a proportion of total waste generated.

Overall, the recycling rate is estimated to be 46%, which represents the amount that has been reprocessed into a usable production input and not just the amount collected for recycling.

Recycling, percentage of total, by state, 2002–03



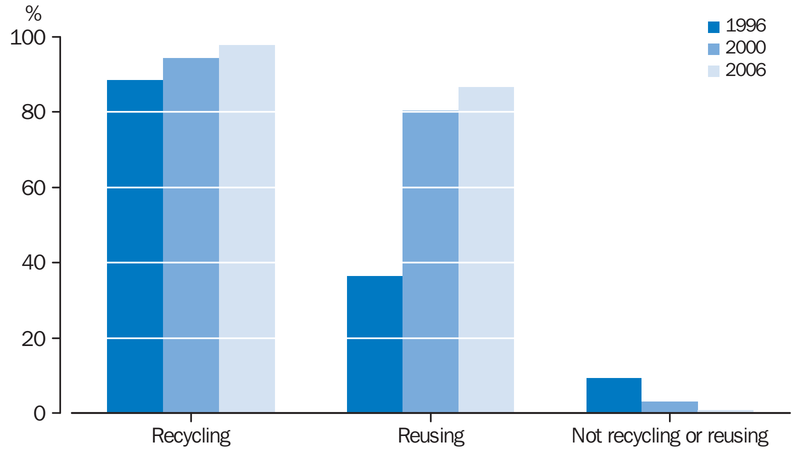
Source: Department of the Environment and Heritage, 2005, Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency.

Of the 15 million tonnes of waste recycled in Australia in 2002–03, 39.0% was in New South Wales, followed by 29.6% in Victoria and 14.4% in South Australia. Less than one-third (30%) of municipal waste was recycled, compared with 44% of commercial and industrial waste and 57% of construction and demolition waste.

1. Productivity Commission, 2006, Waste Management, Report no. 38, Canberra.

Waste

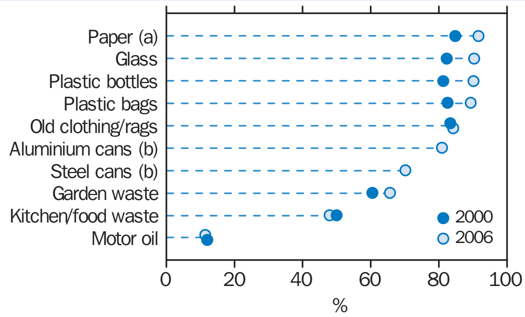
Recycling/reuse of waste in households



Source: ABS, Environmental Issues: People's Views and Practices, 2006 (cat. no. 4602.0).

The recycling activities of households have grown extensively in the past decade. In March 1996, 91% of Australian households said they practised some form of waste recycling and/or reuse activity. By March 2006, almost all households (99%) reported that they recycled and/or reused. There is a disparity in recycling between rural and urban areas, which may be due to limited implementation of kerbside recycling schemes in rural areas due to higher costs.

Waste items recycled and/or reused by households



(a) Includes cardboard and newspapers.
(b) No data available in 1996.
Source: ABS, Environmental Issues: People's Views and Practices, 2006 (cat. no. 4602.0).

In 2006, paper product was the most common material recycled/reused by Australian households (92%), followed by glass, plastic bottles (both 90%) and plastic bags (89%). Only 12% of households recycled motor oil.

There has been greater involvement in recycling of organic waste (e.g. garden waste and kitchen or food waste). Two-thirds (66%) of households recycled garden waste in 2006, up from 62% in 2003 and 51% in 1996.

Australians are some of the highest users of new technology in the world. There are approximately 9 million computers, 5 million printers and 2 million scanners currently in households and businesses across Australia.[1]

However, with the constant drive to have the newest and latest products comes the inevitable wastage of the "old" products they supersede. Obsolete electronic goods, or "e-waste" is one of the fastest growing waste types and the problem of e-waste is global.

1. Department of Environment and Water Resources, Electronic Scrap – A Hazardous Waste, <http://www.environment.gov.au/settlements/publications/chemicals/hazardous-waste/pubs/electronic-scrap-fs.pdf>, last viewed 17 September 2007.

Atmosphere trends

The atmosphere is an essential component of all ecological systems on Earth. The atmosphere surrounding the Earth consists mainly of nitrogen and oxygen. A smaller amount of other gases and particles make up the balance. The atmosphere plays a critical role in regulating global, regional and local climate and is essential to supporting life on Earth. Oxygen is required for life, ozone protects us from harmful solar radiation and historically, greenhouse gases have helped maintain a temperature range suitable for life.

Australia has a unique meteorology as a relatively isolated, continental island. Apart from issues associated with global ozone, greenhouse gas changes and volcanic events, Australia experiences no air quality changes that originate from beyond its borders. However, some human activities change the nature of the atmosphere, affecting air quality, levels of ultraviolet (UV) radiation and climate.

The commentary that follows focuses on the following trends:

- **Greenhouse gases** (GHGs) are a natural part of the atmosphere. They trap the sun's warmth and maintain the Earth's surface temperature at the levels able to support life. However, human actions – particularly burning fossil fuels (coal, oil and natural gas) and land clearing – are increasing the concentrations of these gases which mean they trap more heat and change the climate. This is known as the greenhouse effect, which contributes to global warming. Global warming is widely perceived as one of the most significant international environmental issues. Different greenhouse gases have different effects and remain in the atmosphere for different periods of time. A tonne of methane, for example, contributes as much to global warming as 21 tonnes of carbon dioxide (CO_2). To assess the impact of different gases, emissions of each gas are converted to a common CO_2 equivalent (CO_2-e) scale and added together.

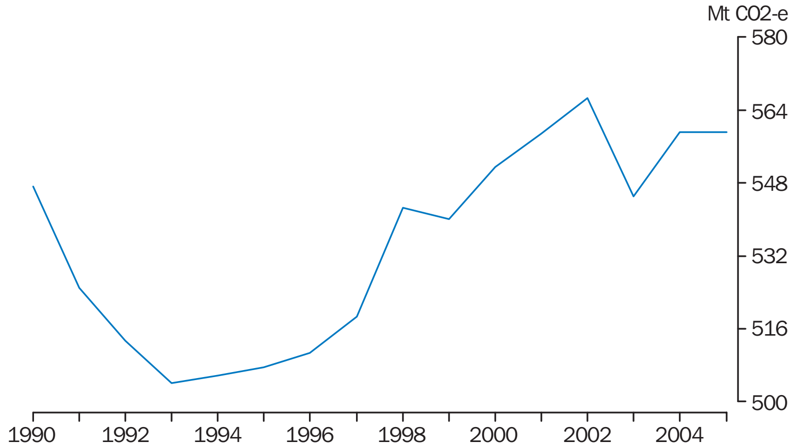
- **Climate change:** According to meteorological records, the global average surface temperature has increased over the past 100 years. In Australia, annual average (mean) temperatures have increased, although this has not been uniform throughout the country. The effects of global warming are very difficult to predict. It is likely Australia will be hotter and drier in coming decades according to climate change projections. Rainfall in Australia is highly variable geographically, seasonally and from year-to-year. In recent years, rainfall has been higher over much of northern Australia, especially in the northwest, while south-eastern Australia has been drier-than-average. Some areas have experienced their lowest rainfall on record.

- **Ozone** near the Earth's surface can be a harmful pollutant, but in the upper atmosphere (the stratosphere) it absorbs most of the harmful ultraviolet (UV) radiation in the sun's rays. When excessive UV radiation reaches the Earth's surface it can cause problems for human and ecosystem health. Human activity has been responsible for increasing the concentrations of ozone depleting substances in the upper atmosphere. As a result of these emissions, between 2% and 4% of ozone over Australia has been lost each decade since the 1950s and we are now exposed to greater levels of UV radiation than in the past.

- **Air quality** is an important factor in the quality of life in Australian cities. The main source of air pollution is motor vehicle emissions. Trends in fine particle pollutants, ozone (photochemical smog), motor vehicle usage and sulphur dioxide in regional centres are presented.

Greenhouse gases

Net greenhouse gas emissions



1990 (base year)	1995	2000	2001	2002	2003	2004	2005
547 127	507 469	551 503	558 831	566 584	545 105	559 088	559 074

Note: Kyoto-based estimates, expressed in million of tonnes (Mt) of carbon dioxide equivalent (CO_2-e,). CO_2-e provides the basis for comparing the warming effect of different greenhouse gases.
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2005.

Net greenhouse gas emissions, percentage change

	Emissions Mt CO2 -e (a)		Per cent change in emissions
	1990	2005	1990 to 2005
Energy	287.0	391.0	36.3
Stationary energy	196.0	279.4	42.6
Transport	61.9	80.4	29.9
Fugitive emissions	29.1	31.2	7.3
Industrial processes	25.3	29.5	16.5
Agriculture	87.7	87.9	0.2
Land use, land use change and forestry (b)	128.9	33.7	–73.9
Waste	18.3	17.0	–6.9
Australia's net emissions	**547.1**	**559.1**	**2.2**

(a) Carbon dioxide equivalent CO2-e provides the basis for comparing the warming effect of different greenhouse gases.
(b) 2005 estimate is interim only and will be revised with the next update of the National Greenhouse Gas Inventory.
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2005.

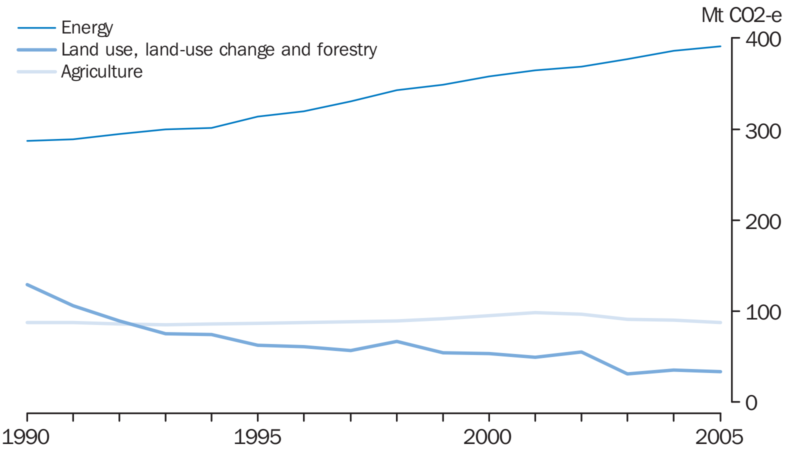
Australia's net greenhouse gas emissions across all sectors totalled 559.1 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2005 under the accounting provisions applying to Australia's 108% emissions target. Emissions in 2005 were 102.2% of 1990 levels.

The largest sectoral increase in greenhouse gas emissions over the 1990 to 2005 period, of 42.6% (83.4 Mt CO_2-e), occurred in the stationary energy sector, driven in part by increasing population, household incomes and export increases from the resources sector. Transport had the next largest growth, with an increase of 29.9% (18.5 Mt CO_2-e). The main driver for the increase in transport emissions is continuing growth in household incomes and number of vehicles.

Offsetting growth in these sectors has been a strong decline in net emissions from the land use, land use change and forestry sector, in particular, reductions in clearing of forest cover.

Greenhouse gases

Net greenhouse gas emissions, selected sectors



Source: Australian Greenhouse Office, National Greenhouse Gas Inventory, 2005.

Greenhouse gases include carbon dioxide, methane and nitrous oxide. Emissions of these and other greenhouse gases may be compared by converting them to carbon dioxide equivalents (CO_2-e).

Carbon dioxide is the most important of the greenhouse gases in Australia's inventory as it accounts for nearly three-quarters (74.3%) or 415.5 Mt of total CO_2-e emissions. Methane accounts for 20.2% (112.9 Mt CO_2-e) and the remaining gases account for 5.5% (30.6 Mt CO_2-e) of Australia's greenhouse gas emissions. The energy sector was the major contributor to carbon dioxide emissions at 88.0%. Agriculture was the main contributor of methane (59.5%) and nitrous oxide (85.3%).

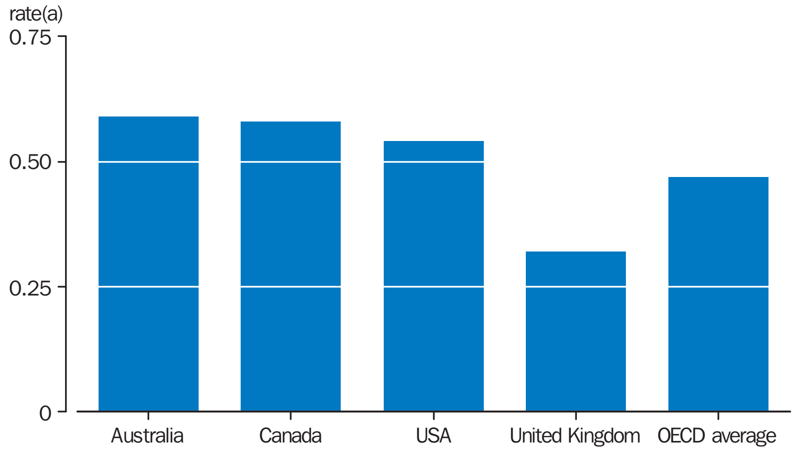
The largest source of greenhouse gas emissions overall, was the energy sector comprising 69.9% (391.0 Mt CO_2-e) of emissions. This represented a 36.3% increase from 1990 levels.

Emissions from agriculture accounted for 15.7% of net national emissions (87.9 Mt CO_2-e). In 2005, emissions from agricultural sources were 0.2% (0.2 Mt) higher than in 1990.

Relatively minor sources of greenhouse gas emissions include industrial processes (29.5 Mt CO_2-e and 5.3% of net national emissions). These emissions were 4.2 Mt (14.2%) higher than 1990 levels, partially attributable to the growth in mineral product and chemical industries.

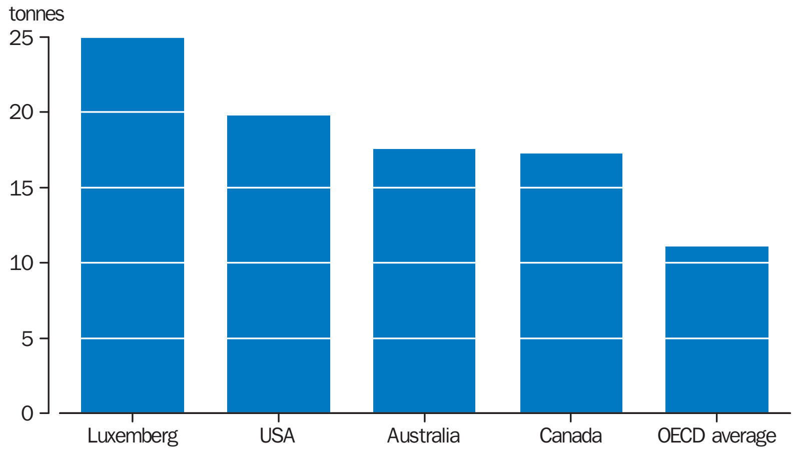
Greenhouse gases

Carbon dioxide emissions intensity, selected OECD countries, 2004



(a) Kilograms of carbon dioxide emissions per dollar of GDP (at 2000$ PPP).
Source: International Energy Agency, 'Key World Energy Statistics 2006'.

Carbon dioxide emissions per person, selected OECD countries, 2004



Source: International Energy Agency, 'Key World Energy Statistics 2006'.

While Australia only accounts for around 1.5% of global greenhouse gas emissions, its CO_2 emissions per person are relatively high compared with other OECD countries. In 2004, 17.53 tonnes of CO_2 were emitted for every Australian, compared with an OECD country average of 11.09 tonnes of CO_2 per person.

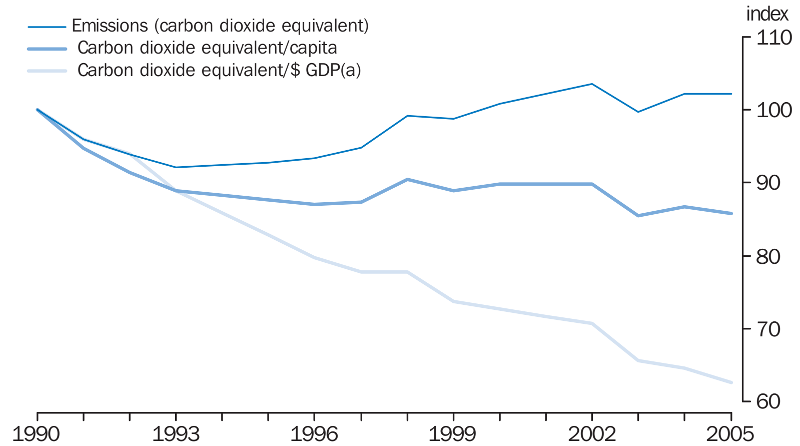
Australia's relatively large emissions per person can be attributed to factors such as the high usage of coal in electricity generation, the energy intensive aluminium smelting sector, and the high dependence on motor vehicles and trucks for transport.

