Australian Government
Department of the Environment, Water, Heritage and the Arts

EPHC
Environment Protection and Heritage Council

National Waste Report 2010

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Foreword

Welcome to Australia's first comprehensive national report on waste management and recycling. The release of the *National Waste Report 2010*, which will be updated every three years, signals a new era of information sharing across government and industry.

Just as the *State of the Environment Report* provides a comprehensive assessment of our environment, the National Waste Report provides information on waste management, identification of costs and opportunities, recycling trends and implications for sustainability.

There are three major challenges with Australia's waste. We must generate less waste; we must re-use and recycle more effectively; and we must keep as much hazardous waste out of our environment as possible.

Managing waste is not just about protecting our environment and our health. It is also about contributing to our country's long term economic growth and creating opportunities for jobs growth and innovation as we move towards a low emissions future.

Despite our best intentions and efforts, the amount of waste we produced increased by 31 per cent between 2003 and 2007. Waste sent to landfill can contain valuable resources which should be recycled. It can also contain potentially dangerous chemicals, metals and other components which we must manage safely.

This report shows that there are still gaps in our knowledge that need to be filled to implement aspects of the landmark National Waste Policy. The policy, launched in November 2009, has been endorsed by all governments.

We can do better, and the findings in the National Waste Report will help us. An informed community can deal with its waste more effectively, and better information will help us measure improvement over time.

The *National Waste Report 2010* provides a strong basis for policy and action. It details the amount and nature of waste we have generated, both nationally and for each state and territory. It also provides an overview of the laws and policies that influence how we handle our waste, so that federal, state and local jurisdictions can better collaborate to determine more unified and effective solutions.

Future reports will use increasingly sophisticated techniques for data gathering and analysis. Between reports, all governments, organisations and individuals with experience and expertise in the field will be able to work together and share their knowledge.

The publication of this landmark report was made possible by the efforts of state and territory governments, local governments, businesses, interest groups and other major stakeholders, who joined with the Environment Protection and Heritage Council to pool their information. I thank them for their contribution and I commend this report to you.

The Hon Peter Garrett AM MP
Chairman
Environment Protection and Heritage Council

Introduction

In November 2008, Australia's environment ministers agreed to prepare the first comprehensive national report on resource recovery and waste management. Just prior to this, the Senate report *Management of Australia's waste streams* had concluded that Australia lacks fundamental information on most aspects of waste generation and management, including physical, financial, economic and social aspects, and needs adequate analytical tools to process such information.

On 5 November 2009, Australia's environment ministers, through the Environment Protection and Heritage Council (EPHC), released the *National Waste Policy: Less waste, more resources*. The policy sets out a comprehensive agenda for national co-ordinated action on waste across six areas, and marks a fundamental shift in the approach to waste management and resource recovery.

A key strategy under the policy is the development and publication of three-yearly reports on current and future trends in waste and resource recovery. These reports will be supported by access to integrated national core data that are accurate, meaningful, up-to-date and accessible.

The *National Waste Report 2010* presents a contemporary national picture of resource recovery and waste management in Australia. It documents what is known about the status of and trends in resource recovery and waste management in Australia, particularly in the light of trends in waste generation. Based on key statistical information, it provides our best understanding of the main aspects of the waste system and how it works. It reviews the current state of infrastructure and explores some scenarios for the future, including innovative technologies that may be harnessed to enhance our waste management practices.

The information in this report will assist governments, businesses and the community to make sound policies and decisions, and will help individuals to contribute to waste minimisation in meaningful and achievable ways.

Scope

The report covers

- municipal solid waste (MSW)—that is, household and council waste
- commercial and industrial waste (C&I)—that is, waste from business, educational institutions and government
- construction and demolition waste (C&D)—that is, waste from residential, civil and commercial construction and demolition activity,* and
- hazardous waste.

It does not cover gaseous, liquid or radioactive waste, and it does not explicitly cover biosolids (the solid waste from sewage treatment plants), although data presented for some jurisdictions include disposal figures for biosolids. Waste and recycling in Australia's external territories are outside the scope of this report.

The report presents information on several issues faced by those who make policy for urban, regional and remote Australia:

- the amount of waste generated and the make-up of that waste;
- the impacts and benefits of waste, including those associated with landfills, resource recovery, hazardous waste and hazardous substances, organic waste, litter and marine debris;

* This excludes construction waste from owner/occupier renovations, which is classified as part of the municipal waste stream.

- how we manage waste, including a brief history of waste management; the values and choices displayed by Australians in relation to resource recovery and waste generation; policies and regulations; strategies such as extended producer responsibility; how the waste and resource recovery markets operate; regional and remote area issues; and waste infrastructure and technology;
- data gathering about waste and recycling in Australia.

Sources

There is no single, definitive, national information source on resource recovery and waste management in Australia, largely due to the fact that the Australian waste industry is regulated mainly by states and territories rather than by one central body. The information in this report has been drawn from a range of published sources, including

- information from Australian Government agencies including the Australian Bureau of Statistics (ABS)
- information from state, territory and local governments
- various industry information sources, and
- *Waste and Recycling in Australia*—three reports prepared by Hyder Consulting:
  - one published in 2006, covering the period 2002–03
  - one published in 2008 covering the period 2006–07, and
  - one published in 2009 updating data for 2006–07 and providing additional data.[1]

Several analyses were commissioned to supplement and strengthen current knowledge. These covered the following topics:

- capacity of landfills until 2030, and their cost and performance;
- current and future innovations, trends and opportunities in the technology and practices that are utilised in waste and resource recovery;
- employment related to landfill disposal of waste and to alternatives such as recycling;
- climate change aspects of resource recovery and waste management;
- lessons learned from overseas product stewardship/extended producer responsibility schemes;
- the degrees to which people value their participation in kerbside and workplace recycling;
- current waste and resource recovery data and the potential value of a new national waste data system.

Parameters of the data

The National Waste Report 2010 is a first step towards establishing baseline data and developing a strong and comprehensive knowledge base on waste management and resource recovery in Australia. It seeks to present key information for each jurisdiction, provide a clear understanding of national trends and their implications for sustainability, and respond to the community's desire for information about how sustainability can be incorporated more fully into daily life.

The authors of this report have taken a 'slice in time' approach, focusing on the data set for the 2006–07 financial year, for which the fullest information was available when the report was being prepared. Much of this information was first gathered by Hyder Consulting in 2008 and revised, in consultation with state and territory governments, during 2009. Other material from various sources supplements the Hyder information.

The fact that waste and recycling data are generated in variable ways by a range of agencies inevitably means that there are wide disparities in the detail, geographic coverage, scale, time frames and scope of the data. Within those limitations, every effort has been made to ensure the accuracy of the information presented. Comprehensive data were not always available, and readers should exercise a degree of caution when using the information in the report.

Main findings of the report: a summary†

Waste, resource recovery and recycling in Australia

- There have been major changes to the way society manages waste in the last two decades.
- Recycling and waste generation have both increased.
- The recycling and waste sector is valued at between $7 and $11.5 billion.

National waste generation profile

- 43 777 000 tonnes of waste were generated in Australia in 2006–07.

Projected waste generation

- If waste generation grows at 4.5% per annum, Australia will generate 81 072 593 tonnes of waste in 2020–21.

Per capita recycling and landfill disposal

- Per capita, Australia generated around 2080 kg (2.08 tonnes) of waste in 2006–07, of which 1080 kg (1.08 tonnes) was recycled.

National recycling profile

- In 2006–07, 22 707 000 tonnes or 52% of Australia's waste was recycled
- Of this quantity,
  - 42% was from the construction and demolition (C&D) waste stream
  - 36% was from the commercial and industrial (C&I) waste stream, and
  - 22% was from the municipal solid waste (MSW) stream.

Waste composition

- Organic material made up 72% of the municipal solid waste sent to landfill in Australia in 2006–07.

Landfill disposal profile

- 48% of Australian waste was landfilled in 2006–07.
- Australia has sufficient unused physical landfill capacity in most of the larger urban centres but this may be constrained by social and environmental factors.
- Landfill standards in Australia have improved in the past 20 years, but controls could be further improved, particularly for small-to-medium sized landfills.

Organic waste

- Organic waste accounts for 62% of total MSW, C&I and C&D waste disposed to landfill.
- 32% of available organic waste is recycled.

Social—values and behaviour

- 99% of households undertake recycling and re-use.
- 80% of employees would like to see more recycling in the workplace.
- Lack of information, facilities and services present barriers to additional recycling.
- National litter levels are trending downwards.

Regional, remote and Indigenous communities

- Almost 33% of Australians live in regional and remote Australia and about 30% of waste is sent to landfills which service these areas.
- There are particular challenges in providing recycling and waste management services to regional, remote and Indigenous communities.

Hazardous substances and hazardous waste

- The estimated quantity of hazardous waste generated in Australia doubled between 2002 and 2006 to around 1.19 million tonnes per annum, but this figure is not comprehensive.
- An average of 30 000 tonnes of hazardous waste is exported from Australia annually.