In 2004, the emissions intensity of the Australian economy (0.59 kg CO_2 per dollar of GDP PPP) was relatively high compared with the OECD average (0.44 kg CO_2 per dollar of GDP PPP), shown in the graph at the top of this page.

However, over the period 1990–2005, Australia's emissions intensity fell by 37% (see graph on following page).

Greenhouse gases

Carbon dioxide equivalent (CO_2-e) emissions, net, per person and per $GDP



(a) GDP is a chain volume measure. In accordance with the Kyoto Protocol base year = 1990.
Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2005.

Greenhouse macro indicators (Kyoto accounting)

	Emissions (CO_2-e)	Tonnes CO_2-e/capita	kg CO_2-e/$GDP
1990	547.1	32.3	0.99
1993	504.0	28.7	0.88
1996	510.7	28.1	0.79
1999	540.0	28.7	0.73
2002	566.6	29.0	0.70
2005	559.1	27.7	0.62

Source: Australian Greenhouse Office, National Greenhouse Gas Inventory 2005.

The greenhouse gas emissions intensity of the Australian economy, expressed as emissions per dollar of GDP, has declined over the period 1990 to 2005 by 37%, from 0.99 to 0.62 kg of carbon dioxide equivalent emissions (CO_2-e). The falling trend in emissions per unit of GDP reflects:

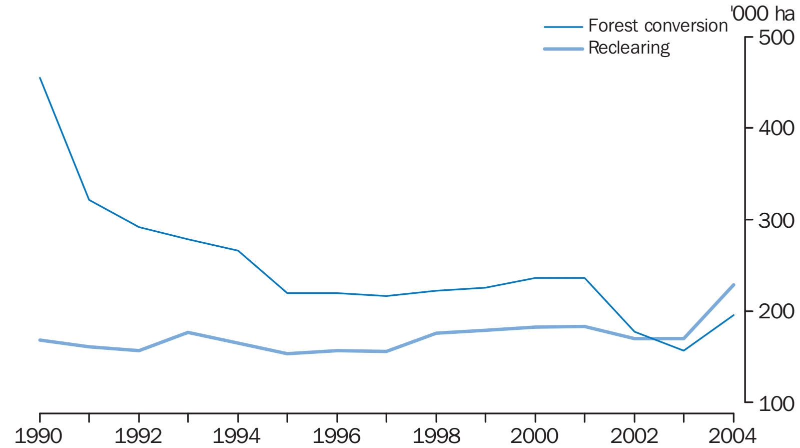
- specific emissions management actions across sectors
- the large decline in emissions over the period, largely due to reductions in forest clearing
- structural changes in the economy with stronger growth in the services sector than in the more energy-intensive manufacturing sector.

Australia has reduced its emissions per capita over the period 1990 to 2005 by 14% from 32.3 to 27.7 tonnes CO_2-e. Australia's high per capita emissions reflect a number of factors:

- the dominance of the use of coal as a fuel in the electricity industry (no nuclear power is produced in Australia and hydro-electric power options are limited)
- the presence of net emissions from the land use, land use change and forestry sector
- the impact of international trade patterns, which result in the production in Australia of many goods with high associated emission levels – that is, resource and agricultural products – that are destined for export and consumption in other countries.

Greenhouse gases

Forest and grassland conversion: rates of forest conversion and reclearing



Note: Forest conversion is land cleared for the first time. Reclearing is clearing of land previously cleared.
Source: Australian Greenhouse Office, 2007, Australian Greenhouse Emissions Information System, <http://www.ageis.greenhouse.gov.au>, last viewed 5 September 2007.

In 2004, 6% of net greenhouse gas emissions came from land use, changes in land use, and the forestry sector. This sector includes land clearing, which was a major source of Australia's net greenhouse gas emissions in the early 1990s, but is now much reduced. This reduction offset most of the increases in emissions that have occurred in all other sectors.[1]

Deliberate removal of forests for the purpose of a change in land use is referred to as deforestation. It is distinct from natural effects, such as dieback and fire, and from the temporary removal of forest by harvesting.

Vast areas of native vegetation have been cleared since Europeans first settled in Australia in 1788.

Over the decade 1995 to 2004, although land clearing continued, the rate of clearing fell by about 11%. The figures do not distinguish between the type of vegetation (native or non-native) that was cleared.

There are a number of environmental, economic and social impacts associated with the clearing of native vegetation, including loss of biodiversity and salinisation.

1. *State of the Environment Committee, 2006,* Australia State of the Environment 2006, *Department of the Environment and Heritage, Canberra,*

Greenhouse gases

Transport mode, estimated greenhouse gas emissions, Mt CO_2 equivalent

	2000	2001	2002	2003	2004	2005
Road	68.8	68.2	69.9	71.9	68.1	70.7
Rail	1.6	1.8	1.8	1.5	1.7	2.1
Civil aviation	4.4	5.5	5.8	5.3	4.8	5.1
Domestic navigation	1.5	1.6	1.6	1.1	1.6	2.4
All domestic transport (a)	**76.3**	**77.2**	**79.2**	**79.8**	**76.2**	**80.4**
International bunkers						
Aviation	7.4	7.9	6.7	6.0	6.0	6.8
Marine	2.8	2.6	2.9	2.8	2.8	3.0

Note: Components may not sum to totals due to rounding.
(a) Does not include ‘Other transport’.
Source: Australian Greenhouse Office, 'National Greenhouse Gas Inventory 2005'.

In 2005, the transport sector contributed 80.4 Mt CO_2-e or 14.4% of Australia’s net greenhouse gas emissions. Transport emissions are one of the strongest sources of emissions growth in Australia. Emissions from this sector were 30% higher in 2005 than in 1990, and have increased by about 1.8% annually.

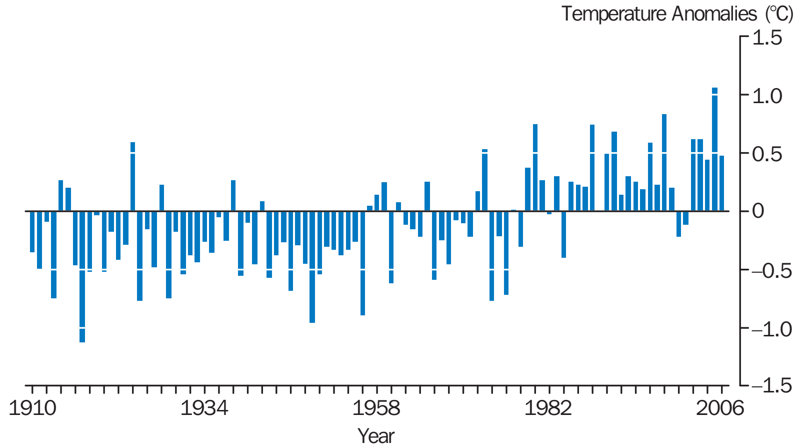
Road transport was the main source of transport emissions in 2005 (87.9%) and accounted for 12.6% of national emissions. Emissions from road transport increased by 31% (16.5 Mt) between 1990 and 2005. Passenger cars were the largest transport source (contributing 43.7 Mt). Emissions from passenger cars increased by 25% (8.6 Mt) between 1990 and 2005. Emissions from light commercial vehicles (LCVs) and trucks have also grown strongly.

Other transport sources are far smaller contributors. Civil aviation contributed 6% (5.1 Mt) of transport emissions, domestic shipping 3% (2.4 Mt) and railways 3% (2.1 Mt).

Domestic air transport emissions were 76% (2.2 Mt) higher than in 1990. Emissions have grown strongly in this sector, particularly in the early 1990s. However, emissions in the 1990 base year were unusually low because of extensive airline disruptions in that year, which contributed to the magnitude of change. By contrast, emissions from shipping have fallen, reflecting improved productivity and changes in activity.

Climate change

Annual mean temperature anomalies



Note: Departures from 1961-90.
Source: Bureau of Meteorology, http://www.bom.gov.au, last viewed 9 August 2007.

Australia experienced its eleventh warmest year on record in 2006 following its warmest year on record in 2005. The annual average temperature for 2006 was 0.47^{0}C above the standard 1960–91 average.

Despite record warm daytime temperatures in the drought-affected south-east, 2006 was cooler than 2005 when temperatures are averaged across the whole country. The annual mean maximum temperature was 0.60^{0}C above average (ninth highest), while the mean minimum temperature was 0.34^{0}C above average (seventeenth highest). Temperature anomalies varied throughout the year, but spring 2006 was particularly warm (+1.42^{0}C), being Australia's warmest spring season on record.

Many of Australia's warmest years on record (such as 1988, 1998 and 2002) were influenced by significant El Niño events.

However, Australia's warmest year on record, 2005, was not accompanied by an El Niño event, making the record temperatures quite unusual.

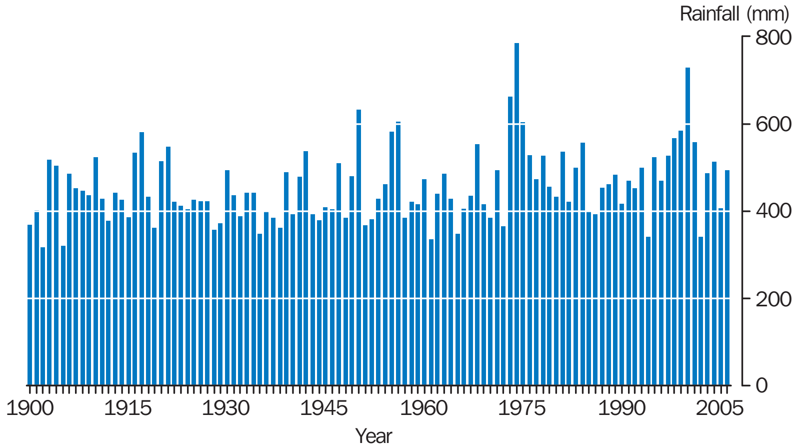
Australian annual mean temperatures have increased by approximately 0.9^{0}C since 1910. However, annual temperatures will continue to vary from year-to-year in association with factors such as El Niño-events. The average Australian temperature for 2006 was cooler than for 2005 (1.06^{0}C above normal).

Since 1979, only four years have been cooler-than-average in Australia.

Globally, the average temperature for 2006 was approximately 0.42^{0}C above average, making it the sixth-warmest year since records began in 1861.

Climate change

Annual rainfall



Source: Bureau of Meteorology, http://www.bom.gov.au, last viewed 9 August 2007.

Rainfall in 2006 was well below normal in the south-east and far south-west of Australia, but was close to normal when averaged over the whole country.

Preliminary data indicate that the average total rainfall throughout Australia for 2006 was approximately 490 millimetres (mm) – slightly more than the long-term average of 472 mm. This total included above-average totals across the north and inland Western Australia, cancelling out the below-average totals recorded in the south-east and far south-west. Parts of south-east Australia experienced their driest year on record, including key catchment areas which feed the Murray River and the Snowy Rivers, as did parts of the Western Australian coast, including Perth.

Conversely, record high falls were observed in parts of the tropics and inland Western Australia. It was the third-driest year on record for both Victoria and Tasmania. For the broader south-east Australian region, which takes in south-east South Australia and southern New South Wales, it was the second-driest year on record.

The dominant cause of the drought experienced throughout south-east Australia in 2006 was the development of an El Niño in the tropical Pacific Ocean.

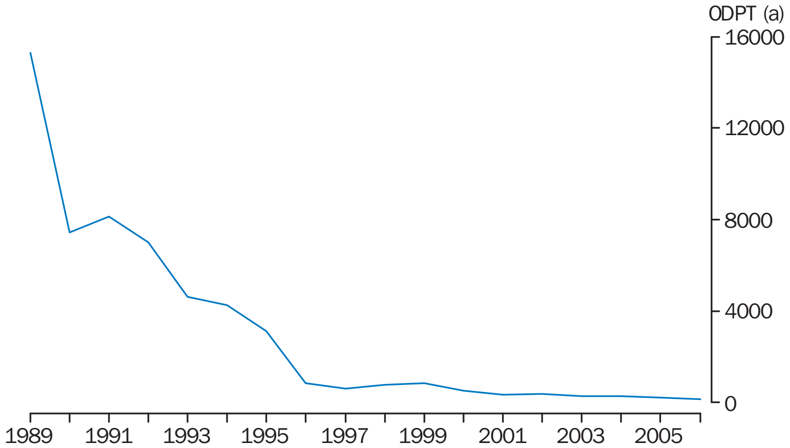
El Niño refers to a warming of surface water over the central and eastern tropical Pacific Ocean. Combined with this warming are changes in the atmosphere (measured by the Southern Oscillation Index which measures the air pressure difference between Tahiti and Darwin) that affect weather patterns across much of the Pacific Basin, including Australia. It is often associated with reduced winter and spring rainfall.

Australian rainfall trends over the last 50 years have seen declines over southern and eastern Australia, and increases across the north-west. The pattern of rainfall during 2006 continued this trend.

The dry conditions in southern and eastern Australia in 2006 have continued the long-term rainfall deficiencies in many regions, some of which extend back more than five years. Aspects of this multi-year drought are highly unusual and unprecedented in many areas. Understanding the role that climate change has played in these anomalies is an area of continuing research.

Ozone

Consumption of ozone depleting substances



(a) Ozone depleting potential tonnes are an aggregated scale of measurement which allows the addition of quantities of different gases and then weights them according to the amount of ozone each could potentially deplete.
Source: Available from the Department of Environment and Water Resources on request.

Ozone in the upper atmosphere protects life on the Earth's surface by absorbing most of the sun's harmful ultraviolet B radiation.

Certain substances trigger the depletion of atmospheric ozone. Human activity has been responsible for increasing the concentrations of ozone depleting substances in the atmosphere. The main substances responsible for ozone depletion are chlorofluorocarbons (CFCs) traditionally used in refrigeration, foam production and aerosols, and halons used in the fire protection industry.

Excessive UV radiation reaching the Earth's surface can cause health problems for people and other organisms, including eye, skin and immune system damage. UV radiation can also affect crop yields and marine plankton (which may have flow-on effects for marine ecosystems). Radiation can degrade wood, paper, cotton, wool and plastics.

Estimates of Australia's total consumption of ozone depleting substances, weighted according to the ozone depleting potential of each, are presented in the graph above as ozone depleting potential tonnes (ODPTs).

Consumption in 1989 was over 15,000 ODPTs. By 1996 it had fallen to just over 800 ODPTs. Between 1996 and 2006, consumption fell by a further 80% to just over 160 ODPTs, which represents around 1% of Australia's consumption of ozone depleting substances in 1989.

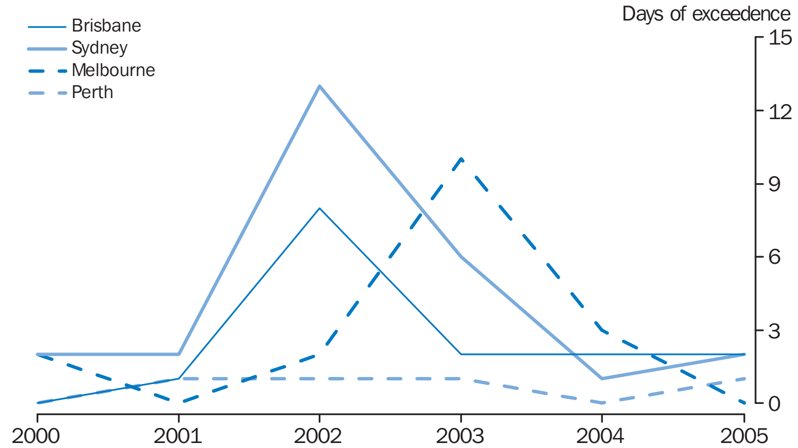
Consumption in 2006 was mostly composed of hydrocholorfluorocarbons (HCFCs) and methyl bromide. Australia stopped the importation and production of CFCs during the 1990s and HCFCs are minor ozone depleting substances used as interim replacements for CFCs.

Following two decades of rapid growth, the ozone 'hole' over Antarctica has maintained its current size of 25 million square kilometres since the mid-1990s. However, there are indications that the concentration of ozone in the upper atmosphere over Australia may have started to increase since 2000.[1]

1. 2006 Australian State of the Environment Committee,, Australia State of the Environment 2006*, Department of the Environment and Heritage, Canberra, p28.*

Air quality

Particulate concentrations, daily 24-hour PM_{10}, selected cities



Note: Shows the number of days when the one-day average concentrations exceeded the NEPM standard.
Source: State environmental protection agencies, 2007 and Environmental Protection and Heritage Council, < http://www.ephc.gov.au> last viewed June. 2007.

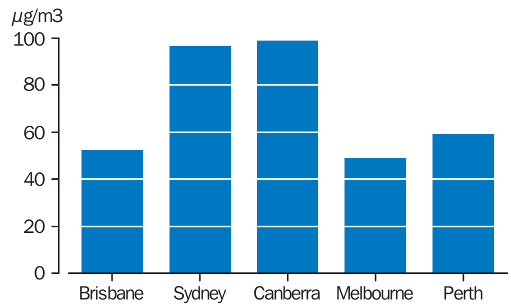
Particles may be solid matter or liquid droplets. PM_{10} particles (10 micrometres in diameter and smaller) are small enough to penetrate deeply into the lungs. Particles can aggravate existing respiratory and cardiovascular disease.

The current NEPM (National Environment Protection Measure) one-day standard for PM_{10} is 50 $\mu g/m^3$ (micrograms per cubic metre), with a maximum allowable exceedence of five days a year.

Particles result from various kinds of combustion, including bushfires and volcanoes. They are also emitted from industrial processes, motor vehicles, domestic fuel burning and industrial and domestic incineration.

Overall, air quality in Australia is relatively good. Between 1997 and 2001, the levels of PM_{10} in Brisbane, Sydney, Melbourne and Perth met the NEPM annual standard. However, there was a rise in 2002 and 2003, mainly due to severe forest fires and dust storms around the Sydney, Canberra and Melbourne areas.

Highest daily concentration, 2005



Note: Shows the highest daily average concentration in micrograms per cubic metre.
Source: State environmental protection agencies, 2007.

While four of the five cities with data available exceeded the one-day NEPM standard of 50 $\mu g/m^3$, the extent to which the standard was exceeded varied between cities. In 2005, Brisbane's highest daily concentration was 52.6 $\mu g/m^3$, which exceeded the standard by 5%. Canberra's highest daily concentration was 98.8 $\mu g/m^3$. This can be attributed at least in part, to emissions from domestic wood heaters.

Air quality

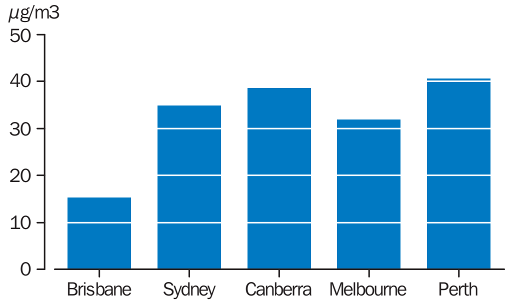
Particulate concentrations, daily 24-hour $PM_{2.5}$, selected cities

Note: Number of days when the one-day average concentrations exceeded the NEPM standard of 25 $\mu g/m^3$.
Source: State environmental protection agencies, 2007 and the Environmental Protection and Heritage Council, <http://www.ephc.gov.au> last viewed June, 2007.

The National Environment Protection Measure (NEPM) was varied in 2003 to introduce advisory reporting standards for particles at $PM_{2.5}$ (particulate matter with an equivalent aerodynamic diameter of up to 2.5 micrometres (μm)).

The NEPM standard for particles up to $PM_{2.5}$ is 25 $\mu g/m^3$ (micrograms per cubic metre) for one day.

Highest daily concentration, 2005



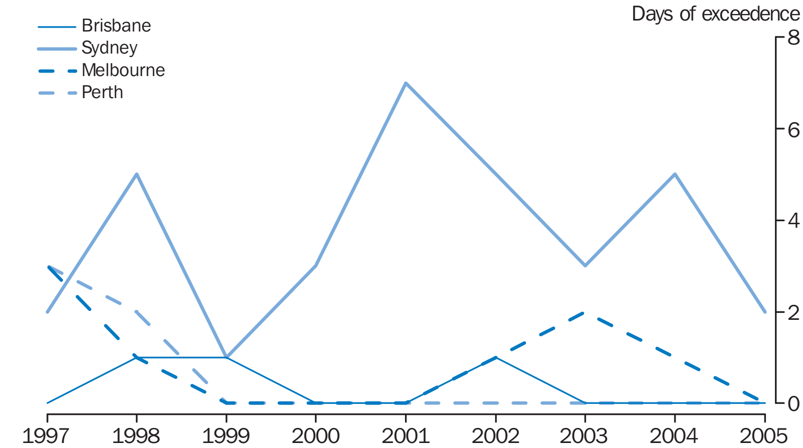
Note: Shows the highest daily average concentration in micrograms per cubic metre.
Source: State environmental protection agencies, 2007.

Levels of $PM_{2.5}$ exceeded the NEPM standards in Sydney, Canberra, Melbourne and Perth in 2005.

Particle pollution is a major air quality issue in Australia. Particles can aggravate existing respiratory and cardiovascular disease. Some plants and animals are particularly sensitive to fine particle pollution. Lichens for example are often among the first life forms to be affected, while particles can cover the leaves of larger plants and damage their ability to photosynthesise.

Air quality

Daily peak 4-hour ozone (photochemical smog)



Note: Shows the number of days when the one-day average concentrations exceeded the NEPM standard.
Source: State environmental protection agencies, 2007 and Environmental Protection and Heritage Council, < http://www.ephc.gov.au> last viewed June. 2007.

Ozone or photochemical smog is a problem in most large cities. It is caused by emissions from industry, motor vehicles, domestic wood combustion and other sources, accumulating under certain meteorological conditions.

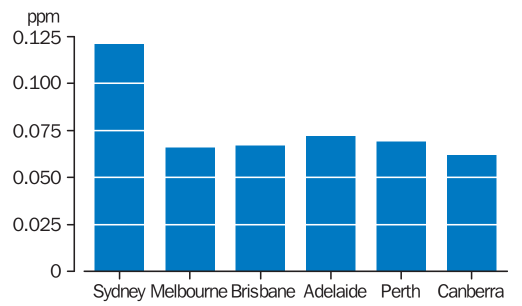
Ozone is produced photochemically in air by reactions between hydrocarbons and nitrogen oxides. Some hours of strong sunlight are required to allow high levels of oxidant to form. High levels are most likely to occur when there is abundant sunshine combined with high temperatures and wind conditions that limit dispersion.

Ozone affects the linings of the throat and lungs, restricting air passages and making breathing difficult. It also increases the risk of respiratory infections and eye irritation. The current four-hour standard level of oxidant is 0.08 parts per million (ppm). The maximum allowable exceedance is one day a year.

Ozone has been monitored in most cities since the late 1970s. Ozone levels have declined significantly since the 1970s, although in recent years a clear trend is not apparent. There is significant year-to-year variability in peak ozone levels due to weather variability.

The levels of ozone in the atmosphere vary between cities. Sydney was the only city that recorded a 4-hour ozone exceedence in 2005, as shown in the graph below. This is partly due to the topography of the Sydney Basin.

Highest daily concentration, 2005



Note: Shows the highest daily average concentration in parts per million (ppm).
Source: State environmental protection agencies, 2007.

Air quality

Sulphur dioxide, days of exceedence, selected regional centres

Note: The National Environment Protection Measure guideline for SO_2 concentrations of 0.2 parts per million is the maximum allowable exceedences should be one day a year for one hour standard limit of sulphur dioxide.

Source: State environmental protection agencies, 2007 and the Environmental Protection and Heritage Council, <http://www.ephc.gov.au> last viewed June. 2007.

Sulphur dioxide (SO_2) is a colourless, irritating and reactive gas with a strong odour. In Australia, emissions of sulphur dioxide are primarily from industrial operations that burn fuels such as coal, oil, petroleum and gas and from wood pulping and paper manufacturing. It is also emitted by vehicles. It irritates the eyes, nose and throat, and people with impaired lungs or hearts and asthmatics are particularly at risk of exacerbating existing health problems.

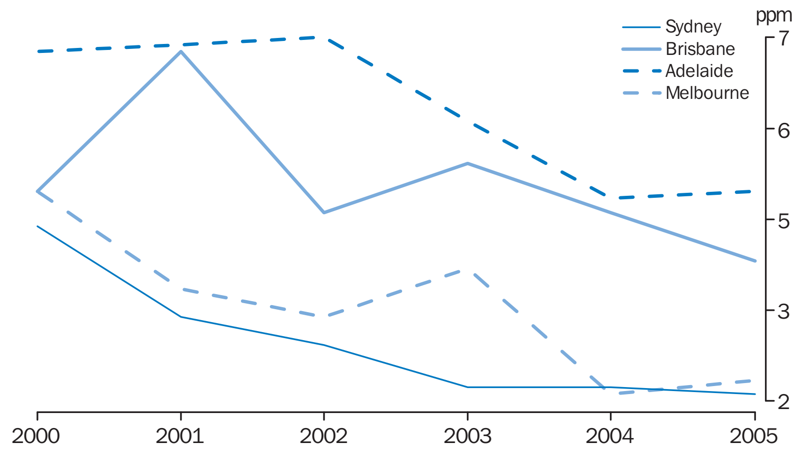
Ambient SO_2 concentrations are generally low. Levels of SO_2 vary between regions due to varied geographical distribution of major sources and different topographical and meteorological conditions. Sulphur dioxide levels in Australian cities are low compared to the USA and Europe because of the limited number of major SO_2 emitting industries and low sulphur fuels.

Sulphur dioxide pollution has been an issue in some mining areas, but is generally improving. Due to improvements in mineral extraction and processing activities at Kalgoorlie in Western Australia, SO_2 levels have been reduced dramatically over the last 12 years.

In recent years, one-hour SO_2 levels have been below the National Environment Protection Measure (NEPM) standard levels at Gladstone, the Lower Hunter and La Trobe Valley (power generation areas using coal), however, levels remained high at Port Pirie and Mount Isa.

Air quality

Carbon monoxide concentrations, highest 8-hour concentration



Source: State environmental protection agencies, 2007.

Motor vehicle usage, million vehicle kilometres, Australia

Vehicle type	2001	2002	2003	2004	2005
Passenger vehicles	143 925	144 676	151 743	147 728	155 068
Motor cycles	1 448	1 681	1 376	1 478	1 429
Light commercial	30 728	31 349	32 671	34 007	33 764
Rigid trucks	6 627	7 080	7 768	7 639	7 671
Articulated trucks	5 321	5 425	5 841	6 013	6 308
Non-freight carrying trucks	267	224	203	221	286
Buses	1 835	1 775	1 893	1 968	1 856
Total	**190 152**	**192 209**	**201 497**	**199 055**	**206 383**

Source: ABS, Survey of Motor Vehicle Use (cat. no. 9208.0).

Carbon monoxide (CO) is an odourless and tasteless gas, and cannot be detected by humans. Volcanoes and bushfires are natural sources of CO. In Australia, the main sources of additional CO are motor vehicles and specific industrial activities.

CO is poisonous to humans because it reduces the amount of oxygen that can be carried by red blood cells, resulting in insufficient oxygen reaching organs of the body to allow proper functioning.

The NEPM standard for CO is 9 parts per million (ppm) averaged over an 8-hour period. Between 2000 and 2005, no exceedances of the NEPM were recorded in Sydney, Melbourne, Brisbane, Perth or Adelaide.

Changes in the volume of road traffic impact on the concentration of atmospheric pollutants, such as carbon monoxide (CO).

There have been positive changes in fuel standards and vehicle design, resulting in a reduction in the concentration of CO in major Australian cities. This is despite a continued increase in the number of vehicles and the number of vehicle kilometres travelled.

In 2005, there were an estimated 13.9 million vehicles registered in Australia. Cars accounted for approximately three-quarters of all vehicles. Australian's drove an estimate 206 billion kilometres in 2005, an increase of 8.5% since 2001.

Water trends

Water supply and use in Australia needs to be viewed in the context of Australia's climate. Australia's long-term annual average rainfall is the lowest of all the continents (except Antarctica). Rainfall in Australia is also highly variable, not only from region-to-region but also from year-to-year and from season-to-season.

In recent years, below-average rainfall in many parts of Australia has resulted in urban water restrictions and reduced availability of water for irrigators. The ABS *Water Account Australia, 2004–05* (cat. no. 4610.0) shows decreases in water consumption for households and agriculture compared with 2000–01.

This section is divided into four main parts:

- **Water consumption**: Agriculture accounted for 65% of total water consumed in 2004–05. Household water use, which includes water for drinking, cooking, cleaning and outdoors, accounted for about 11% of total water consumed in Australia. The majority of household water is used for outdoor purposes (44%), such as water for gardens.

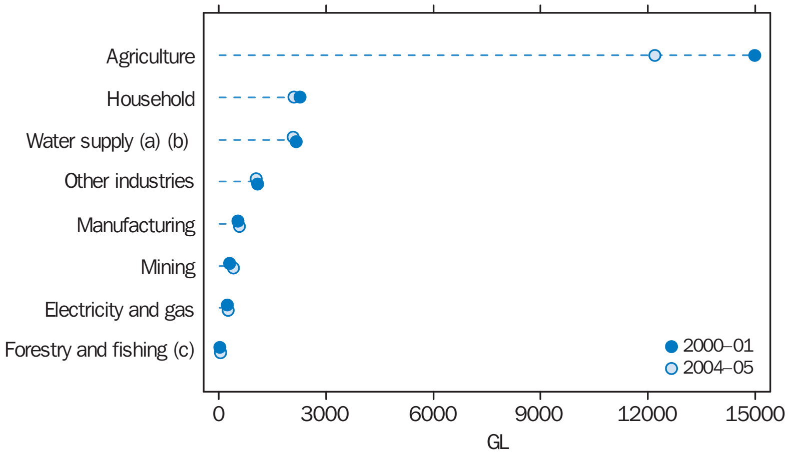
- **Water conservation and management**: The recent drought and ensuing water restrictions have firmly focused attention on the need to conserve water. While mandatory water restrictions in many parts of Australia limited household outdoor water use, many Australians have been voluntarily conserving water by adopting water saving practices and installing water saving devices (such as dual flush toilets and reduced flow shower heads).

- **Water for the environment**: Water quality and flows are directly related to river and wetland health. Diverting water from rivers for irrigation and urban uses disturbs the natural balance of freshwater ecosystems, including the animals and plants that live in and around them. Environmental flows recognise the need for an amount of water to maintain ecological health in rivers and wetlands.

- **Marine and coastal waters:** The marine environment and coast is important for Australia's society, economy and ecology. Many people like to live on or near the coast and take holidays at the beach. Economic benefits flow from marine industries such as shipping, tourism, fisheries, offshore oil and gas. The coastal and marine regions support a large range of species, many of them found only in Australian waters. The state of marine and coastal waters and efforts to preserve the marine environment are important for the benefit of future generations.

Water consumption by sector

Water consumption



(a) Includes sewerage and drainage services.
(b) Includes water losses.
(c) Includes services to agriculture; hunting and trapping.
Note: Water consumption is equal to the sum of distributed water use from water suppliers plus self-extracted water use and reuse water use less water supplied to others less in-stream use and less distributed water use by the environment.
Source: ABS, Water Account Australia, 2004-05 (cat. no. 4610.0).

Many parts of Australia experienced below average rainfall in 2004–05, with drought conditions existing in some areas. These dry conditions have led to urban water restrictions and reduced availability of water for irrigators. Water consumption in Australia for 2004–05 was 18,767 gigalitres (GL), a decrease of 14% from 2000–01 when it was 21,703 GL.

The agriculture industry had the highest water use in 2004–05, accounting for 65% of total water consumption (12,191 GL). This was a decrease from 14,989 GL in 2000–01.

In New South Wales and the Australian Capital Territory combined, water consumption was 5,977 GL in 2004–05, a decrease of 32% from 2000–01 (8,783 GL).

Victoria had water consumption of 4,993 GL in 2004–05, a 7% decrease compared with 2000–01 (5,375 GL). In 2004–05, the agriculture industry accounted for two-thirds of Victoria's water consumption.

In Queensland, 4,361 GL of water was consumed in 2004–05, a decrease of 2% from 2000–01 (4,267 GL). The agriculture industry accounted 67% of Queensland's water consumption.

South Australia's water consumption stayed about the same between 2004–05 (1,365 GL) and 2000–01 (1,383 GL). In 2004–05, the agriculture industry in South Australia accounted for 75% of the state's total water consumption, followed by households with 11% (144 GL).