Product Stewardship

- Product stewardship is an approach for managing the impacts of a product or material during and at end-of-life.

Data and classification

- Data collection at present does not provide comprehensive national data on waste and recycling.

† These principal findings are also in the *National Waste Overview* published in November 2009, and can be found at <http://www.ephc.gov.au/taxonomy/term/86

Future Reports

This report lays the groundwork for similar reports at three-yearly intervals, and highlights the gaps in available knowledge which need to be closed in order to secure a better understanding of the challenges to be faced, and to measure progress. This and future reports will play a vital role in the implementation of the National Waste Policy. If Australia is to continue to develop effective resource recovery and waste management policies in the future, policy makers need accurate, contemporary, national data and trend information. Only with such knowledge will they be able to respond confidently to future needs.

Endnotes

1 Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, February 2006; *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2008; and *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, amended November 2009.

Chapter 1
Context

CHAPTER 1.1 THE AUSTRALIAN CONTEXT

This chapter briefly describes Australia's population, demographic and income trends and the impacts of these factors on consumption, waste generation and resource recovery.

At over 7.66 million square kilometres and with a coastline of over 57 million kilometres,[1] Australia is the world's sixth largest country measured by landmass area, after Russia, Canada, China, the USA and Brazil. Australia's population, at just 21.8 million in March 2009, is much smaller than the populations of those countries.[2] Within Australia, the states and territories also have very different geographic, spatial and demographic profiles which contribute to unique patterns of consumption of goods and services, patterns of waste generation, and challenges for waste management.

Demands for products and services, and the waste they generate, are strongly linked to population factors such as growth, density and distribution, and demographic and lifestyle factors.

Population factors

Australia's population growth between 1992 and 2009 was around 25%—slightly greater than world population growth. **Table 1.1** shows a comparative selection of national and international population growth rates, including that of Australia, although recent data released by the Australian Bureau of Statistics indicates that the present annual population growth rate for Australia may be in excess of 2%.*[3]

Table 1.1: OECD figures on the average population growth rate for selected countries

	Average growth rate 2000–09 (%)
Israel	1.86
India	1.59
Brazil	1.42
Ireland	1.40
Turkey	1.32
Australia	**1.29**
EU27 total	0.32
OECD	0.63
World	1.23

The Australian Bureau of Statistics predicts that population will increase to between 30.9 million and 42.5 million people in 2056 (depending on fertility and migration).[4] Treasury projections in the 2010 Intergenerational Report indicate that Australia's population could reach 35.9 million in 2050.[5] Together, these figures show that Australia can be expected to have one of the highest population growth rates among developed countries, especially OECD countries, into the future. Assuming consumption levels per person remain constant, the total level of consumption will continue to rise

* The growth rate for each country from 2000–2009 is quoted directly from the OECD source. The average rate of growth was calculated by the Department of Environment, Water, Heritage and the Arts. Information on the population growth rate for Australia in 2009 of 2.1% can be found at <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0> accessed 12 November 2009.

with population growth, increasing demands within Australia for additional resource recovery and waste management infrastructure.

Population densities are low across Australia, and those of major population centres are also relatively low compared with those of major cities in Europe and in North America. This can have implications for the logistics and economics of resource recovery and waste management, affect the availability of landfill space in urban areas, and influence the economic feasibility of resource recovery facilities—in particular the introduction of modern alternative waste treatment and the production of energy from waste.

Australia is highly urbanised, with over two-thirds of the population living in major cities and the remainder living in regional and isolated, remote locations. People live in two widely separated coastal regions, the south-west and the east. Concentration of population in these regions, with the rest of the landmass sparsely inhabited, creates particular patterns of waste generation and particular challenges for its management.

Demography

Demographic changes can be expected to generate new demands on resource recovery and waste management. The number of people living alone, for instance, is projected to increase from 1.8 million in 2001 to at least 2.8 million in 2026—an increase of at least 57%. In 2001, Australia had 7.4 million households with an average size of 2.6 persons per household. It is projected that by 2026 average household size will decrease to between 2.2 and 2.3 persons. Finally, the number of one-parent families is projected to increase from 838 000 families in 2001 to between 1.1 and 1.4 million in 2026 or by up to 63%.[6]

These changes can be expected to lead to greater demand for housing and associated consumables, such as furniture, furnishings (carpets, blinds etc.), whitegoods, electronic products and lighting.

Future growth in consumption may be moderated by an ageing population. The percentage of people over the age of 65 is expected to increase from 13% in 2007 to around 24% in 2056.[†]

A high proportion of people over 65 rely on government pensions and allowances, and their lower income means that they spend less on goods and services than other age groups. They also spend a relatively high proportion of their income on non-discretionary items such as food and housing.[‡]

While the average number of people in a household is falling, the size of dwellings has increased. The average number of bedrooms per dwelling increased from 2.8 to 3.1 between 1976 and 2005–06, while the average number of people per household declined from 3.1 to 2.5 over the same period.[7] Children are less likely to share bedrooms than they did in the past, and extra rooms are used for a variety of purposes such as home offices, home theatres and guest accommodation.

Rising incomes

Real national disposable income per person increased by an average of 2.8% per year between 1997–98 and 2007–08, a much faster rate than during the previous 20 year period.[8]

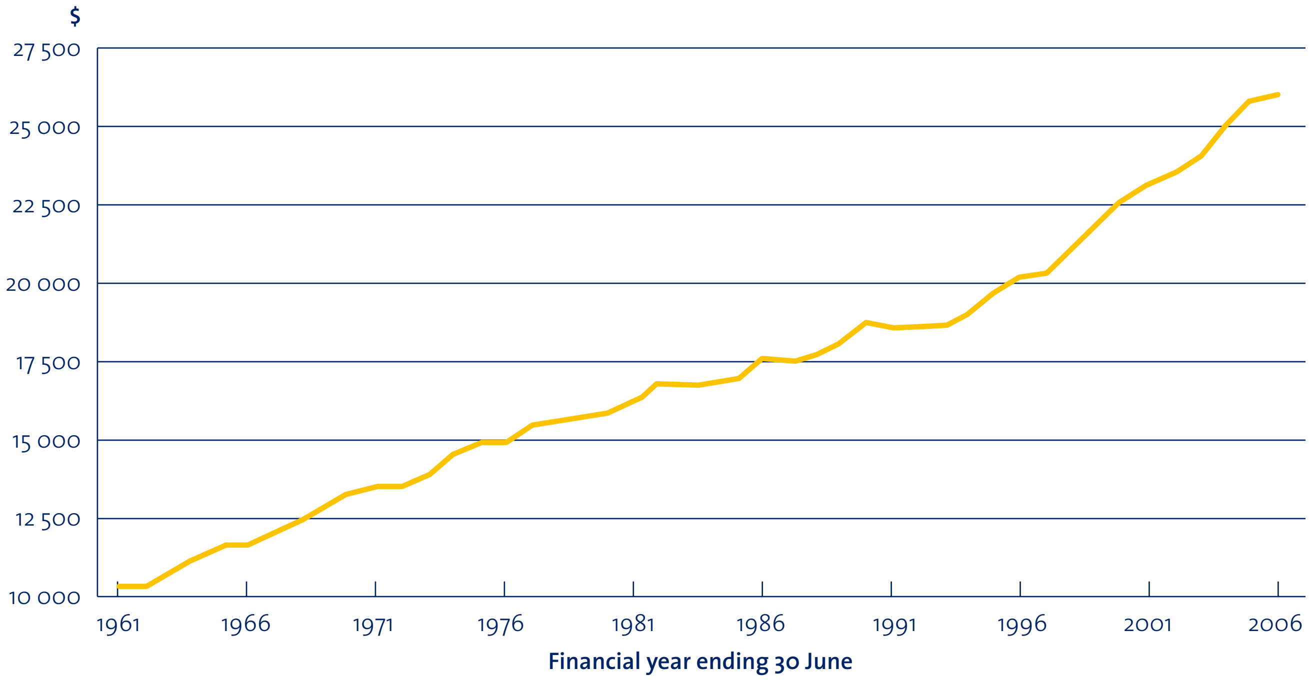
Consumers increased spending on discretionary products at a faster rate than spending on basic goods and services.

Figure 1.1 presents a picture of real household final consumption expenditure in real terms (at 2004–05 prices) between 1960–61 to 2005–06. After rising by 1.9% a year per capita between 1960–61 and 1992–93, expenditure then began to increase by 2.6% a year in the period to 2005–06. While the Global Financial Crisis is likely to have reduced household consumption, it is feasible that households will return to these patterns of rising consumption expenditure as markets recover.

† This is due to the high proportion of people under the age of 50 in 2007; as well, increasing life expectancy means that this group may remain relatively large over the years. See Australian Bureau of Statistics, *Australian social trends 2008*, ABS Catalogue No. 4102.0, pp. 2–3.

‡ In 2003–04 a couple over the age of 65 spent an average of $615 per week on goods and services, compared to $1169 per week for a couple under the age of 35. See Australian Bureau of Statistics, *Australian social trends 2006*, ABS Catalogue No. 4102.0, p.161.