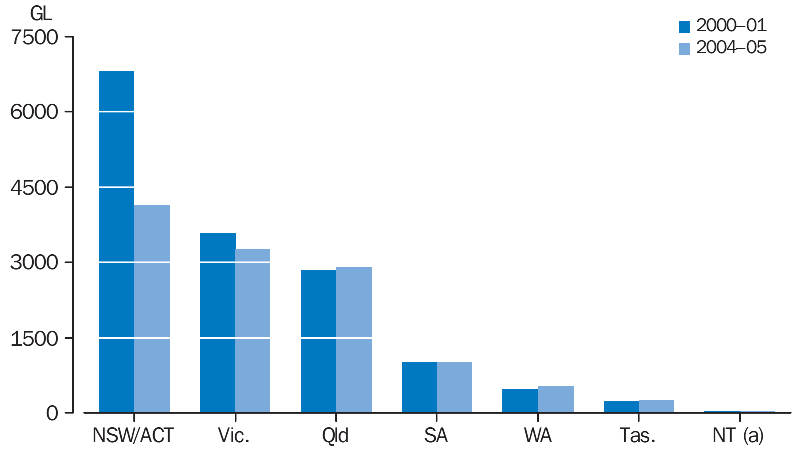
In Western Australia, 1,495 GL of water was consumed in 2004–05 compared to 1,353 GL in 2000–01 (an increase of 10%). Agriculture in Western Australia accounted for just over one-third (36%), followed by households (24%) and mining (12%).

Tasmania consumed 434 GL of water in 2004–05, up 6% from 2000–01 (408 GL). In this state, agriculture accounted for nearly two-thirds (59%), followed by households (16%) and manufacturing (11%).

In 2004–05, the Northern Territory consumed 141 GL of water, an increase of 5% from 2000–01 (134 GL), with agriculture accounting for about one-third (33%), followed by households (22%).

Water consumption – agriculture

Water consumption by agriculture



(a) NT values are too small to show on graph.
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

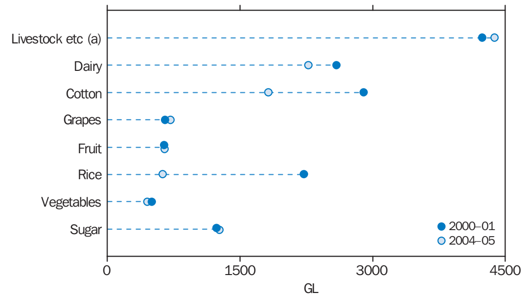
The agriculture industry is the largest consumer of water in Australia, accounting for about two-thirds of total water consumed in 2004–05. Nearly all (91%) of the water used for agriculture is for the irrigation of pastures and crops.

Water consumption by the agriculture industry is very much influenced by climatic conditions and this must be taken into account when assessing changes in water use.

For large parts of southern and eastern Australia, dry conditions have persisted for nearly 11 years. For the agriculturally important Murray-Darling Basin, October 2007 marked the sixth year of lower-than-average rainfall totals.[1]

In 2004–05, the agriculture industry consumed 12,191 gigalitres (GL), nearly one-fifth (19%) less water compared with 2000–01 (14,989 GL).

Water consumption by agriculture, by activity



(a) Includes livestock, pasture, grains and other agriculture (excluding dairy farming).
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0)

The largest percentage decreases in water consumption from 2000–01 to 2004–05 were in rice (72%) and cotton (37%). This was due to the dry conditions in New South Wales and a decrease in the area irrigated for rice and cotton in response to reduced water allocations because of the drought.

1. Australian Government Bureau of Meteorology, *Special Climate Statement 14,* 1 November 2007.

Water consumption – irrigation

Selected pastures and crops irrigated, 2005–06

Pasture / crop	Area under pasture or crop	Area irrigated	Application rate
	'000 ha	'000 ha	ML/ha
Rice	100	100	12.3
Cotton	336	277	6.3
Nurseries, cut flowers or cultivated turf	19	17	5.4
Sugar cane	503	222	5.0
Fruit trees, nut trees, plantation or berry fruits (a)	197	140	4.8
Pasture for hay and silage	na	211	3.7
Vegetables for human consumption	135	121	3.7
Pasture for grazing	389 225	811	3.5
Pasture for seed production	na	44	3.5
Grapevines	199	180	3.5

(a) Excludes grapevines.
Source: ABS, Water Use on Australian Farms, 2005–06 (cat. no. 4618.0).

Most of the water (91%) used for agricultural production is for irrigation of crops and pastures, with the rest used for other agricultural purposes such as drinking water for stock and dairy/piggery cleaning.

Climate conditions affect both availability of water for irrigation and the need to irrigate in order to supplement rainfall.

Some crops such as rice, cotton and grapevines are highly dependent on irrigation. For other crops such as grazing pasture and sugar cane, irrigation water supplements natural rainfall or provides moisture at critical periods of plant growth. The area to be irrigated and the volume applied depend on the crop type and location.

In 2005–06, the total volume of water used for irrigation was 10,844,708 megalitres (ML). 'Pasture for grazing' used the most water in Australia in 2005–06. It accounted for just over one-quarter (26.4%) of the total volume of irrigation water and for just under one-third (31%) of the total area irrigated nationally in 2005–06 (2,583,000 ha).

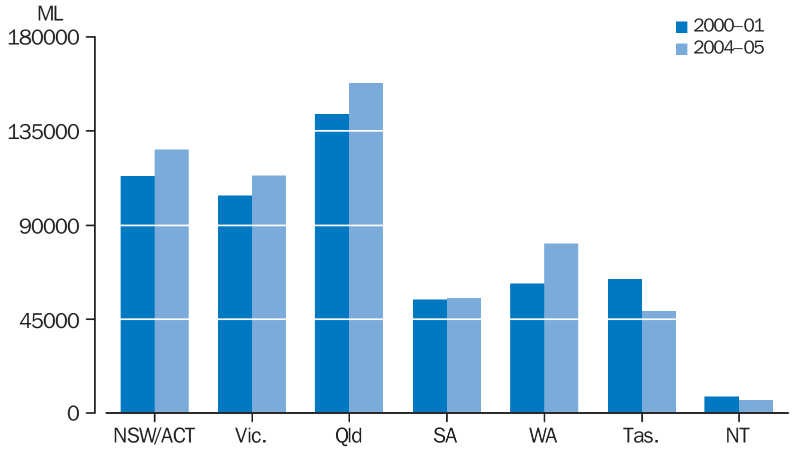
The most heavily irrigated crop in terms of the volume of water applied was rice, which had an average application rate of 12.3 ML per hectare (ha) in 2005–06. This was almost three times the national average rate across all crops and pastures (4.2 ML/ha). Cotton was the next highest (6.3 ML/ha).

Cotton farming used 16% of water consumed in the agriculture industry (1,746,386 ML), followed by rice (11% or 1,230,379 ML) and sugar cane farming (10% or 1,103,802 ML).

It should be noted that the 2005–06 data cannot be directly compared with previous years' data provided in the Feature Article (page 12) because a different methodology was used for their compilation.

Water consumption – manufacturing

Water consumption by manufacturing



Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

In 2004–05, total water use by the manufacturing industry was 589,333 megalitres (ML), or 3% of Australia's total water consumption). This was 7% higher than the water used by manufacturing in 2000–01 (548,887 ML).

Queensland had the highest total water consumption for manufacturing in 2004–05 (157,754 ML), followed by New South Wales (125,995 ML), Victoria (113,589 ML) and Western Australia (81,089 ML). Between 2000–01 and 2004–05, water consumption increased in New South Wales and the Australian Capital Territory (combined), Victoria, Queensland, and Western Australia, but decreased in Tasmania and the Northern Territory. South Australia remained approximately the same.

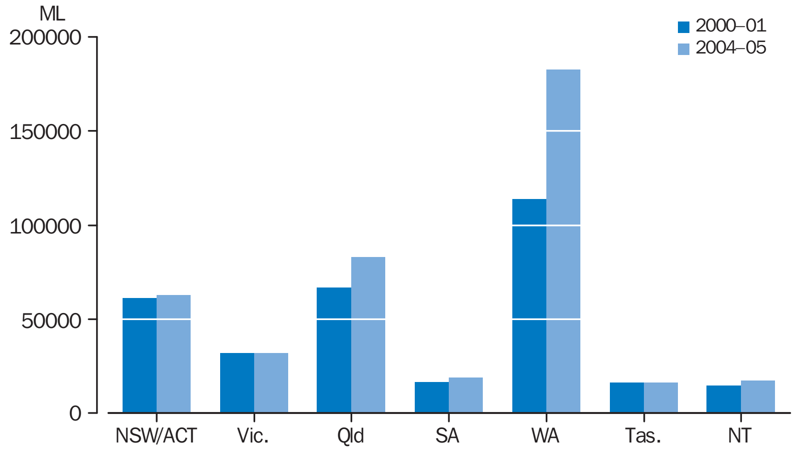
Water consumption in the manufacturing industry varies according to what is being produced. The largest volume of water was used by the Food, beverage and tobacco manufacturers (215,029 ML), followed by Metal products (146,218 ML) and Wood and paper products (99,238 ML).

While most manufacturers used distributed water, Metal product and Wood and paper product, manufacturers used more self-extracted water (water extracted from water bodies, such as rivers, by the manufacturers themselves) than distributed water.

The use of reuse water by manufacturers increased by nearly three-quarters (74%) between 2000–01 and 2004–05 from 7,474 ML to 13,035 ML. The definition of reuse water is drainage, waste or storm water that is used again without being discharged to the environment.

Water consumption – mining

Water consumption by mining



Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Mining broadly refers to the extraction of minerals occurring naturally as solids such as coal and ores, liquids such as crude petroleum, or gases such as natural gas. Australia continues to rank as one of the world's leading mining nations with substantial resources of major minerals and fuel close to the surface.

The mining industry is the second largest export earner for Australia, accounting for 38% of the total value of exports in 2005–06, principally from the coal and metal ore mining industries. Total production of the mining industry, as measured by industry gross value added, increased by 4% between 2003–04 and 2004–05. This rise has seen a corresponding increase in water consumption for this industry.

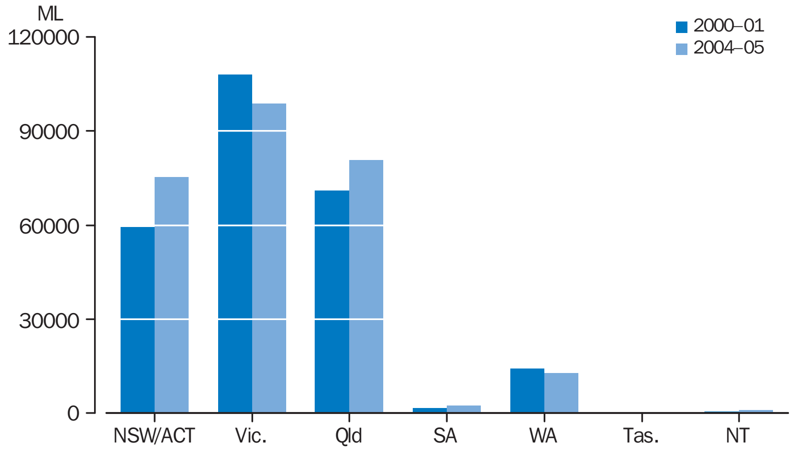
In 2004–05, total water consumption by the mining industry was 413,266 megalitres (ML), or 2% of total water use in Australia. This was 29% higher than water consumed by the mining industry in 2000–01 (320,848 ML).

Western Australia had the highest total water consumption for mining in 2004–05 (182,552 ML), followed by Queensland (83,057 ML), New South Wales and the Australian Capital Territory combined (62,868 ML) and Victoria (31,736 ML).

Most water consumed in the mining industry is from self-extracted sources (that is, water that mining companies extract themselves). Water is also often obtained from mine dewatering, which occurs when water is collected through the process of mining and mineral extraction, or rainfall, run-off and water infiltration, and is later discharged.

Water consumption – electricity and gas

Water consumption by electricity and gas



Note: Tas. And NT values too small to show.
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

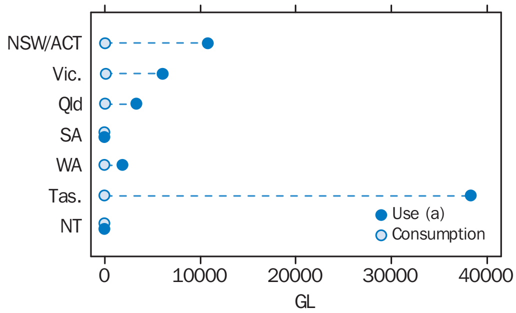
The electricity and gas industry is a significant user of water. In 2004–05, 271,220 megalitres (ML) of water was consumed by the electricity and gas supply industry. This is an increase of 6% across Australia since 2000–01.

There were increases in all states and territories except Victoria and Western Australia, as shown in the graph above.

Of the 271,220 ML consumed by the electricity and gas supply industry in 2004–05, nearly all (271,035 ML) was used by electricity generators only. Coal-fired power stations use considerable volumes of water in boilers and cooling towers.

Water used for hydro-electric power generation is not considered to be 'consumed'. This is because water passes through turbines to generate electricity and is immediately discharged back to the environment where it is made available for users downstream. Water used in this way is referred to as 'in-stream use'.

Water consumption and use(a) by electricity generators, 2004–05

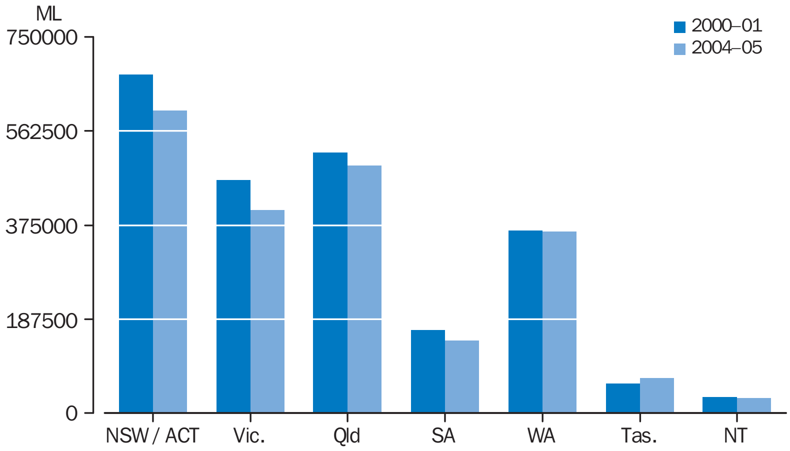


(a) Includes in-stream use.
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

The difference between the volumes of water used 'in-stream' and 'consumed' by electricity generators is highlighted in the graph. It shows that the volume of water used by electricity generators in Tasmania is considerably greater than the volume consumed. The same applies in the other states and territories that have significant in-stream use.

Water consumption – households

Household water consumption



Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Household water consumption includes water for drinking, cooking, cleaning and outdoors (e.g. gardens, swimming pools). In 2004–05, household water consumption was 2,108,263 megalitres (ML), accounting for 11% of total water consumption in Australia.

This was a 7% decrease since 2000–01 (2,278,173 ML). The decrease may be attributed in part to mandatory water restrictions in most states and territories since 2002 and households voluntarily conserving water.

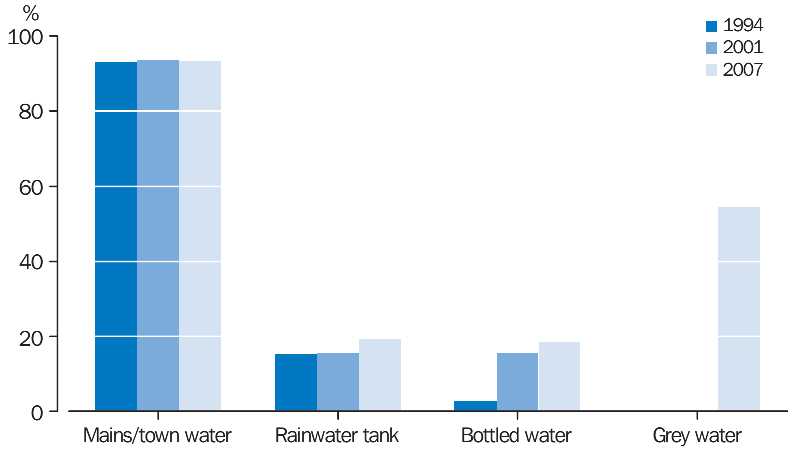
New South Wales households consumed the largest volume of water (572,711 ML), followed by Queensland (492,908 ML) and Victoria (404,632 ML). Total household water consumption decreased in all states and territories from 2000–01 to 2004–05, with the exception of Tasmania which showed an increase of 17%.