Figure 1.1: Household consumption expenditure per person



Source: *2005-06 Australian System of National Accounts* (ABS cat. no. 5204.0); *Australian Historical Population Statistics, 2006* (ABS cat.no. 3105.0.65.001); *Australian Demographic Statistics, September 2006* (ABS cat.no. 3101.0)

The above factors present a challenge not only to those sectors which manage waste and products at end of life, but to all who design, manufacture, and consume products, systems and services and who wish to minimise waste generation.

Endnotes

1 Geoscience Australia, <http://www.ga.gov.au/education/geoscience-basics/dimensions/index.jsp>, accessed 21 July 2009.

2 Australian Bureau of Statistics, *Australian Demographic Statistics, March 2009*, ABS Catalogue No. 3101.0.

3 OECD Factbook 2009: Economic, Environmental and Social Statistics—ISBN 92-64-05604-1—© OECD 2009—Population growth rates, <http://statlinks.oecdcode.org/302009011P1T002.XLS>, accessed 19 January 2010.

4 Australian Bureau of Statistics, *Population Projections, Australia, 2004 to 2101*, September 2008, ABS Catalogue. No. 3222.0.

5 Treasury, *2010 Intergenerational Report, Australia to 2050: future challenges*, January 2010, <http://www.treasury.gov.au/igr/igr2010/default.asp>, accessed 1 February 2010.

6 Australian Bureau of Statistics, 'Future Living Arrangements', *Australian Social Trends 2005*, ABS Catalogue No. 4102.0.

7 Australian Bureau of Statistics, *Year Book Australia 2008*, ABS Catalogue No. 1301.0.

8 Australian Bureau of Statistics, *Measures of Australia's progress, Summary Indicators 2009*, ABS Catalogue No. 1383.0.55.001.

CHAPTER 1.2
GLOBAL CONTEXT

This chapter outlines key international activities in waste and resource recovery, and places Australia's activities in a global context. It examines how overseas countries are managing materials in more sustainable ways, including through sustainable manufacturing.

Factors that influence waste generation have changed: population has increased, the way people consume goods and services has changed, and economic growth has increased, all of which potentially add to the quantity of waste generated. From 5.48 billion in 1992[1] the world's population grew to 6.77 billion in 2009,[2] an increase of around 24%.

Over the same period, there has been increased awareness of the need for sustainability, resulting in pressure on governments and industry to introduce policies and regulations which encourage waste avoidance and resource recovery, and policies requiring the use of products which contain fewer hazardous materials. Innovative technologies and processes have been developed to minimise waste generation and maximise the level of resource recovery, including through composting, energy recovery and recycling.

International policies and conventions

United Nations conventions, to which Australia is a party, provide a basis for action by individual nations on waste-related matters.

Australia became a party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (the Basel Convention) in 1992 and is required to ensure that the generation of hazardous and other wastes (in particular household wastes) is reduced to a minimum (taking into account social, technological and economic aspects); that adequate disposal facilities exist for the environmentally sound management of wastes; and that managers of waste take steps to prevent pollution, but if pollution occurs, minimise the consequences for human health and the environment. In 2004 Australia became a party to the Stockholm Convention on Persistent Organic Pollutants (POPs) (the Stockholm Convention) under which there is the further requirement to restrict and ultimately eliminate the production, use, trade, release and storage of dangerous long-lasting chemicals. Australia is a party (2004) to the Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade which relates to the international movement of chemical substances (the Rotterdam Convention). Australia is also a party to the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer, and the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which are agreements to reduce ozone-depleting substances and synthetic and other greenhouse gases. In 2009 there was international agreement to begin the development of a Legally Binding Instrument on Mercury that will seek to reduce its use, encourage the use of alternatives, and provide for its safe management and storage.

More information about the Basel, Stockholm and Rotterdam Conventions is available in **Chapter 3.3**

United Nations World Summit on Sustainable Development (WSSD)

In Johannesburg in 2002, governments, industry and community groups jointly tackled some major sustainability issues. Decisions taken at the WSSD, which are embodied in the Johannesburg Plan of Action, prompted work in two significant areas

- improving consumption and production patterns to make them more sustainable, and
- preventing and minimising waste, and maximising re-use, recycling and use of environmentally-friendly alternative materials.

Countries are continuing to develop this work through what is known as the Marrakesh Process—a ten-year framework of programs on sustainable consumption and production to assist countries to 'green' their economies, to help corporations develop greener business models, and to encourage consumers to adopt more sustainable lifestyles.[3]

Organisation for Economic Co-operation and Development (OECD)

In 2001, the OECD, which covers major developed countries including Australia, identified waste generation as one of ten key environmental indicators.[4] The OECD has periodically reported on the status of all indicators. In 2008 it reported that the quantity of municipal waste generated in member countries had steadily risen from 1980 to 2006, when it exceeded 650 million tonnes, or 560 kg per capita.[5] On average, generation per capita rose at a lower rate than GDP, with a significant slowdown in recent years. Should this pattern continue, municipal waste generation in OECD countries is projected to grow by 43% from 1995 to 2020, and reach approximately 700 million tonnes per year.[6]

The OECD's main focus is on the potential impact of inappropriate waste management on human health and on ecosystems (soil and water, air quality, land use and landscape). It noted that important questions remain about the capacities of existing facilities for final treatment and disposal, the location and social acceptance of new facilities (including 'not in my backyard'—NIMBY—views about controlled landfill and incineration plants) and illegal shipments of waste. The OECD concluded that the main challenge is to strengthen measures for waste minimisation, especially for waste prevention and recycling, and to move further towards life-cycle management of products and extended producer responsibility.[7]

Member countries concluded in the 1990s that waste minimisation policies which address end-of-life items alone were not likely to be effective in reducing the increasing volumes of material consumption and waste. In 2005 the OECD therefore initiated a program to develop integrated material and waste policies which address environmental aspects of the whole life cycle of materials from cradle to grave. The principles of sustainable materials management include the promotion of sustainable materials use, actions which target reducing negative environmental impacts, and the preservation of natural capital throughout the life cycle of materials, taking into account economic efficiency and social equity.

In 2008 the OECD reported that by 2030 the world economy is expected to nearly double, and world population to grow from 6.5 billion to over 8.2 billion people. Most of the growth in income and population will be in emerging economies and in developing countries. Rising incomes and aspirations for better living standards will increase the pressure on the planet's natural resources. The document concluded that the economic prospects of many of the poorest countries are threatened by several factors, including the unsustainable use of natural resources. In particular, it urged action to ensure efficient resource use and eco-innovation, and noted that globalisation should provide opportunities to promote both of these aspects. The OECD also reaffirmed that due to growing global demand for materials, current waste policies alone are not sufficient to offset the increasing waste-related environmental impacts of materials production and use.[8]

Work of the G8 countries

In May 2008, environment ministers from the G8 countries agreed to pursue initiatives promoting the efficient use of resources and to harmonise environmental and economic concerns through efforts to reduce, re-use, and recycle materials and wastes—otherwise referred to as the '3Rs'. Initiatives included

- to prioritise 3Rs policies and improve resource productivity
- to establish a sound material-cycle society, and
- to collaborate for 3Rs capacity development in developing countries.

The ministers are due to consider a report on progress in 2011.

World Business Council on Sustainable Development (WBCSD)

Business continues to take a leading role in sustainable consumption, globally and within individual countries. Globally, the World Business Council on Sustainable Development (WBCSD) is driving change. A CEO-led global association of 200 companies which deals exclusively with business and sustainable development, the WBCSD considers that sustainable consumption and production are essential requirements for sustainable development. It has introduced a 'Sustainable Value Chain' initiative which aims to promote, assist and support life-cycle thinking and life-cycle approaches among WBCSD member companies and their suppliers, customers and industry partners, leading to sustainable innovation and global trade of more sustainable products.

As part of its work in this area, the WBCSD created the concept of 'eco-efficiency' in 1992:

> As defined by the WBCSD: Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity. In short, it is concerned with creating more value with less impact.[9]

The WBCSD explains the relevance of the concept of eco-efficiency to business:

> Eco-efficiency is primarily a business concept because it talks the language of business. Put simply, it says that becoming more efficient makes good business sense. Eco-efficiency calls for businesses to achieve more value from lower inputs of materials and energy and with reduced emissions. It applies throughout a company—to marketing and product development as much as to manufacturing or distribution. It is concerned with three broad objectives:
>
> 1. Reducing the consumption of resources
> 2. Reducing the impact on nature
> 3. Increasing product or service value.

Many countries have since embedded this concept in policies and program initiatives. Indeed, in Australia the concept formed part of the federal Business of Sustainable Development program which was initiated in 2000 and has since been used in state and territory sustainability programs.

Australia's trading partners

Australia's major trading partners are seeking to reduce waste generation and its impacts and improve the way that waste is managed. Action is being taken to

- improve landfilling management practices for municipal and hazardous waste
- manage materials more sustainably
- minimise the amount of waste that is landfilled
- increase the level of recycling, and
- increase energy recovery from the waste.

Other actions include making products more recyclable, using fewer hazardous materials, and using government purchasing power to improve sustainability outcomes. Countries have used a mix of policies, regulations and economic instruments to deliver results in these areas. The following is a brief summary of the main waste management and resource recovery initiatives underway in some of Australia's key trading partners.

United States

In 2003, the US Environment Protection Agency published *Waste and Material Management in the Year 2020*,[10] a vision document which provided broad outlines for what a resource recovery policy of the future might look like and what forces might shape it. It focused mainly on the sustainable use of resources, a life-cycle approach to managing chemical risk, and safe, environmentally sound waste management. It articulated three possible goals:

- to reduce waste and increase the efficient and sustainable use of resources;
- to prevent exposure of humans and ecosystems to hazardous chemicals;
- to manage wastes and clean up chemical releases in a safe, environmentally sound manner.

In 2005, the United States Government set a long-term indicative national recycling target of 35% of municipal waste, and encouraged the achievement of this target, mainly through voluntary initiatives.[11] It identified three targeted waste streams: paper and paperboard, organic waste, and packaging/containers. It proposed recovery goals for 2008 for each of the targeted streams, and listed criteria for identifying projects to help achieve the goals. The aim was to create a national culture that emphasises recycling and builds recycling infrastructure.

Many state and local governments in the US have legislated to promote recycling and ban the landfilling of recyclable material (such as green waste, oil, and recyclables easily collected in kerbside recycling programs). Some of the targeted products include packaging and electronic equipment.

Japan

Japan has adopted a regulatory approach to implementing waste reduction and other sustainable production and consumption policies under the '3Rs' (reduce, re-use, recycle) umbrella.[12,13] Key legislation from 2000 and 2001 aims to

- establish a recycling-based society
- encourage effective utilisation of resources
- promote green purchasing, and
- increase waste diversion to decrease waste volumes and decrease disposal of industrial wastes.

National legislation to establish Japan as a recycling-based society sets out roles and responsibilities for different parties, establishes priorities for waste disposal and recycling that address electronic equipment, end-of-life vehicles, construction materials and food, and requires producers to adopt a life-cycle approach to product development. Legislation also aims to improve the utilisation of resources, promotes waste diversion policies across government, encourages business to address waste reduction, re-use of parts, material-specific recycling targets, recycling labels, design for the environment, product stewardship, and waste planning to encourage the 3Rs.

Japan has established national targets for waste prevention, waste recycling and avoidance of final disposal—for example, it aims to recycle 24% of municipal waste and to limit final disposal of waste to 50%.

China

In its 2006 *Environmental Performance Review of China*,[14] the OECD noted that China was seeking to curb the generation of all types of waste by fostering a high quality, low material intensity, economic growth model. The OECD also noted that China's drive to reduce its material intensity parallels the drive to reduce its energy intensity.

The concepts of the 3Rs and of the 'circular economy' are important parts of China's approach to waste and sustainable materials management. The term circular economy, enshrined in law in 2008, denotes an economy in which reduction, re-use and recycling of waste is central to production, circulation and consumption of goods. Forward planning, adjustment to local conditions, and participation by the public are integral to the circular economy. Under the legislation, enterprises producing certain products or packages which by law must be recycled, are responsible for recycling them when they are discarded. Industries such as electric power, oil processing, chemical industry, steel, non-ferrous metal and building materials must replace fuel oil with clean energy.[15]

Canada

The Government of Canada works with provinces, territories, municipalities, and non-governmental organisations to provide support, research, and tools that encourage sustainable municipal solid waste management practices. Statistics Canada conducts a biennial Waste Management Industry Survey.[16] The national government also has a Green Procurement Policy, through the Office of Greening Government Operations created in 2005, with a mandate to accelerate the greening of the government's operations.[17]

As is the case in Australia, the management of municipal and other non-hazardous wastes is generally the responsibility of municipal and provincial governments.

Canada's two largest provinces have taken steps to reduce the impact of waste. Ontario issued a discussion paper in 2008[18] which proposed major changes in the way waste is managed in that province, including a forward-looking waste diversion framework based on further promoting extended producer responsibility, focusing on waste reduction and re-use and greater action by the commercial and industrial sector. Quebec has just reached the end of a ten-year Waste Management Action Plan.[19] That plan pursued strategies which flow from the waste hierarchy (source reduction, re-use, recycling, resource recovery and disposal and greater producer responsibility: see **Chapter 2.1** for details). It set a range of recovery targets covering municipal solid waste (ranging from 50 to 80%), industrial commercial waste (ranging from 60% of putrescible material to 95% of metals and glass) and construction and demolition waste (60%).

European Union (EU)

In 2005 the European Commission proposed a new strategy on the prevention and recycling of waste[20]—one of the seven thematic strategies under the European Union's 6th Environmental Action Plan. The EU's approach to waste management is based on three principles:

- waste prevention
- recycling, and
- improving final disposal and monitoring.

Reducing the amount of waste generated in the first place, and reducing the presence of hazardous substances in products, are key elements of this approach. The main waste streams targeted by EU countries include packaging waste, end-of-life vehicles, batteries, and electrical and electronic waste. Where waste generation cannot be prevented, as much material as possible is to be recovered, preferably by recycling. Waste that cannot be recycled or re-used is to be safely incinerated (with energy recovery), with landfill being a last resort. The EU has set strict guidelines for landfill management and banned the landfilling of certain wastes such as used tyres. It has set targets to reduce the landfilling of biodegradable waste.

England

In 2007 the UK Department for Environment, Food and Rural Affairs document *Waste Strategy for England*[21] concluded that England was consuming natural resources at an unsustainable rate. Reducing waste was identified as an important factor in helping England move towards 'One Planet Living'. The *Waste Strategy* aims to reduce waste by using fewer natural resources in making products, and by breaking the link between economic growth and waste growth. It states that most products should be re-used, their materials recycled and energy recovered where possible. The strategy covers producer and consumer responsibility, action across the supply chain, eco-design (sustainable design) requirements and the re-use and re-manufacture of products. The *Waste Strategy* targets paper, food and green waste, plastics and aluminium.

A progress report published in July 2008 indicated that:

- household waste had decreased by 22% from 2000–01 to 2006–07 or by an average of 16 kilograms per person per year
- total waste to landfill had fallen by a fifth between 2000–01 and 2006, from 80 million tonnes to 65 million tonnes
- household recycling had increased from 26.7% in 2005–06 to 31% in 2006–07, and
- the amounts of commercial and industrial waste sent to landfill fell by 23% from 2000–01 to 2006–07.[22]

New Zealand

In September 2008 New Zealand passed legislation[23] building on the *New Zealand Waste Strategy* of 2002 (the *2002 Strategy*),[24] in which New Zealand had concluded that waste was a significant risk to human health and the environment and there was evidence that the country was using resources inefficiently. It recognised that reducing waste was the cornerstone of New Zealand's commitment to sustainable development. The *2002 Strategy* set targets for organic wastes, special wastes, construction and demolition wastes and some hazardous wastes including organochlorine and trade wastes. It also set 30 aspirational targets for improved waste management, waste minimisation and resource efficiency. A review of results in 2006 concluded that the foundations for minimising and managing waste in New Zealand have been laid, and that good progress has been made towards meeting the Strategy's objectives and targets. The 2008 legislation moves NZ towards zero waste objectives through:

- improved public recycling
- dedicated funding to support waste minimisation and management, and
- regulations to support industry led product stewardship scheme.

Other international initiatives

Europe has been at the forefront of exploring ways to foster eco-innovation and sustainable manufacturing. Examples of eco-innovation programs are shown in **Table 1.2**.