Western Australia reported the highest water consumption per person with 180 kilolitres (kL), followed by the Northern Territory (153 kL), Tasmania (143 kL) and Queensland (124 kL). Victoria had the lowest average household water consumption per capita (81 kL) followed by New South Wales (84 kL), South Australia (94 kl) and the Australian Capital Territory (95 kL).

Nationally, Australians consumed 103 kL per person during 2004–05 compared to 2000–01 when average water consumption was 120 kL per person.

Water conservation – households

Sources of water for households



Note: Grey water not collected as a source of water in 1994 or 2001.
Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

The majority of Australian households (93.4%) had access to mains water in March 2007. Other households relied on rainwater tanks, bores or wells or water from rivers creeks and dams.

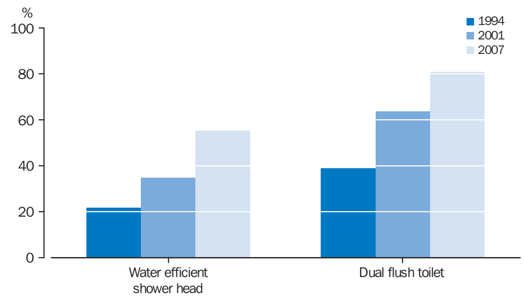
Some households supplemented their water supply by collecting water in containers or by using rainwater. Many Australian households also reported using grey water (54.5%) and bottled water (18.6%).

Household water use and conservation has been a widely discussed issue in recent years due to drought conditions and water restrictions in many parts of Australia.

In addition to mandatory water restrictions in many parts of Australia, many Australians have been voluntarily conserving water by adopting water saving practices and installing water saving devices, such as dual flush toilets.

In 2007, the majority of Australian households had some type of water conservation device installed in their home. In June 1994, only 39.0% of households had a dual flush toilet. In 2007, 80.9% of households had a dual flush toilet. Water-efficient shower heads rose from 21.8% in 1994 to 55.1% in 2007.

Households with water conservation devices



Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

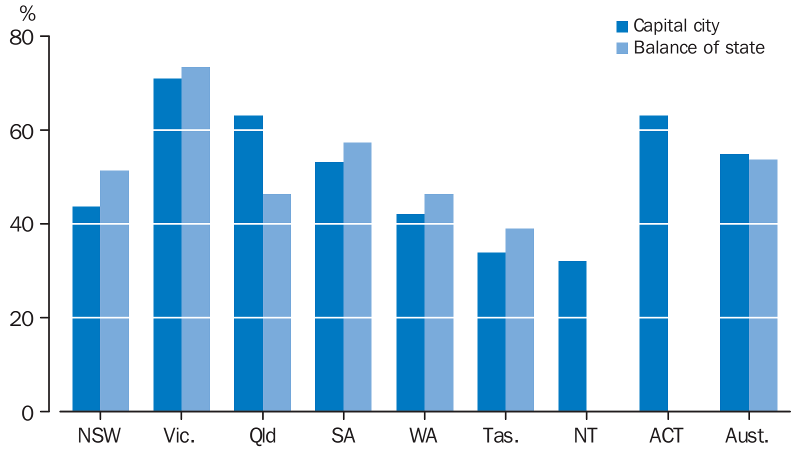
In dwellings less than one year old, 96.0% of households had dual flush toilets only, and 74.4% had water-efficient shower heads only. When the dwelling was more than 30 years old, these figures fell to 64.0% for dual flush toilets and 45.8% for water-efficient shower heads.

Australia's Water Efficiency Labelling Scheme (WELS), the first scheme of its kind in the world, requires mandatory water efficiency labels on all shower heads, washing machines, toilets, dishwashers, urinals and some types of taps.[1]

1. WELS web site <http://www.waterrating.gov.au>, last viewed 6 September 2007.

Water conservation – households

Use of grey water, 2007



Note: NT and ACT data refers to the whole territory.
Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

Grey water is used water from the shower/bath, laundry or kitchen that households collect for re-use. In 2007, grey water was the second most common source of water for households, after mains/town water. More than half (54.5%) of Australian households reported grey water as a source.

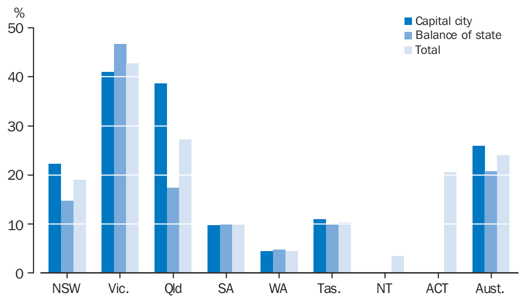
Victoria had the highest percentage of households reporting grey water as a source (71.7%), followed by the Australian Capital Territory (63.1%). The Northern Territory had the lowest reported use of grey water, but this was still substantial at almost a third of households (32.2%). In Tasmania, just over a third (37.0%) of households reported using grey water.

Water restrictions since 2002 have affected households primarily by limiting their use of water in the garden. In 2000–01, outdoor water use was the single largest component of domestic water consumption (44%).

In 2007, nearly a quarter (24.0%) of Australian households reported grey water as their primary source of water for the garden. More than four in ten households reported mains/town water (42.1%) as their primary source of water for the garden.

In Victoria and Queensland grey water was the most common main source of water for the garden (42.7% and 27.2% respectively). The Australian Capital Territory (20.5%) and New South Wales (19.0%) also reported high proportions of grey water use in the garden. The Northern Territory (3.5%) and Western Australia (4.5%) had the lowest proportion of households reporting grey water as their main source of water for the garden.

Grey water as the main source of water for the garden, 2007

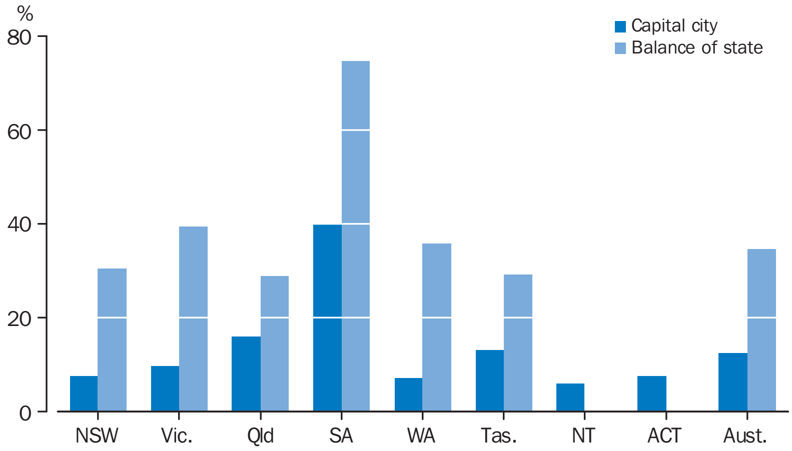


Note: Includes only households that have a garden. NT and ACT data refers to the whole territory.
Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0)

In March 2007, more than four out of five of Australian households had their own garden, 83.5% compared with 86.3% in 1998. Slightly more than one-quarter (25.5%) of households with a garden don't water or relied on rainfall only. In Brisbane, 47.9% of households did not water or relied on rainfall only compared to a third (33.3%) in the rest of Queensland.

Water conservation – households

Households with a rainwater tank, 2007



Note: NT and ACT data refers to the whole territory.
Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

In 2007, more than one-fifth (20.6%) of all households reported that their dwelling had a rainwater tank.

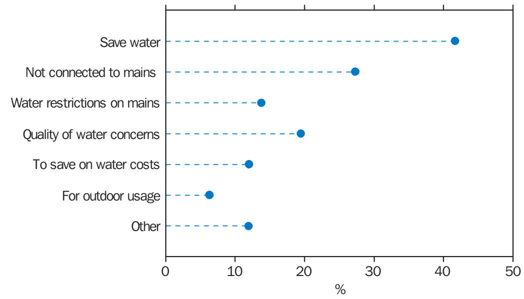
South Australia had by far the highest proportion of dwellings with a rainwater tank, (40.2% in Adelaide and 74.7% in the rest of the state). The Australian Capital Territory and the Northern Territory had the lowest proportion with a rainwater tank, 7.6% and 6.0% respectively.

In 2007, saving water was the main reason (41.7%) reported by Australian households for why they had installed a rainwater tank.

Rainwater tanks are much more prevalent outside capital cities (34.7%) than within capital cities (12.5%). However, reasons for installing a water tank differed markedly between capital cities and the rest of the state. In areas outside capital cities, the most commonly reported reason was to save water. In the rest of the state the most common reason was that the dwelling was not connected to mains water.

More than 60% of households without a rainwater tank (but which had a dwelling suitable for a tank and which were home owners or purchasers) had considered installing one. Cost was the most common reason reported for not installing a rainwater tank (47.5%).

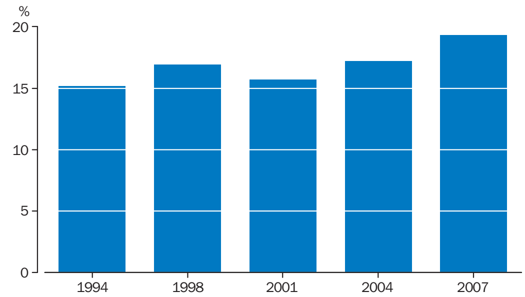
Reasons why household installed a rainwater tank, 2007



Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

In 2007, 19.3% of households reported that a rainwater tank was a source of water for their dwelling. This was an increase of 4.1 percentage points since June 1994 when 15.2% of households reported rainwater as a source.

Households using a rainwater tank as a source of water



Source: ABS, Environmental Issues: People's Views and Practices, 2007 (cat. no. 4602.0).

Water for the environment

Environmental provisions

	NSW/ACT	Vic.	Qld	SA	WA	Tas.	NT	Aust.
	ML	ML	ML	ML	ML	ML	ML	ML
2000–01	200 528	253 172	4 462	873	–	358	–	459 393
2004–05	127 190	373 929	383 606	713	18	118 718	1 103	1 005 277

– Nil or rounded to zero (including null cells)
Source: ABS, Water Account Australia, 2004–05 (cat. no. 4610.0).

Human water use has had a significant effect on the nation's waterways, both in terms of water quality and its availability for aquatic ecosystems (animal and plant life). Extensive development of Australia's water resources since the 1970s through dam construction, with water stored and diverted for agriculture and domestic use, has led to reductions in water flows.

Reductions in flow and changes in water quality due to human activity can have significant environmental consequences. They can cause unhealthy rivers and reduced biodiversity through loss of habitat. For example, the Barmah-Millewa Forest in New South Wales and Victoria is the world's largest river red gum forest, however, decreased flooding in recent years has led to declining forest health and decreased waterbird breeding and native fish-spawning.

Decreased water flows can also affect water quality leading to problems such as blue-green algae. Such issues do not only pose a threat to the natural environment but can also result in problems such as reduced suitability of water for stock and reduced crop yields.

In the interest of maintaining the health of rivers, a number of states and territories have begun plans to allocate and provide water to the environment – generally known as "environmental flows".

Environmental flows recognise the needs of rivers for an amount of water to maintain ecological health for the protection of the environment and sustainability of water resources.

The ABS *Water Account Australia, 2004–05* presented information on water released for the purpose of the environment in accordance with specific environmental regulations. This has been termed environmental provisions, in recognition that it does not represent all environmental flows, but only the volume of water released by water suppliers. Other methods of providing water to the environment include placing limits and rules on licences for water extraction and strategic management of flows and water quality.

In 2004–05, 1,005,277 megalitres (ML) of water was supplied to the environment by water providers. This is an increase of 119% across Australia since 2000–01. States with large increases were Queensland, Victoria and Tasmania.

Water quality

River and wetland health

Environmental component	Details of measurement
Catchment Disturbance Index	Incorporates the effects of land use, change in vegetation cover and infrastructure on the likely runoff of sediments, nutrients and other contaminants to rivers and wetlands. The index should incorporate the effect of large-scale, non-point source impacts.
Physical Form Index	Uses measures of sediment inputs, riparian vegetation structure and connectedness (dams, weirs, levee banks, groundwater abstraction) to assess the state of local habitat and its likely ability to support aquatic life.
Hydrological Disturbance Index	Recognises the importance to aquatic ecosystem function of the water regime, both surface flow and groundwater, depending on the ecosystem.
Water Quality and Soils Index	Considers the effects on biota of long-term changes in water quality characteristics (rivers and wetlands) and soil quality (wetlands), such as changes in suspended sediment and total nutrient concentrations or loads, and the effects of short-term changes in salinity and toxicity levels.
Fringing Zone Index	Represents structural and condition features of the streamside zone, or the zone surrounding a wetland. While this index could contain features relevant to the Physical Form and Aquatic Biota indices, the zone is seen as such an important focus of management that is requires its own category.
Aquatic Biota Index	Represents the response of biota to changes in the environment. This index can be based on extensive national sampling of invertebrates sensitive to disturbance. Other components of the biota (for example, fish, water plants, algae, and riparian vegetation condition) would give a fuller picture of the response of ecosystems to change.

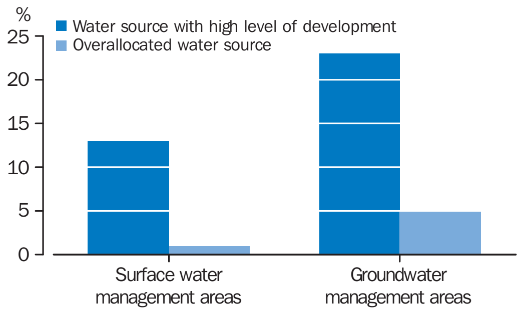
Source: AWR 2005, Framework for the Assessment of River and Wetland Health.

Water quality is directly related to river and wetland health. The National Water Commission (NWC) commissioned an assessment of water resources, Australian Water Resources 2005 (AWR 2005) to provide a picture of Australia's water resources at June 2005 and to provide a baseline of conditions at the start of the NWI reform process.

The AWR 2005 included a Framework for the Assessment of River and Wetland Health (FARWH). The assessment is based on the six key components listed in the table above. The results are aggregated and ranked to produce an index between 0 (severely degraded) and 1 (pristine) of the health of the river or wetland. The FARWH was tested in Victoria and Tasmania, where it was found that some water management areas were of lower overall condition. They include: Moorabool, Loddon, Campaspe, Avoca, South Gippsland and Hopkins water management areas in Victoria; and the Jordan water management area in Tasmania.

The AWR 2005 also considered resource development and sustainable extraction of water.

Water resources level of development, 2004–05



Source: AWR 2005.

A water source with a high level of development is one where water access entitlements are between 70% and 100% of sustainable yield. An overallocated water source is one where water access entitlements are more than 100% of sustainable yield. Sustainable yield is the level of water that can be removed from a water system without compromising key environmental assets or ecosystem functions.

Water trading

Water trading, 2004–05

	Permanent water trades		Temporary water trades	
	no.	GL	no.	GL
NSW	164	41.3	2 042	382.6
Vic.	702	57 .4	9 323	444.3
Qld	168	20 .3	1 874	194 .2
SA	364	33.4	446	49 .5
WA	218	62.8	8	8 .6
Tas.	232	37.6	111	5.6
NT	–	–	–	–
ACT	–	–	–	–
Australia	**1 802**	**247.6**	**13 456**	**1 052.8**

– nil or rounded to zero (including null cells)
– Note: Total for Australia cannot be calculated by taking the sum of the states and territories as this would double count interstate trades
Source: ABS, Water Account, 2004–05 (cat. no. 4610.0).

Australia is one of a small number of water-scarce countries that has instituted markets for trading water.

The National Water Commission (NWC) regards water trading of all kinds – interstate and intrastate trade, permanent and temporary trades – as fundamental to water reform because it will help governments, water users and communities to better value and use the nation's water resources.

Trading can occur on a temporary or permanent basis. Temporary transfers, where water entitlements are leased for a specified period of time (usually one year), are the most commonly used method of trading water in Australia. This market depends mainly on how much rain has fallen and how hot the season has been. The advantage of temporary transfers includes the ability to increase and decrease water allocations as needed. Buying water entitlements on a permanent basis usually involves a significant financial investment.

In 2004–05, 1,802 permanent and 13,456 temporary water trades were conducted in Australia, involving 247.6 gigalitres (GL) of water traded permanently and 1,052.8 GL traded temporarily. The highest number of permanent and temporary water trades was in Victoria (702 and 9,323 respectively).