Table 1.2: Examples of eco-innovation programs

Program name	Organisation	Features
Energy Using Products Directive (Eco-design Directive), 2009–2011	European Union	Enforces eco-labelling through eco-design requirements.
Competitiveness and Innovation Framework Programme (CIP), 2007–2013	European Union	Aims to boost competitiveness and productivity of small-to-medium sized enterprises (SMEs) in Europe. One of its three programs—Entrepreneurship and Innovation Programme (EIP)—directly engages with entrepreneurship and innovation.
The Seventh Framework Programme for research and technological development (FP7) 2007–2013	European Union	Fosters co-operation and development of European research, including for eco-innovation, through its themes of 'Nanoproduction', 'Energy, Food, Agriculture and Fisheries, and Biotechnology' and 'Environment'. Nanoproduction focuses on shifting away from resource-intensive practices to knowledge-intensive ones.
The Environmental Technology Action Plan (ETAP) (2004)	European Union	The main policy of the EU for stimulating development and uptake of environmental technologies on a broad scale. Key elements: technology verification, definition of performance targets (best environmental performance which is economically realistic), improving financing of environmental technologies, market-based instruments (including state guidelines, environmentally harmful subsidies etc., procurement of environmental technologies), applying life-cycle costing, and business and consumer awareness-raising and targeted training.
The Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy (2008)	European Union	Aims to improve environmental performance of products and improve demand for sustainable goods and production technologies. It encourages industry to take opportunities to innovate. It seeks to influence consumer behaviour and improve the environmental performance of products across the lifecycle. It encourages resource efficiency and environmental performance.
European Directive on Waste from Electrical and Electronic Equipment (WEEE)	European Union	Aims to reduce the amount of e-waste through legal criteria and standards for collection, treatment, recycling and recovery. It works alongside RoHS (see below) and the 'Directive for the Setting of Eco-Design Requirements for Energy Using Products'.
European Directive on Restriction of the Use of Certain Hazardous Substances (RoHS)	European Union	Aims to ban the placing on the EU market of new electrical and electronic equipment containing more than agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants.
Scheme of Aggregates Levy and Aggregates Levy Sustainability Fund (ALSF)	United Kingdom	These economic instruments add to the prices paid for such materials an amount that reflects the environmental costs of extracting and using construction materials. Funds raised are then diverted into environmental initiatives.
Environment-driven Business Development, 2001–2004	Sweden	Aims to strengthen the competitiveness of SMEs through sustainable product and business development.
Material Efficiency Services (MASCO) project	Finland	Allows companies to outsource management of certain material groups to a MASCO service provider, to free resources for their own core business activities, while improving material efficiency—project covers a range of materials but targets chemicals.
Textile Panel	Denmark	Product panels draft plans of action to increase the environmental improvement of products and services in the market place.
Top Runner Policy	Japan	This program searches for the most eco-efficient model available on the market and then stipulates that the efficiency of this 'top runner' model becomes the standard for all products on the market within a specified time. The focus is on improving the energy efficiency of appliances.[25]

Industrial ecology

Many countries have initiatives stemming from the concept of industrial ecology.

Industrial ecology promotes enhanced sustainability by stimulating innovations in the re-use of waste materials. The wastes or by-products of one industry are used as inputs in another industry, thereby closing the material loop of industrial systems and minimising waste.[26]

Comparative waste generation/ resource recovery achievements

In 2008 Australia's waste and recycling performance was compared with that of four countries with similar geographical and/or socio-economic features.[27] The findings, on a per capita basis, are shown in **Table 1.3**.

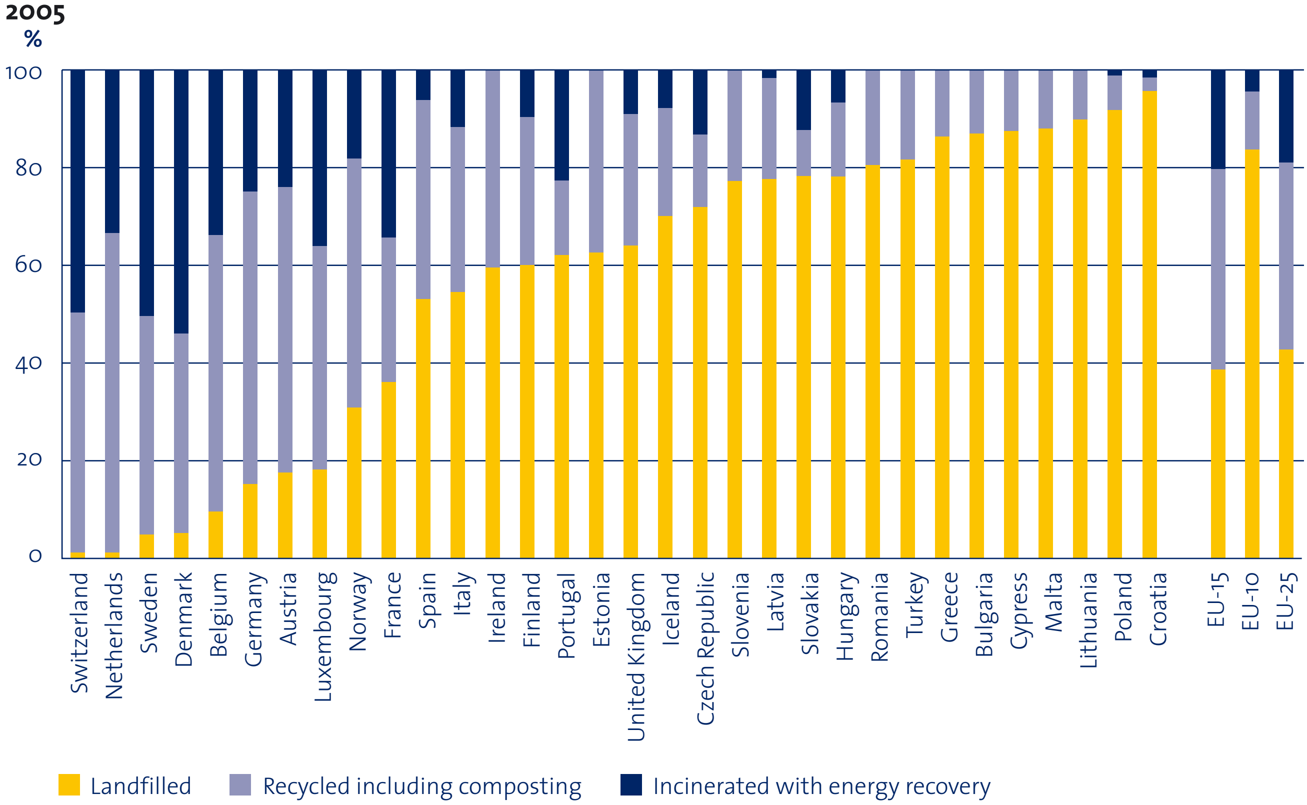
Table 1.3: Municipal waste, ranked by the rate of diversion from landfill (per capita)

Country	Generated (kg)	Disposed (kg)	Recycled (kg)	Diversion rate (%)
Germany	555	215	341	61
Australia	566	349	217	38
United States	927	625	302	33
England	574	398	176	31
Canada	411	292	118	29

In considering this table, it is important to recognise that many other countries have greater incineration and energy recovery infrastructure than Australia and that this contributes to some of the high resource recovery rates in some countries like Germany. For example, **Figure 1.2** shows that in 2005 about half of all waste generated in European countries like Switzerland, Sweden and Denmark was disposed by incineration that resulted in energy recovery.[28]

In 1999 the capacity for dedicated MSW incineration throughout the EU was estimated to be 45 million tonnes per annum.[29] Europe had 304 incinerators in 2000.[30] England had 12 incinerators in 2001, 11 of which were being used for disposing municipal solid waste. Incineration combined with energy recovery accounted for 9% of all waste in England, with 12% being recycled or composted and 78% landfilled. The only data found for the US indicate that 111 incinerators existed in 1990 and this was predicted to reach 300 by 2000.[31] While these figures are dated, they indicate that incineration with or without energy recovery is a key component of other countries' strategies for managing MSW and can contribute substantially to resource recovery rates.

Figure 1.2: Rate of recycling vs. incineration with energy recovery of municipal waste in European countries, 2005



These figures were compared with data from Eurostat 2006. The analysis showed that Australia ranked 13th for MSW generation, 10th for diversion and 15th for landfilling, as illustrated by **Figures 1.3**, **1.4** and **1.5**.[32]

Figure 1.3: Municipal waste generation per capita (kg), selected countries

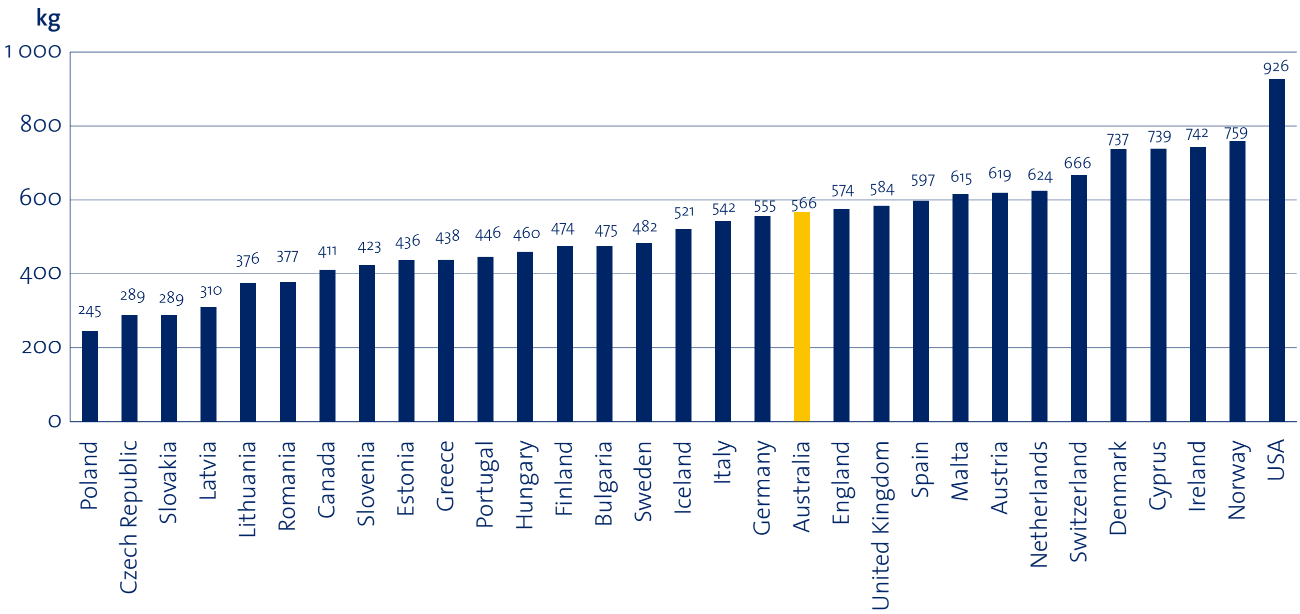


Figure 1.4: Diversion rate for municipal waste, selected countries

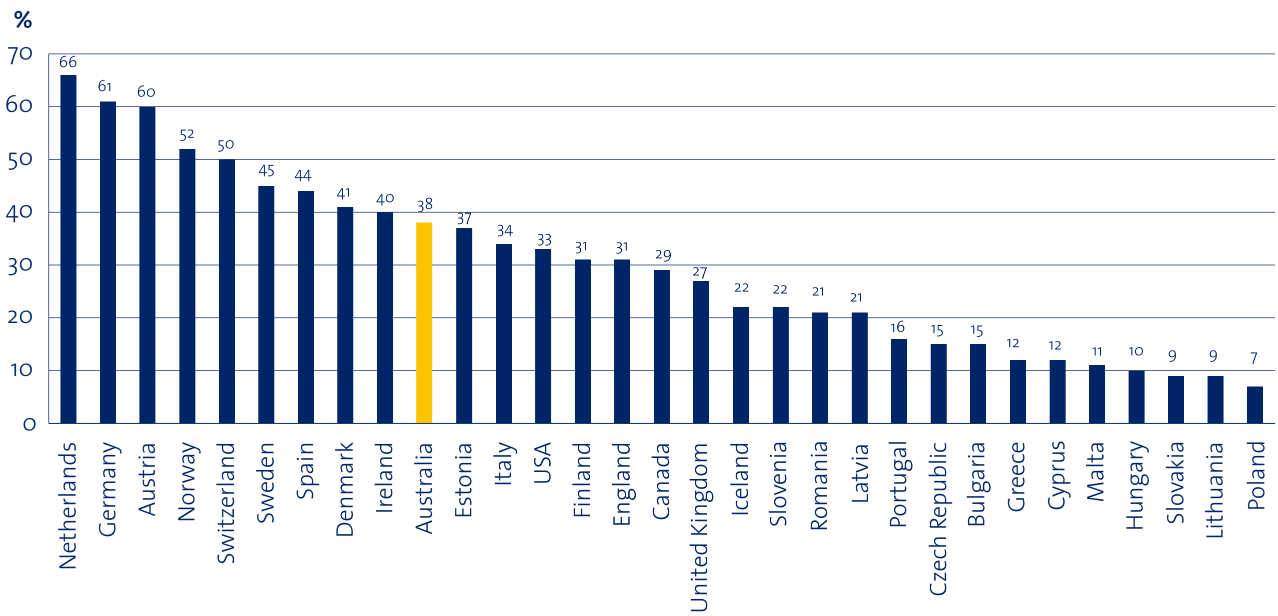
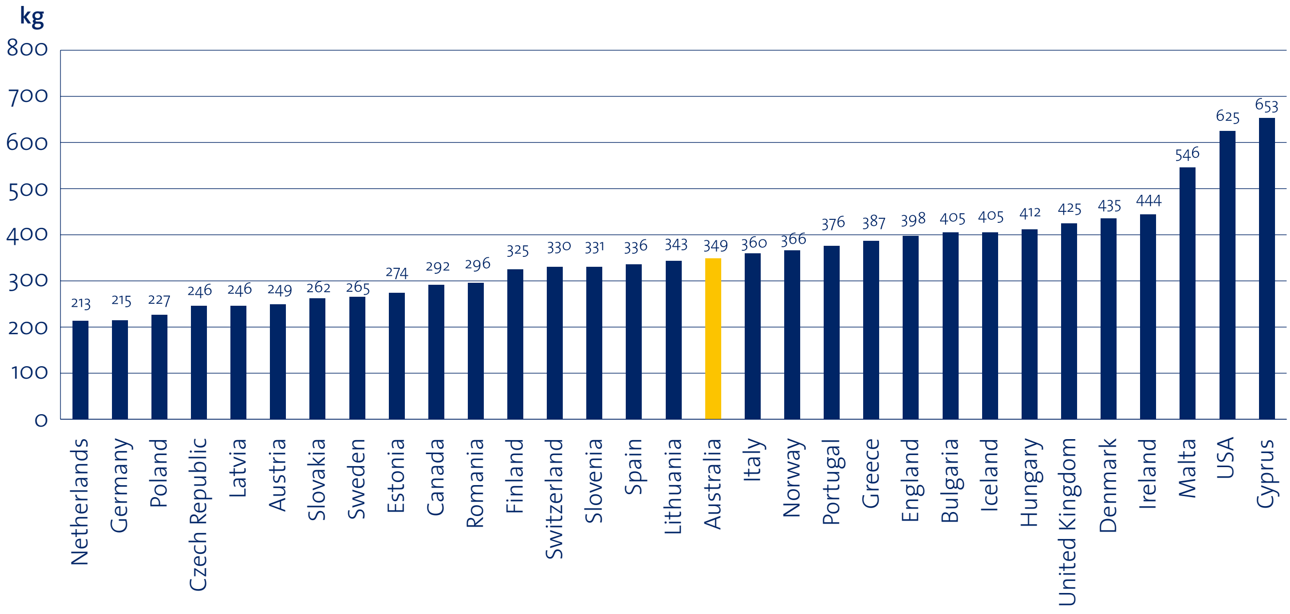


Figure 1.5: Disposal to landfill per capita for municipal waste, selected countries



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Chapter 2
Resource recovery and waste management in Australia today

Introduction

This chapter presents key data on the generation, recycling and disposal to landfill of waste in Australia. The main source of the data is Hyder Consulting's report *Waste and Recycling in Australia* (amended 2009). Where other sources are used, references are provided. Waste and recycling in Australia's external territories are outside the scope of the National Waste Report.

Three waste streams are covered—municipal solid waste (MSW), commercial and industrial (C&I) waste, and construction and demolition (C&D) waste. MSW is primarily waste collected from households and councils, such as through kerbside waste and recycling collections. C&I waste is mainly collected from commercial buildings, government facilities, educational institutions and industrial sites, while C&D waste is residential, civil and commercial waste produced by demolition and construction of buildings (though excluding most waste from owner/occupier renovations, which are usually included in the municipal waste stream).

This chapter does not cover gaseous waste, liquid waste or radioactive waste and it does not explicitly cover biosolids (the solid waste from sewage treatment plants), even though the data presented for some jurisdictions include biosolids disposal figures.

Chapter 2.1 presents a national picture for waste and recycling, using 2006–07 as the base year—the most recent year for which data were available from all jurisdictions. It provides information on

- total and per capita waste generation
- recycling and landfill disposal for the three streams
- projections of future growth to 2020–21
- the known locations of Australian landfills
- gas emissions from landfill and how they are captured, and
- what MSW materials can be recycled where in Australia.

Local councils provided the data for the maps, and while some of the information has been checked, its accuracy and comprehensiveness cannot be guaranteed.

Chapters 2.2 to 2.9 present a picture of individual state and territory jurisdictions. Each jurisdiction's chapter draws on publicly available data to present information on:

- the materials and items in the MSW stream that can be recycled
- recycling services for a range of materials in different waste streams
- organics processing
- Alternative Waste Treatment (AWT) facilities, and
- landfill facilities.

The data used in the figures and tables presented in this chapter have been drawn from a range of sources and they represent the best available information at the time the report was compiled.

The reader is asked to note, however, that there are some significant differences between jurisdictions in terms of definitions, classifications and approaches to waste data. Comparisons between jurisdictions should be made with caution. As this is the first National Waste Report, it is expected that data will become more comprehensive, accurate and comparable over time.

Chapter 2.10 describes the mixes of materials found within the MSW, C&I and C&D waste streams in Australia. Where data are available, information is presented about the materials that comprise the waste that is generated, recycled and disposed to landfill.

CHAPTER 2.1
NATIONAL

This chapter presents a range of data on national waste and recycling, estimates growth in waste generation to 2020–21, and provides waste generation, recycling and disposal to landfill rates for each jurisdiction. It provides a combined metric for waste generation and recycling and, for the first time, maps Australian landfills and what can be recycled where.