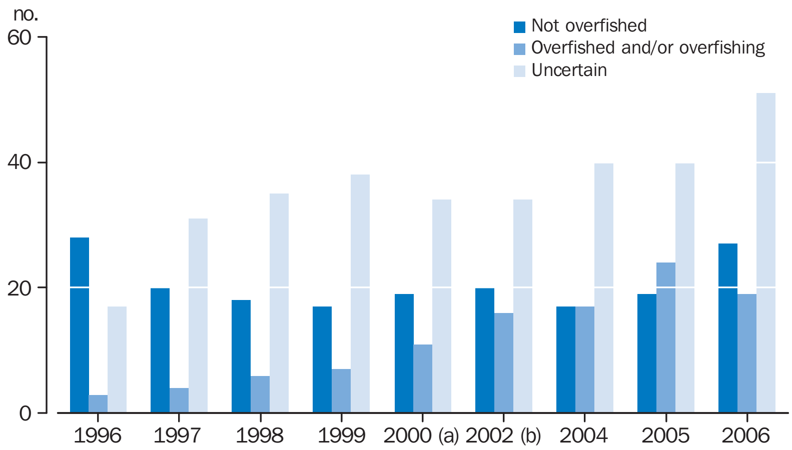
Victoria also had the largest volume of water temporarily traded in Australia – 444.3 gigalitres (GL).The highest volume of water traded permanently occurred in Western Australia (62.8 GL).

With the separation of water access entitlements from land titles, permanent water trade may involve a change of ownership, a change of location, or both. It should be noted that permanent trading data for New South Wales, Western Australia and Tasmania include trades that result in ownership changes from land sales, while Queensland has excluded these transactions. Therefore, comparisons between states require caution.

Water reform in Australia is complex because states and territories largely have the responsibility for water and catchment management, but each one has different approaches to defining environmental needs and acceptable levels of water quality. This is further complicated when a river crosses state boundaries, such as in the Murray-Darling Basin which includes New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory.

Marine and coastal waters

Status of fish stocks managed by the Australian Government



(a) For financial year 2000–01.
(b) For financial year 2002–03.
Source: Bureau of Rural Sciences, Fishery Status Report, 2006.

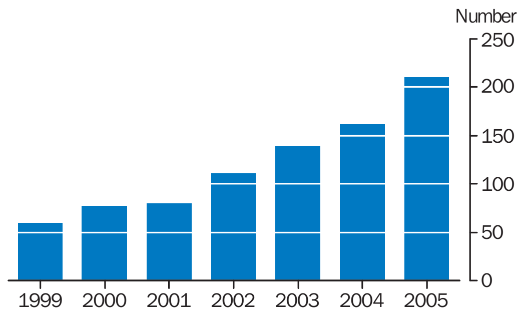
Australia's coastal and marine regions support a large variety of species, many of which are only found in this country's waters. Amongst the 97 stocks (species or groups of species) that are in Commonwealth-managed fisheries, the following trends are emerging:

- The number of stocks that are overfished (referring to the number of fish left within a stock) or subject to overfishing (referring to the amount of fishing a stock is experiencing) reached a record high level of 24 stocks (24.7%) in 2005, but fell to 19 stocks (19.6%) in 2006.
- The number of primary stocks or species classified not overfished had remained generally stable since 1997, but rose sharply to 27 stocks (27.8%) in 2006.
- The number classified uncertain has increased from a mean (average) of 13 species in 1993–96 to a mean of 44 in 2004–2006.

The number of stocks classified has increased since 1992. The fisheries included in the graph exclude those where state or territory government agencies have primary management responsibility, for example, the Norfolk Island Fishery.

Illegal fishing is an added pressure on some fisheries and fish species. The number of fishing vessels apprehended for illegal fishing increased by 250% between 1999 and 2005. Patagonian Toothfish in the Southern Ocean and species of shark in northern waters are the worst affected.

Apprehensions for illegal fishing, number each year



Source: 2006 Australian State of the Environment Committee, Australia State of the Environment 2006, Department of the Environment and Heritage, Canberra.

Marine and coastal waters

Marine parks and protected areas, Australia and external territories

Marine, national oceanic islands & external territory protected area IUCN	1997 no.	1997 ha.	2002 no.	2002 ha.	2004 no.	2004 ha.
Category IA	16	2 779 192	18	15 207 232	26	14 689 494
Category IB	0	0	2	202	2	202
Category II	16	69 080	24	2 151 068	47	15 072 908
Category III	0	0	0	0	9	345
Category IV	80	586 334	106	12 045 534	99	17 347 773
Category V	7	4 716 993	0	0	0	0
Category VI	23	35 426 842	38	35 236 024	29	24 715 160
Category not specified	6	46 910	0	0	0	0
Total	**148**	**38 908 358**	**188**	**64 640 060**	**212**	**71 825 882**

Source: Department of the Environment and Heritage, Summary of Protected Areas <http://www.environment.gov.au/parks>, last viewed 7 August 2007.

Efforts to preserve Australia's marine environment include the establishment of a system of protected areas and guidelines to select and manage protected areas.

Protected Areas are not the only mechanism for conserving biodiversity but they are an important element of the overall approach.

The World Conservation Union (IUCN) defines a protected area as: "An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means".

In 1994, Australia adopted the IUCN definition of a protected area and the internationally recognised IUCN six level system of categories used to describe the management intent as basis for documenting Australia's various types of protected areas. The six categories are:

- Category IA – Strict Nature Reserve: Protected Area managed mainly for science.
- Category IB – Wilderness Area: Protected Area managed mainly for wilderness protection.
- Category II – National Park: Protected Area managed mainly for ecosystem conservation and recreation.
- Category III – Natural Monument: Protected Area managed for conservation of specific natural features.
- Category IV – Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention.
- Category V – Protected Landscape/Seascape: Protected Area managed mainly for landscape/seascape conservation and recreation.
- Category VI – Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

The total number of marine parks and protected areas in Australia and its external territories has increased in number from 148 (and nearly 39 million hectares) in 1997 to 212 in 2004 to encompass nearly 72 million hectares.

Landscape trends

Australia's population continues to increase, both in numbers and in affluence, putting great pressure on land and resources. Since European settlement in 1788, the way in which people use the land has significantly changed Australia's natural systems and landscapes. Some land management practices place enormous pressures on the land which can result in damage to ecosystems, reductions in biodiversity and degradation of soils and waterways.

This section is divided into two main parts:

- **Land**: Australia's landscape has been highly modified since European settlement. Native vegetation, which provides a protective cover for the land, has been removed or degraded in many areas due to urbanisation, agriculture, mining, pastoralism and infrastructure development. Altering land from its natural state inevitably results in changes to soil health and landscape functionality. If persistent, these changes can lead to environmental problems and rapid deterioration of both aquatic and terrestrial ecosystems, which can also have economic and social impacts.

- **Biodiversity**: Australia is home to more than one million species, many of which are endemic – that is, they are found only in Australia. Globally, Australia is recognised as one of 17 "mega-diverse" countries, with ecosystems of exceptional variety and uniqueness. Changes to the landscape and native habitat as a result of human activity have put many of these unique species at risk. Ideally, the trends included in this section would consider all Australian biodiversity – the abundance and diversity of micro-organisms, plants and animals, the genes they contain and the ecosystems which they form. To measure change as comprehensively as this would be difficult, if not impossible, and so here we focus on seven trends. These trends are closely linked to the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and include: Parks and protected areas, threatened fauna, threatened flora, threatened ecological communities, the register of critical habitat, key threatening processes and the number of recovery plans.

Land

Land use

	Area (km^2)	% of total
Conservation and natural environments	2 684 877	34.92
Production from relatively natural environments		
Grazing natural vegetation	4 194 721	54.56
Production forestry	133 064	1.73
Production from dryland agriculture and plantations		
Plantation forestry	16 879	0.22
Dryland agriculture and grazing	466 445	6.07
Production from irrigated agriculture	30 535	0.4
Intensive uses	15 984	0.21
Mining	1 366	0.02
Water	134 869	1.88
No data	9 763	0.13
Total	**7 688 503**	**100**

Source: Bureau of Rural Sciences, 2001–2002 Land Use of Australia, Version 3.

Almost two-thirds of land in Australia has been modified for human uses, primarily grazing of natural vegetation.

The loss of native vegetation and habitat is a major threat to Australia's environment. Clearing of native vegetation continues to occur for agriculture, plantation forestry, and urban development.[1]

Land uses vary in the degree of pressure they place on the environment. Generally environmental impacts increase as land use intensifies – from grazing natural vegetation to dryland agriculture and plantations and irrigated agriculture. Intensive uses such as mining and urban development involve the greatest level of modification and thus generally have the greatest environmental impact.

Intensive uses account for less than 1% of total land use. However, their impact is often highly concentrated. For example, the environmental impacts of urban development are a major concern in coastal areas near capital cities where growing populations are increasing demand for housing near the coast.[1]

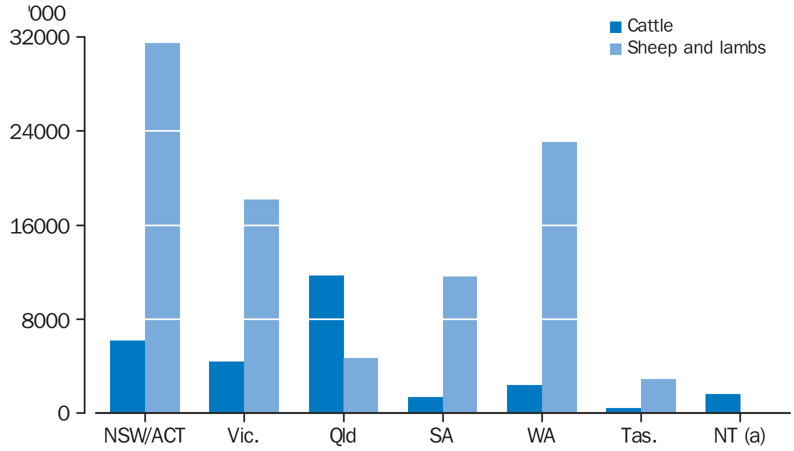
Grazing of natural vegetation accounts for just over half of all land use. Environmental issues associated with sheep and cattle grazing include habitat loss, surface soil loss, salinity, and soil and water quality issues. Drought condition in 2002–03, exacerbated soil loss, leading to the highest dust storm activity since the 1960s.[1]

Land classified as "conservation and natural environments" accounts for just over a third of Australia. Only a small proportion of this area (7% in total) is formally protected in reserves or protected areas.

1. *State of the Environment Committee, 2006,* Australia State of the Environment 2006, *Department of the Environment and Heritage, Canberra, pp.10, 69 – 74.*

Land

Livestock grazing pressures, 2005–06



(a) Milk cattle data not available in NT.
Source: ABS, Principal Agriculture Commodities, 2005-06 (cat. no. 7111.0).

Agriculture is the most extensive form of land use. Livestock grazing accounts for the largest area of land use in agriculture. However, grazing pressures can also result from native and feral animals such as goats, camels, rabbits and kangaroos.

At June 2006, sheep and lamb numbers were reported as 91.9 million, about 10% less than in 2005. This is the lowest reported estimate since 1925. Farmers reported significant destocking during the year. This is because the availability of feed for stock is reduced in times of drought, and buying in feed is expensive.

New South Wales had the highest number of sheep (31.4 million), followed by Western Australia (23 million) and Victoria (18.2 million). Queensland had the highest number of cattle (11.7 million), followed by New South Wales and the Australian Capital Territory (6.2 million), and Victoria (4.4 million).

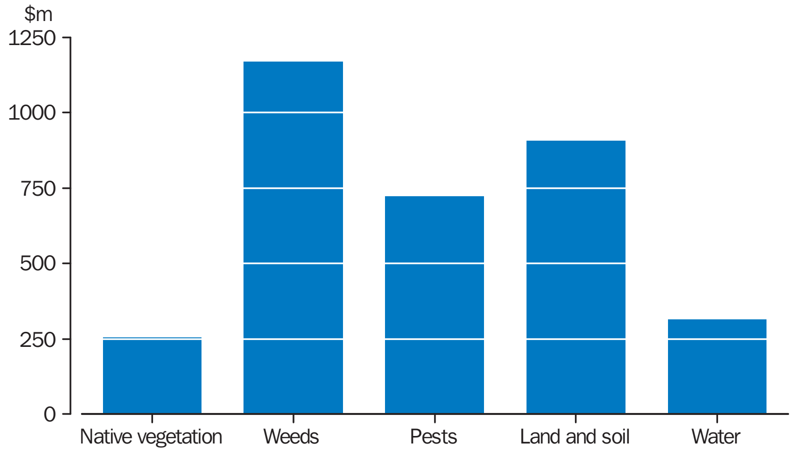
Meat cattle were reported as 25.7 million – the largest reported estimate since 1978. Milk cattle were reported as 2.8 million, a 9% decrease on 2004–05 numbers. Victoria continued to dominate the dairy industry with 63% of Australia's total dairy herd.

Although the numbers of cattle and sheep have not increased in recent times, they continue to place pressure on the land. The impact of grazing varies in different parts of Australia. In the higher rainfall and irrigated areas, livestock grazing has led to the replacement of large areas of native vegetation with more productive introduced pastures and grasses, many of which have now become naturalised. Grazing also modifies soil structure and leads to soil compaction.

In the arid and semi-arid areas of Australia, despite lower stock densities, the impact of grazing on biodiversity can be greater than in high rainfall zones. The low productivity of arid and semi-arid areas limit forage and stock compete with native animals for limited resources. The provision of water through bore holes, earth tanks and dams has resulted in grazing occurring in areas previously unsuitable for livestock.

Land

Farm expenditure on Natural Resource Management, 2004–05



Source: ABS, Natural Resource Management on Australian Farms, 2004–05 (cat. no. 4620.0).

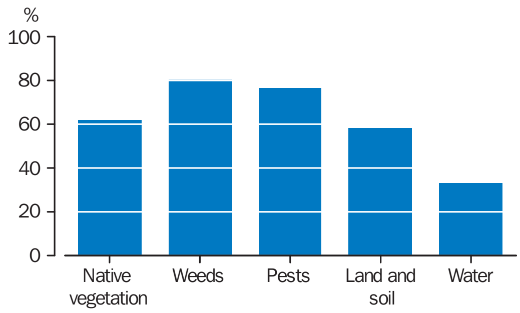
Australian farmers reported spending more than $3.3 billion on Natural Resource Management (NRM) in 2004–05. A third of this was spent on management of weed related issues. Management of land and soil was the next highest category of spending, followed by pests.

To prevent or manage weed issues, eight out of ten farmers undertook activities such as application of herbicides, use of biological control agents, slashing, cutting or mowing, cultivation, pulling, manual removal or chipping and burning.

Issues impacting upon the condition of soil and land on Australian farms include soil acidity, salinity, soil compaction, surface waterlogging and erosion. In 2004–05, farmers spent $907 million to prevent or manage such issues.

Animal and insect pest management accounted for a total of $721 million in 2004–05. More than three-quarters of farmers reported activities to prevent or manage pest related issues such as damage to native vegetation, decreased crop production or damage, and killed or harmed livestock.

Farms reporting NRM activities, 2004–05



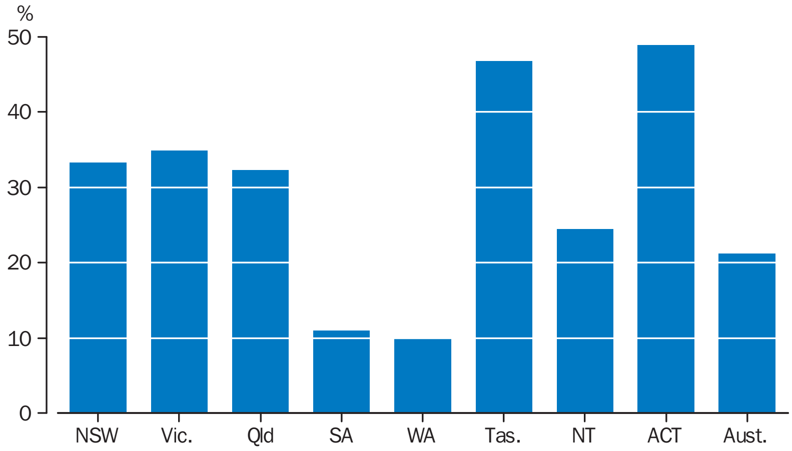
Source: ABS, Natural Resource Management on Australian Farms, 2004–05 (cat. no. 4620.0).

Nearly two-thirds (63%) of farmers have native vegetation on their land. Of these, nearly two-thirds (62%) managed their native vegetation through activities such as fencing off vegetation from stock, planting and/or seeding, clearing, thinning of re-growth, allowing regrowth, and fire management.

Farmers reported spending $314 million to manage and prevent issues related to water quality and availability.

Forest

Native forest as a proportion of area, 2003



Source: Bureau of Rural Sciences, National Forest Inventory, 2003 and ABS, Year Book 1997 for land area data.