The data used in the figures and tables presented in this chapter have been drawn from a range of sources and they represent the best available information at the time the report was compiled. The reader is, however, asked to note that there are some significant differences between jurisdictions in terms of definitions, classifications and approaches to waste data. Comparisons between jurisdictions should be made with caution. As this is the first National Waste Report, it is expected that data will become more comprehensive, accurate and comparable over time.

Waste policy in each jurisdiction is anchored in the 1992 Council of Australian Governments' (COAG) National Strategy for Ecologically Sustainable Development (NSESD) which agreed the national approach to waste minimisation and management:

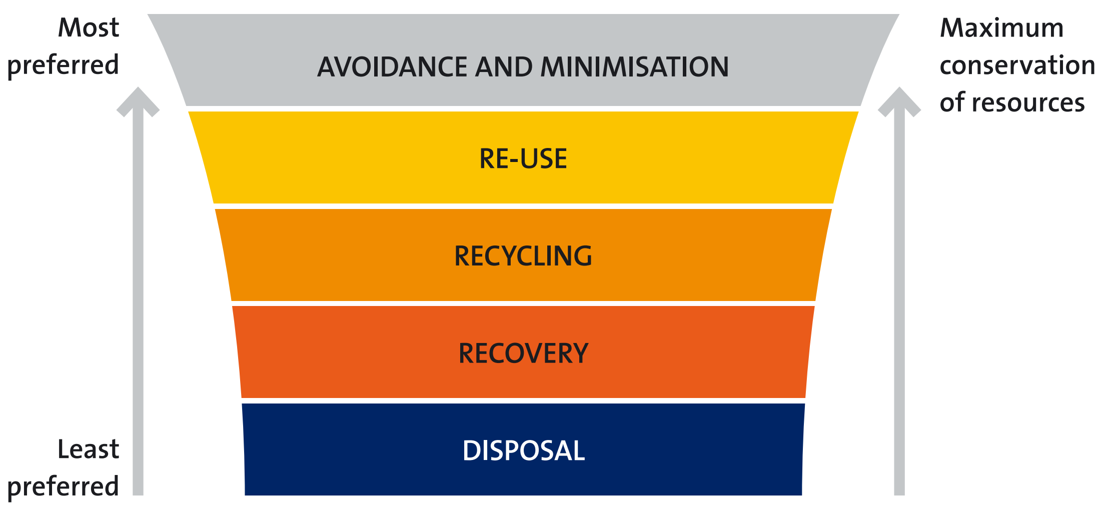
> to improve the efficiency with which resources are used and reduce the impact on the environment of waste disposal, and to improve the management of hazardous wastes, avoid their generation and address clean-up issues.[1]

Following the 1992 agreement, all jurisdictions established comprehensive legislative and policy instruments to protect the environment and conserve natural resources. Many of these instruments reference the 'waste hierarchy' (see **Figure 2.1**) a list of strategies with waste avoidance as the highest preference, then minimisation, re-use, recycling and re-processing, with the last being disposal. Recent updates to state policies and legislation focus even more strongly on resource recovery and avoidance.

Details of relevant policies and legislation for each jurisdiction are in **Chapter 4.4**.

This first National Waste Report focuses on presenting waste generation, recycling and landfill disposal for each jurisdiction, as waste avoidance, minimisation and re-use are difficult to quantify. If data become available, future reports may broaden in scope to also cover these elements of the waste hierarchy.

Figure 2.1: Waste hierarchy



National waste and recycling

In 2006–07, Australia generated 43 777 000 tonnes of waste in the municipal solid waste (MSW), commercial and industrial waste (C&I), and construction and demolition waste (C&D) streams. Of that waste, 22 707 000 tonnes (52%) were recycled, with 21 069 000 tonnes (48%) sent to landfill.

In 2002–03, Australia generated 32.4 million tonnes of waste. In the period to 2006–07, national waste generation increased by 35%.

Some of this increase can be attributed to better data collection for the same time period and to expanded coverage of generation data (especially in Tasmania, the NT and non-metro WA). Correcting for these factors, the generation of waste in Australia increased by 31% between 2002–03 and 2006–07.*

Trends and scenarios

Simple projections of growth in waste generation, recycling and landfill disposal to 2020–21 show that Australians will

* generate 81 072 593 tonnes of waste
* recycle 52% of that waste (42 157 748 tonnes), and
* send 48% to landfill (38 914 845 tonnes).

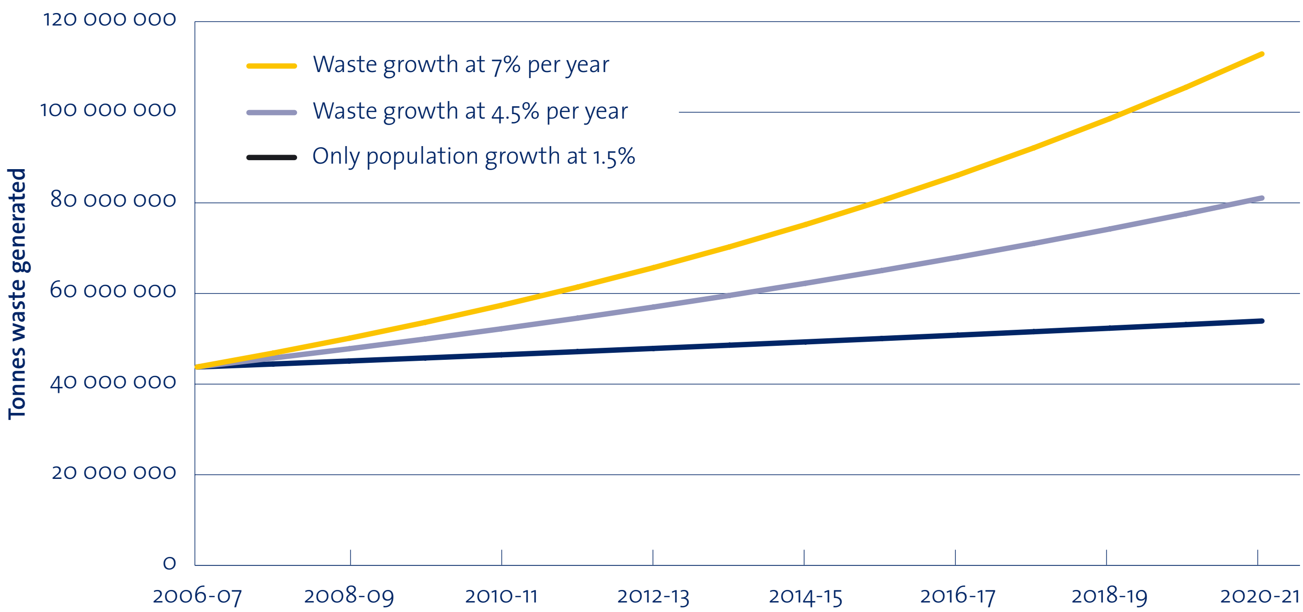
These projections are based on growth in generation of 4.5% per annum (including the contribution from 1.5% a year population growth), and maintenance of the 2006–07 recycling rate (52% recycling). The simple projections do not factor in potential variations in economic growth over the period, nor the achievement of recycling or waste minimisation targets which some jurisdictions have, and which would increase diversion rates. More complex projections from states and territories that take these factors into account are at **Appendix D**.

As seen in **Figure 2.2**, if growth in waste generation can be held to 1.5% a year (the rate of expected population growth), then 2020–21 waste generation would be 53 922 571 tonnes for that year. The medium-growth path for generation (4.5% per year), has 2020–21 waste generation at 81 072 593 tonnes. The difference, for 2020–21, between a low-growth scenario and a medium-growth pathway is 27 150 022 tonnes. That difference is 62% of current (2006–07) waste generation.

If growth continues on the trajectory followed between 2002–03 and 2006–07, which is 7% per year, then in 2020–21 Australia will generate

* This correction is based on excluding WA, Tasmania and the Northern Territory from the 2002–03 and 2006–07 comparisons. The increase in waste generation was 8.968 million tonnes.

Figure 2.2: Comparative waste generation scenarios, 2006–07 to 2020–21[2]



112 880 489 tonnes of waste. The difference between this and the low growth pathway is 58 957 918 tonnes of additional generation in 2020–21, which is a difference of 135% on current (2006–07) generation.