Forests are classified as land with trees with an actual or potential height greater than two metres and 20% crown cover. When Europeans settled Australia in 1788, it is estimated that forests covered about one-third of the continent. This has fallen to about one-fifth (21%) in 2003. Native forests accounted for 162.7 million hectares (ha), of a total of 164 million ha. The rest was plantation forests.

Forests are an important resource for the forestry and wood products manufacturing industry, for biodiversity conservation and as a recreational resource. More than 16,500 plants and 3,800 animals have been identified as forest-dependent.[1]

While the Australian Capital Territory and Tasmania have the smallest area of total native forest of all states and territories, they have the largest area of native forest as a proportion of the state/territory area (48.8% and 46.7% respectively).

Native forest, 2003

	Area of native forest '000 ha
New South Wales	26 658
Victoria	7 935
Queensland	55 734
South Australia	10 866
Western Australia	25 365
Tasmania	3 169
Northern Territory	32 836
Australian Capital Territory	117

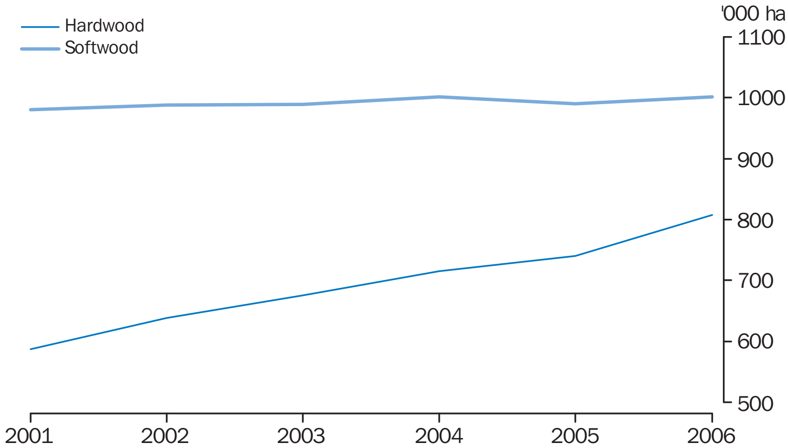
Source: Bureau of Rural Sciences, National Forest Inventory, 2003.

Thirteen per cent of Australia's native forests were formally protected in nature conservation reserves in 2003. About 70% were privately managed and 7% were available for timber production in multi-use forests.

1. Bureau of Rural Sciences, *Australia's Forests at a Glance, 2005*.

Forest

Hardwood and softwood plantation forest



Source: Bureau of Rural Sciences, National Plantation Inventory Australia, 2000, 2002 and 2004; Australia's Plantations 2006, 2007; Australia's State of the Forests Report 2003.

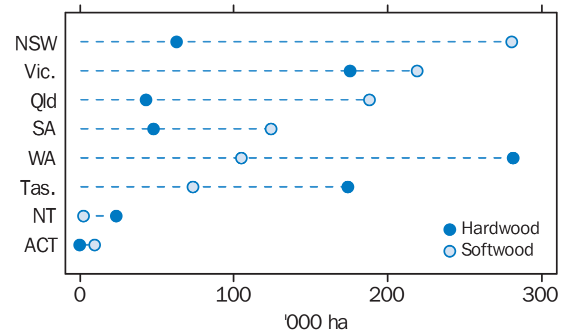
Current information indicates that forest cover in Australia is decreasing. Although regrowth on cleared agricultural land and establishment of new plantations, farm forestry and environmental planting are occurring, this does not exceed current conversion of forest for other uses such as agriculture and urban expansion.[1]

Plantations are 'intensively managed stands of trees of either native or exotic species, created by the regular replacement of seedlings or seeds'.[2] Hardwood plantations are mainly made up of eucalypt species, while softwood plantations are mainly pine species.

The data show that while the area planted to softwood species has remained relatively stable, the area planted to hardwood species is increasing. Between 2003 and 2006, the area planted to hardwood species increased by almost one-fifth (19%).

The area planted to hardwood and softwood species varies greatly between states and territories. In most states and territories the area planted to softwood is greater than that planted to hardwood species. However, in Western Australia, Tasmania and the Northern Territory, the reverse is the case.

Hardwood and softwood plantations, 2006



Source: Bureau of Rural Sciences, Australia's Plantations 2007.

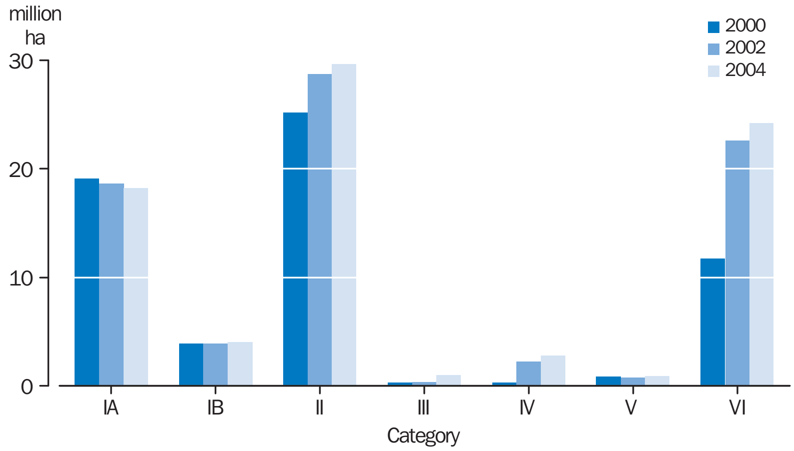
While plantations host fewer forest-dwelling native animals than native forests, plantations can provide habitat for some flora and fauna compared with cleared land. Animals frequently found in softwood forests include echidnas, kangaroos, wombats, possums and birds such as yellow-tailed black-cockatoos.

When sited appropriately, plantations can provide wind shelters, improve water quality and reduce soil erosion.

1. Bureau of Rural Sciences, *Australia's State of the Forests Report 2003*, p.29.
2. Bureau of Rural Sciences, *Australia's Forests at a Glance, 2007*, p.26.

Biodiversity

Parks and protected areas, area

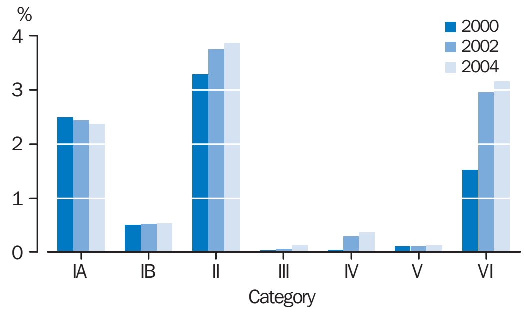


Note: 2000 data for Category III too small to show.
Source: Department of the Environment and Water Resources, CAPAD, <http://www.environment.gov.au/parks/nrs/capad/index.html>, last viewed 7 September 2007.

Australia employs the World Conservation Union (IUCN) definition of a protected area. The system of protected area categories applied in Australia has six levels:

- Category IA – Strict Nature Reserve: Protected Area managed mainly for science.
- Category IB – Wilderness Area: Protected Area managed mainly for wilderness protection.
- Category II – National Park: Protected Area managed mainly for ecosystem conservation and recreation.
- Category III – Natural Monument: Protected Area managed for conservation of specific natural features.
- Category IV – Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention.
- Category V – Protected Landscape/Seascape: Protected Area managed mainly for landscape/seascape conservation and recreation.
- Category VI – Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems.

Parks and protected areas as percentage of area of Australia

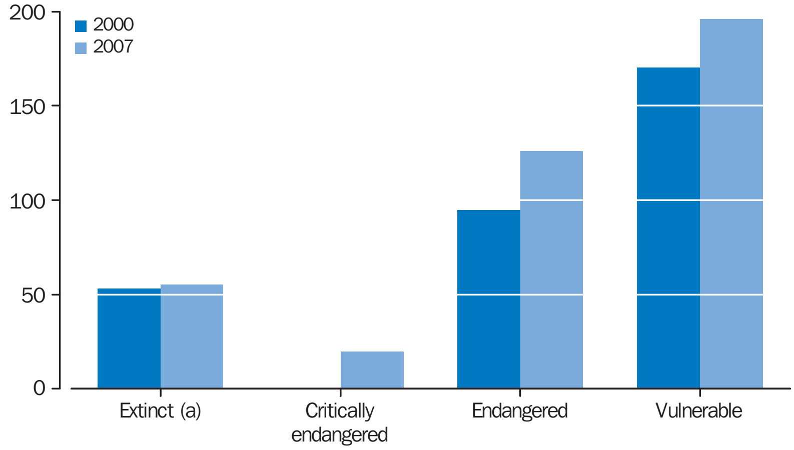


Note: 2000 data for Category III too small to show.
Source: Department of the Environment and Water Resources, CAPAD, <http://www.environment.gov.au/parks/nrs/capad/index.html> last viewed 7 September 2007 and ABS, Yearbook 1997 (cat. no. 1310.0).

From 2000 to 2004, Australia's terrestrial protected areas increased by more than 19 million hectares and now extend across almost 81 million hectares or 10.5% of Australia. Protected areas include botanic gardens, national parks and fish habitat areas.

Biodiversity

Threatened fauna species



(a) Includes the category 'extinct in the wild'.
Note: The graph shows the number of species listed under the EPBC Act as at October 2007. If a species had been included in a different category prior to 2007 only the 2007 categorisation is shown. If a species has been removed from the list since 2000, then it is not included in this graph. The category 'conservation dependant' is not shown since figures are too small to show.
Source: Department of the Environment and Water Resources, <http://www.environment.gov.au/biodiversity > last viewed October 2007.

The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) classifies listed threatened species into six categories – extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent.

At the commencement of the EPBC Act in 2000, the list of threatened fauna consisted only of those previously listed under the Endangered Species Protection Act 1992. For the purpose of this publication, this data has been presented against the year 2000.

Since the introduction of the EPBC Act, the number of threatened fauna rose by nearly 25% from 318 to 399 in 2007. Almost half (49%) were vulnerable, 32% were endangered, and 14% were presumed extinct or extinct in the wild in 2007. Birds and mammals accounted for the majority of vulnerable and endangered species, and half of extinct species were mammals. However, these increases may reflect taxonomic revisions, curation of collections, data-basing information and field investigations and do not necessarily represent a change in the conservation status of the fauna.

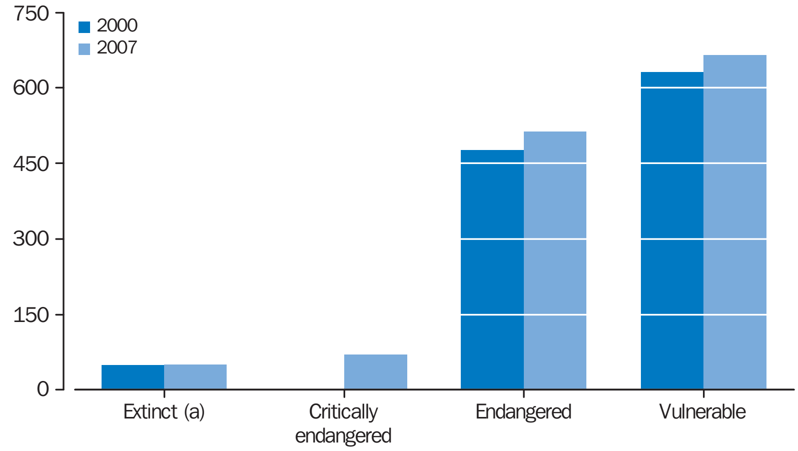
List of threatened fauna, 2007

Extinct	Frogs (4)
	Birds (23)
	Mammals (27)
Extinct in the wild	Fishes (1)
Critically Endangered	Fishes (3)
	Frogs (2)
	Reptiles (1)
	Birds (6)
	Mammals (3)
	Other animals (5)
Endangered	Fishes (16)
	Frogs (13)
	Reptiles (13)
	Birds (40)
	Mammals (33)
	Other animals (11)
Vulnerable	Fishes (24)
	Frogs (12)
	Reptiles (38)
	Birds (62)
	Mammals (54)
	Other animals (6)
Conservation dependent	Fishes (1)
	Mammals (1)
Total	**Fauna (399)**

Source: Department of the Environment and Water Resources, <http://www.environment.gov.au/biodiversity> last viewed October 2007.

Biodiversity

Threatened flora species



(a) Includes the category 'extinct in the wild'.
Note: The graph shows the number of species listed under the EPBC Act as at October 2007. If a species had been included in a different category prior to 2007 only the 2007 categorisation is shown. If a species has been removed from the list since 2000, then it is not included in this graph. The category 'conservation dependant' is not shown since figures are too small to show on graph.
Source: Department of the Environment and Water Resources, <http://www.environment.gov.au/biodiversity > last viewed October 2007.

The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) classifies listed threatened species into six categories – extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent. At the commencement of the EPBC Act, the list of threatened flora consistent only of those previously listed under the Endangered Species Protection Act 1992. For the purpose of this publication this data has been presented against the year 2000.

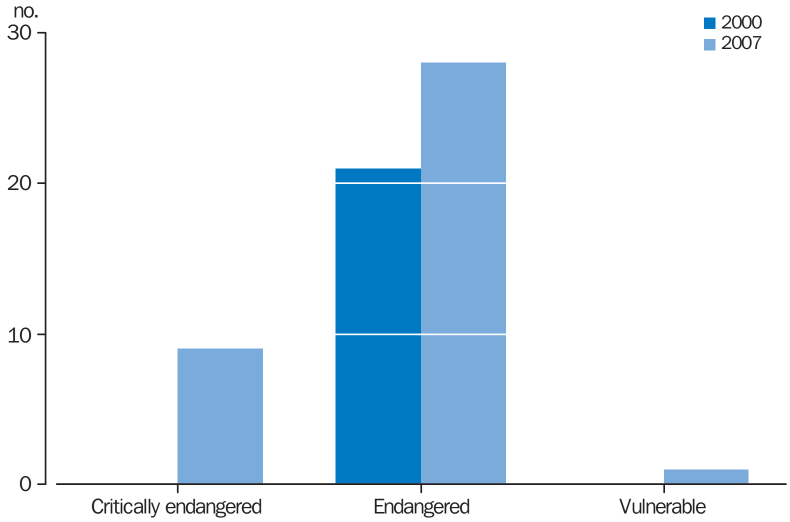
Since the introduction of the EPBC Act, the number of listed threatened flora rose by 12% from 1,156 in 2000 to 1,298 in October 2007. Of the eucalypts, 23 species were listed as endangered and 49 species were listed as vulnerable. Two species of wattle were listed as extinct; 3 as critically endangered; 28 as endangered; and 44 as vulnerable.

Variations to the list under the EPBC Act can be made by the Australian Government Minister for the Environment and Water Resources following consideration of their conservation status by the Threatened Species Scientific Committee. Thus changes need to be treated cautiously. Species can be removed or added because of improved knowledge or sometimes new species are discovered, or those thought to be extinct are rediscovered.

To assist the conservation of listed threatened species, the EPBC Act provides for: the identification of key threatening processes, the registration and conservation of critical habitat, and the making of: recovery plans; threat abatement plans; wildlife conservation agreements and conservation orders.

Biodiversity

Threatened ecological communities



Note: The graph shows the number of ecological communities listed under the EPBC Act as at October 2007. If a community had been included in a different category prior to 2007 only the 2007 categorisation is shown. If a community has been removed from the list since 2000, then it is not included in this graph.
Source: Department of the Environment and Water Resources, <http://www.environment.gov.au/biodiversity> last viewed July 2007.

Another measure of environmental condition includes recording the number of ecological communities threatened with extinction. Scientific committees examine the case for listing ecological communities. The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) classifies listed threatened communities into three categories – critically endangered, endangered and vulnerable.

The listed communities are not necessarily the only ones in danger of extinction. To be listed a community must undergo significant investigation and survey work as part of the assessment of the scientific committee, but it is likely that other communities are also under threat of extinction.

The number of threatened communities rose from 21 in 2000 to 38 in 2007. However, these increases may reflect improved information and field investigations and do not necessarily represent a change in conservation status of ecological communities. Of those listed as critically endangered three are in New South Wales, two in Queensland and three in South Australia. Of those listed as endangered five are in New South Wales, one each in Victoria and Queensland and 16 in Western Australia. The only community listed as vulnerable is in Tasmania. Additionally, five endangered communities and one critically endangered community cross state borders.

The EPBC Act protects Australia's native species and ecological communities by providing for:

- identification and listing of species and ecological communities as threatened
- development of conservation advice and recovery plans for listed species and ecological communities
- development of a register of critical habitat
- recognition of key threatening processes
- where appropriate, reducing the impacts of these processes through threat abatement plans.

Biodiversity

Register of critical habitat

	2000	2001	2002	2003	2004	2005	2006	2007
Number on Register of critical habitat	0	0	3	3	4	5	5	5

Effective Date	Critical Habitat
2002	*Diomedea exulans* (Wandering Albatross) - Macquarie Island
	Thalassarche cauta (Shy Albatross) - Albatross Island, The Mewstone, Pedra Branca
	Thalassarche chrysostoma (Grey-headed Albatross) - Macquarie Island
2004	*Manorina melanotis* (Black-eared Miner) - Gluepot Reserve, Taylorville Station and Calperum Station, South Australia, excluding the area of Calperum Station south and east of Main Wentworth Road
2005	*Lepidium ginninderrense* (Ginninderra Peppercress) - Northwest corner Belconnen Naval Transmission Station, ACT

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – Register of critical habitat, <http://www.environment.gov.au/biodiversity> last viewed July 2007.

The Australian Government Minister for the Environment and Water Resources may identify and list habitat critical to the survival of a listed threatened species or ecological community. Details of this identified habitat will be recorded in a Register of Critical Habitat.

The first listings were made in 2002 for the habitat of three species of albatross. Macquarie Island, Albatross Island, The Mewstone and Pedra Branca are four major breeding locations for these species which are under Australian jurisdiction. These three species of albatross are listed as vulnerable fauna under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It should be noted that habitat critical to the survival of a species or ecological community will depend largely on the particular requirements of the threatened species or ecological community concerned. For example, areas only incidentally used by a threatened species, and which the species is unlikely to be dependent upon for its survival or recovery, may not be areas of habitat critical to the survival of that particular species.

The identification of critical habitat for the Register of Critical Habitat, including location and extent information, is a matter of ecological judgment, and is based on the most up-to-date scientific information available to the Threatened Species Scientific Committee and the Commonwealth Minister for the Environment and Water Resources at the time the habitat was being considered. As new or additional information becomes available, critical habitat identified on the Register may be amended.

The Minister must, when making or adopting a recovery plan, consider whether to list habitat that is identified in the recovery plan as being critical to the survival of the species or ecological community. There is no legal provision for public nomination of Critical Habitat.

Biodiversity

Listed key threatening processes

Effective Date	Listed Key Threatening Processes
2000	♦ Competition and land degradation by feral goats
	♦ Competition and land degradation by feral rabbits
	♦ Predation by feral cats
	♦ Predation by the European red fox (*Vulpes vulpes*)
	♦ Dieback caused by the root-rot fungus (*Phytophthora cinnamomi)*
	♦ Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations
2001	♦ Land clearance
	♦ Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
	♦ Incidental catch (bycatch) of sea turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South
	♦ Predation, habitat degradation, competition and disease transmission by feral pigs
	♦ Psittacine Circoviral (beak and feather) disease affecting psittacine species
2002	♦ Infection of amphibians with chytrid fungus resulting in chytridiomycosis
2003	♦ Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris
	♦ The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Soloenopsis invicta* (fire ant)
2005	♦ Loss of biodiversity and ecosystem integrity following invasion by the yellow crazy ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean
	♦ The biological effects, including lethal toxic ingestion, caused by cane toad (*Bufo marinus*)
2006	♦ Predation by exotic rats on Australian offshore islands of less than 1000 km^2 (100,000 ha)

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – Listed key threatening processes, <http://www.environment.gov.au/biodiversity> last viewed July 2007.

The number of listed key threatening processes has increased from 6 in 2000 to 17 in 2007. However, the increase may reflect improved reporting and knowledge and does not necessarily reflect an increase in the occurrence of key threatening processes.

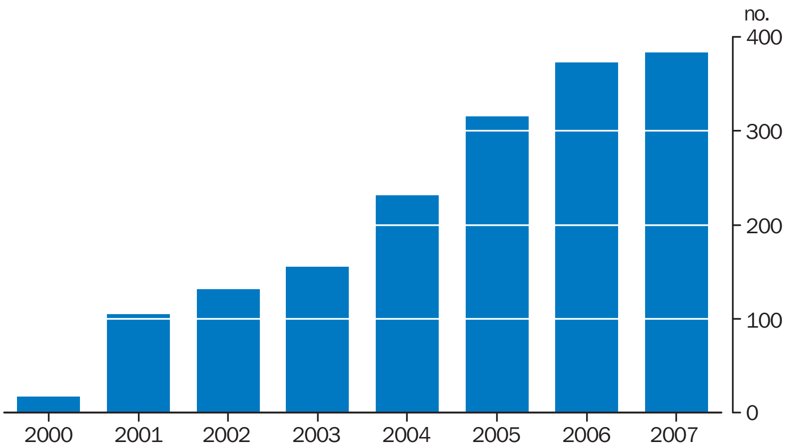
A process is defined as a key threatening process if it threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community (for example predation by the European red fox).

A process can be listed as a key threatening process if it could cause a native species or ecological community to become eligible for adding to a threatened list (other than conservation dependent), or cause an already listed threatened species or threatened ecological community to become more endangered, or if it adversely affects two or more listed threatened species or threatened ecological communities.

The assessment of a threatening process as a key threatening process is the first step under law enacted by the Australian Government to address the impact of a particular threat. Once a threatening process is listed under the EPBC Act, a Threat Abatement Plan can be put into place if it is proven to be 'a feasible, effective and efficient way' to abate the threatening process.

Biodiversity

Recovery plans made or adopted, cumulative total



Recovery plans made or adopted, per year

	2000	2001	2002	2003	2004	2005	2006	2007
Recovery plans made or adopted in each year	17	89	26	24	76	84	57	11

Source: Data compiled from the Environment and Protection and Biodiversity Conservation Act 1999 (Cwlth) – Recovery plans made or adopted, <http://www.environment.gov.au/biodiversity> last viewed July 2007.

The Australian Government Minister for the Environment and Water Resources may make or adopt and implement recovery plans for threatened fauna, threatened flora (other than conservation dependent species) and threatened ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Before making a recovery plan, the Minister must consult with the appropriate Minister of each state and territory in which the species or ecological community occurs, consider advice from the Threatened Species Scientific Community, invite public comment on the plan, and consider all comments received regarding the proposed plan.

Recovery plans set out the research and management actions required to stop the decline of, and support the recovery of, listed threatened species and ecological communities. Recovery plans aim to maximise the long-term survival in the wild of species and communities. The plans outline what is to be done to protect and restore important populations of threatened species and ecological communities, as well as how to reduce and manage threatening processes.

Recovery plans provide a logical and planned framework for key interest groups and responsible government agencies to coordinate their work. Plans remain in force until and unless the flora or fauna species or ecological community is removed from the threatened list.

The graph shows the number of recovery plans listed under the EPBC Act by the year they were listed, as at October 2007. The current list of recovery plans covered approximately 450 species and ecological communities through 384 plans.

It should be noted that recovery plans made under the EPBC Act are Australian Government recovery plans. State and territory governments may also make and adopt recovery plans, and the counts of these are not included in the figures presented here.

Appendix A – Frameworks and indicators

Environmental reporting involves a range of physical, chemical, biological and/or socioeconomic indicators that represent the key elements of complex ecosystems or environmental issues.

Selecting which indicators to focus on depends on which model or framework is used to examine environmental issues or progress. Many different approaches are used to observe environmental trends depending on the context and purpose. There is no universal set of environmental indicators and the selection of different indicators varies by country and by region. For example, a country whose economy relies heavily on fisheries will focus on trends such as level of fish stocks and marine pollution levels, while a landlocked country will be more interested in trends such as agricultural land use and air pollution.

Environmental indicators are often grouped into different types including:

- state of the environment indicators, which reflect the quality of the environment
- sustainable development indicators, which are long-term measures
- environmental economic and accounting indicators, which evaluate cost-benefits.

Some of the most common approaches are outlined below.

Pressure–state–response model

A popular environmental model is the Organisation for Economic Co-operation and Development's (OECD's) pressure–state–response (PSR) framework. The PSR framework is based on the linkages between human activities, the state of the environment and the societal and economic responses to environmental change.

Using this approach, indicators are classified according to whether they signal:

- Pressure indicators – which describe the pressures from human activity that affect the natural environment.

- The state (or condition) indicators – which measure the quality of the environment and the functioning of important environmental processes.

- Response indicators – which identify the efforts by society to address the pressures.

The OECD warns that the PSR model tends to suggest linear relationships in the human activity-environment interaction, which may obstruct the view of more complex relationships in ecosystems and in environment-economy interactions.

State of the Environment reporting

The OECD's PSR model provides the basis for the Australian Government's State of the Environment (SoE) reporting. Described as a national stocktake of the Australian environment, SoE reports have been released five-yearly, starting in 1996. SoE 2006 features a comprehensive suite of key environmental indicators, developed by independent experts, for each of its environmental themes – Atmosphere, Land, Inland Waters, Coasts and Oceans, Biodiversity, Human Settlements, Natural and Cultural Heritage, and Australia's Antarctic Territories.
Most state and territory governments in Australia prepare SoE reports on a regular basis and it is a legislative requirement in New South Wales, the Australian Capital Territory, Tasmania, Queensland and South Australia.

Sustainability Reporting Frameworks

The indicators used for sustainability reporting differ from SoE reporting as they are based on different models that combine social, economic and environmental trends, and the inter-relationships between these systems. The OECD has taken special responsibility for leadership in sustainable development reporting. Most OECD governments have national sustainable development strategies in place, prepared as part of the United Nations Programme for Action for Sustainable Development, Agenda 21, signed at the Rio Earth Summit in 1992.

Australian Headline Sustainability Indicators

Australia developed its National Strategy for Ecologically Sustainable Development (NSESD) in 1992 to address many key areas for action identified in Agenda 21. The NSESD defines ecologically sustainable development as “using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased”.

In 2001, Commonwealth Ministers endorsed a set of headline sustainability indicators for Australia, selected to collectively measure its national performance against the core objectives of the NSESD. The 2002 publication *Are We Sustaining Australia: A Report Against Headline Sustainability Indicators for Australia* was the first report against these headline sustainability indicators. Comparing successive sets of indicators will help to determine Australia's progress towards sustainability. The report is available from the Department of Environment and Heritage web site at: <http://www.deh.gov.au/esd/national/indicators/report/index.html>.

Other sustainability reporting frameworks include The Natural Step (discussed below), as well as those developed for specific industries and agendas such as The Montreal Process for the Conservation and Sustainable Management of Temperate and Boreal Forests <http://www.mpci.org>, and Agricultural Sustainability Indicators for Regions of South Australia <http://www.pir.sa.gov.au/pirsa/communities>.

The Natural Step

The Natural Step (TNS) Framework is a science and systems-based approach to organisational planning for sustainability. It provides a practical set of criteria that can be used to direct social, environmental, and economic actions. More information is at: <http://www.naturalstep.org>.

Decoupling indicators

Decoupling indicators monitor the extent to which economic growth is becoming decoupled from pressures on the environment, in order to make an assessment of whether levels of growth are sustainable in the longer term. An example of this might be when a developed nation experiences economic growth without a corresponding increase in its greenhouse gas emissions. This sort of assessment is relatively straightforward in some cases, such as the sustainability of fish stocks. In other cases, such as the emission of air pollutants, government targets can be used as a proxy for the environmental limit. In other cases, such as resource use, further research is needed before either limits or targets can be established. Caution is required when reporting on decoupling indicators, which may appear to convey a positive message although in practice the cumulative impact of the pressure on the environment is unsustainable at a national, local or seasonal level. For example, the link between water use and its impact on the environment is extremely sensitive to when and where the water is extracted, as well as the total amount extracted. For example, taking water out of the Murray-Darling Basin, which lowers the water level at certain times can affect the breeding patterns of fish and birds that live in or near those rivers.

Community environmental reporting – Local Agenda 21

Local Agenda 21 provides the opportunity for local governments to work with their local communities to create ecologically sustainable development (ESD) agendas for the 21st century. It recognises that local governments and their wider communities can serve as leaders to achieve ecologically sustainable development through integrating environmental, social and economic goals.

In South Australia, councils have developed a practical guide for using community indicators to monitor the strategic directions of a local government area or region or to measure progress and sustainability of a local council. See <http://www.onkaparingacity.com/>.

Measures of Australia's Progress model

The ABS' *Measures of Australia's Progress* (MAP) provides 14 headline indicators to measure economic, social and environmental progress.

MAP 2006 environmental headline indicators are:

- threatened birds and mammals
- annual area of land cleared
- salinity, assets at risk in areas affected, or with a high potential to develop salinity
- water management areas, proportion where use exceeded 70% of sustainable yield
- fine particle concentrations, days health standards exceeded, selected capital cities
- net greenhouse gas emissions.

The headline indicators are concerned with assessing dimensions of Australia's progress, rather than explaining the underlying causes of change. MAP's supplementary indicators are intended to supplement the information provided by the headline indicators. For the environment, they included trends in threatened species, mammalian extinctions, species-threatening invasive animals, weeds of national significance distribution, native forest area, water diversions in the Murray-Darling Basin and days when ozone concentrations exceeded guidelines.

Composite (or aggregated) indicators

Composite indicators combine disparate measures of progress into just one number. For example, to measure the quality of life in a nation, approaches such as the Genuine Progress Indicator (GPI), attempt to adjust traditional measures of economic activity, such as gross domestic product (GDP), to account for changes to environmental and social capital. For example, a GPI might begin with GDP and then make allowances such as taking out spending to offset social and environmental costs and accounting for longer term environmental damage and the depreciation of natural capital. The Australia Institute has calculated a Genuine Progress Indicator for Australia. Details are available at: <http://www.gpionline.net>. Another example of a composite indicator is the Ecological Footprint.

Composite indicators are valued for their ability to integrate large amounts of information into a single ranking that can be easily understood. However, because their construction is not straightforward they can provide misleading information.

The Ecological Footprint

The Ecological Footprint framework varies from SoE reporting and sustainability reporting in that it acknowledges ecological limits by suggesting whether a population is living within its ecological means. It also places less emphasis on the social and economic aspects of sustainability. Expressed as an area of land, the Ecological Footprint is a measure of how much individuals, organisations, cities, regions and nations, or humanity as a whole, consumes and compares this amount to the available resources.

The more natural resources consumed per head of population and the more waste that is produced, the larger the 'footprint' (area of land). Ecological footprint estimates are based on assumptions that may not be applicable to all places.

The Powerhouse Museum has developed a Footprint calculator calibrated to Australian data to give individuals a rough estimate of their footprint. More information is available at: <http://www.powerhousemuseum.com/education/ecologic/resources.htm>.

Accounting frameworks

SEEA and SESAME

The *System of National Accounts* (SNA 1993) is an international framework for economic accounting. Australia's national accounts record the essential elements of the Australian economy: production; income; consumption; assets and liabilities; and wealth. The *System of Integrated Environmental and Economic Accounting 2002* (SEEA) complements the SNA by providing an international standard for incorporating environmental and social effects into a national accounting framework. SEEA describes techniques for valuing environmental goods and services that are not part of the market economy, for example, accounting for stocks and flows of natural resources.

The Dutch Government has compiled a System of Economic and Social Accounting Matrices and Extensions (SESAME), which is also an extension to the standard national accounts framework. Key features are data integration and multiple classifications, which provide links (both conceptual and numerical) between monetary and non-monetary units. SESAME can be used to analyse the links between the structure of an economy, people and the environment. Countries such as Canada and Norway use a “capital” approach to measure sustainability where the focus of measurement is on the stocks and flows of different national assets.

Triple bottom line

Triple Bottom Line (TBL) became popular in the late 1990s and describes reporting that goes beyond a financial “bottom line” to also include assessing and reporting environmental and social outcomes. This notion of reporting against economic, social and environmental performance is directly tied to the concept of sustainable development. A number of companies in Australia produce TBL reports. The Department of the Environment & Heritage web site has many Public Environmental Reports available electronically at: <http://www.deh.gov.au/industry/finance/index.html>.

The CSIRO report, *Balancing Act,* applies the principle of triple bottom line reporting at a national economic sector level for 135 sectors of the Australian economy. The analysis merged the System of National Accounts input-output tables published by the ABS, with a range of social and environmental indicators. More information is available at: <http://www.cse.csiro.au/research/balancingact/index.htm>.

The Department of the Environment & Heritage publishes Australian guidelines for environmental reporting of organisations in *Triple bottom line reporting in Australia: a guide to reporting against environmental indicators (2003),* available at: <http://www.deh.gov.au/industry/corporate/reporting>.

Cumulative topic list

Cumulative topic list

Water trends

Measuring environmental values, changes and condition trends

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