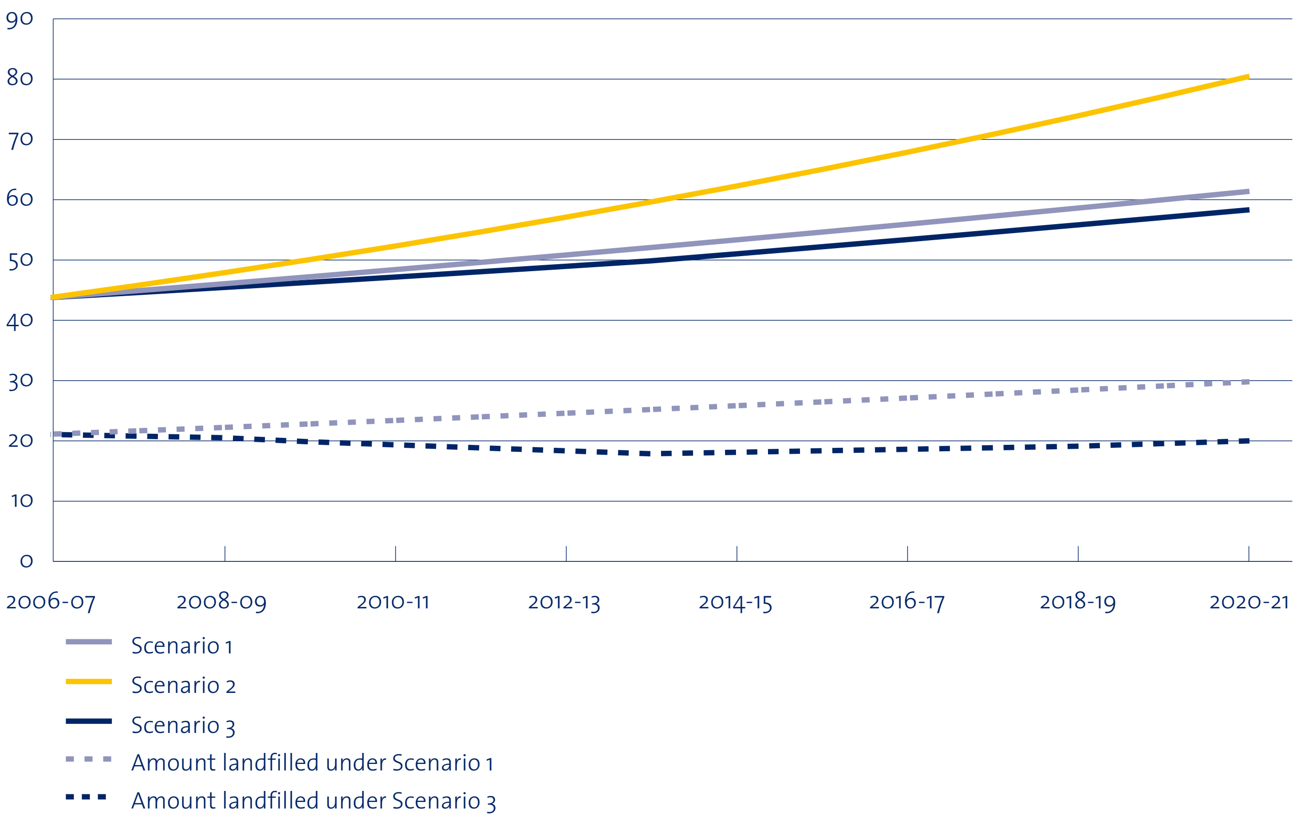
These expanding volumes of waste will increase demands for new recycling and landfill infrastructure, as well as increase potential emissions of greenhouse gases. Infrastructure needs issues are discussed in **Chapter 4.7** of this report. Landfill gas generation and capture issues are addressed in **Chapter 3.1**.

To better understand the nature of possible future infrastructure demands, three waste scenarios were modelled for the period from 2006–07 to 2020–21. The three scenarios, covering MSW, C&I and C&D waste where data were available, are:

- **Scenario 1:** population growth plus low additional waste generation (1% p.a.) and a 'business-as-usual' recovery rate of 51.5%
- **Scenario 2:** population growth plus higher additional waste generation (3% p.a.) and a 'business-as-usual' recovery rate of 51.5%
- **Scenario 3:** jurisdictions' existing strategies and targets for waste reduction and increased recovery are achieved for the period from the end of FY 2006–07 to the end of FY 2020–2021. It should be noted that the time frame of the assessment varies from existing jurisdictional strategic plans, as jurisdictional assessments are mostly in the 2014 or 2015 time frame.

The national figures are presented in **Figure 2.3**. Due to an absence of data, the C&I projection excludes recycling data from the Northern Territory and the C&D projection excludes recycling data from Tasmania and the Northern Territory. Further information for each waste stream is at **Appendix D** along with information on the methodology for the scenarios.

Figure 2.3: Australia—total projected waste generation and landfill scenarios, 2006–07 to 2020–21



The results indicate that waste generation, in total and for each of the three waste streams, increases under all scenarios over the period to 2020–21, growing by over 130% under Scenario 2. Scenario 3 indicates that jurisdictional targets and strategies will hold waste generation levels to below population growth plus 1% (Scenario 1).

State waste strategies and targets are predicted to have a greater impact on reducing the amount of waste disposed to landfill from 2012, particularly for the MSW stream. Such predictions are based on an expectation that increased recycling and re-processing will occur.

Waste generation, landfill and recycling by stream

The three streams (MSW, C&I and C&D) do not operate in identical ways. Different points of generation, materials, supply chains, service providers, infrastructure, institutional arrangements and regulations apply across the three streams. Later sections of this report describe these differences in more detail. **Figures 2.4**, **2.5** and **2.6** show the contributions each stream makes to generation, landfill disposal and recycling.

Of the 43 777 000 tonnes of waste generated in 2006–07, the C&D waste stream contributed the largest share at 38%.

Recycling accounted for 22 707 000 tonnes or 52% of total waste generated. As **Figure 2.5** shows, the C&D waste stream contributed the largest share at 42%.

The gap between percentage of total generation and percentage of total recycling indicates further recovery opportunities. These are greatest for the MSW stream which contributed 29% of total generation but only 22% of total recycling.

Total waste disposed to landfill in 2006–07 was 21 069 000 tonnes. At the national level the three waste streams contributed approximately one third each of the flow of waste to landfill in Australia for 2006–07.

Figure 2.4: Australia—waste generation apportioned by source, 2006–07

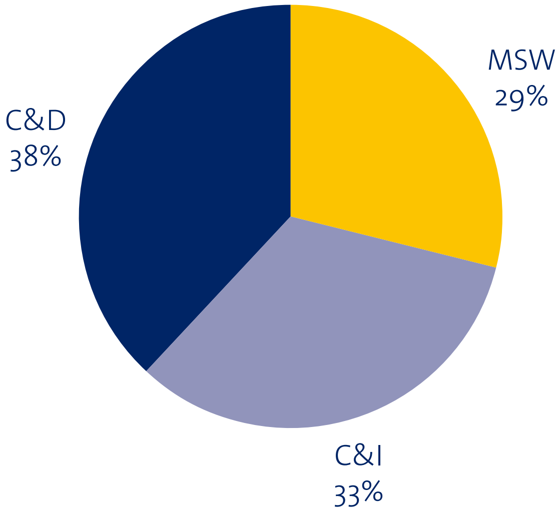


Figure 2.5: Australia—recycling apportioned by source, 2006–07

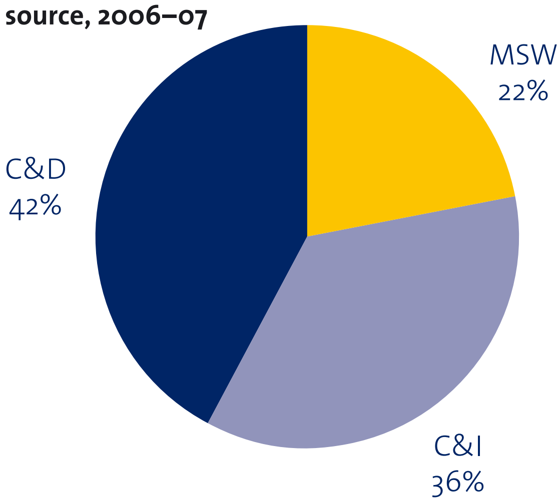


Figure 2.6: Australia—waste to landfill apportioned by source, 2006–07

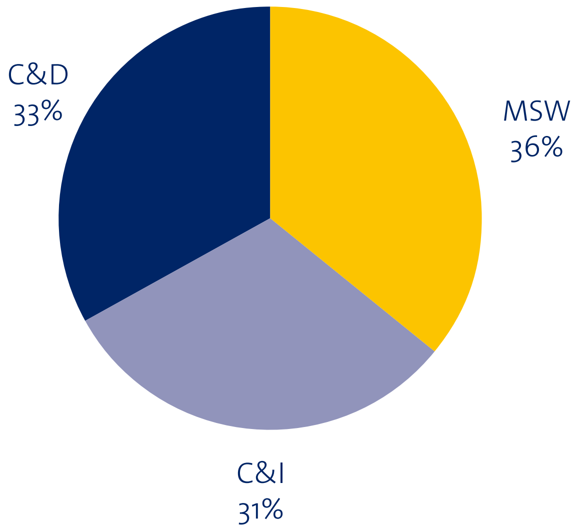


Figure 2.7 shows a breakdown of recycling by waste stream and jurisdiction. Nationally, recycling rates within each stream in 2006–07 were

- municipal solid waste (MSW)—40%
- commercial and industrial waste (C&I)—56%, and
- construction and demolition waste (C&D)—58%.

Recycling rates for each stream within individual jurisdictions can differ markedly from each other, and from the national average.

These differences are the product of many factors, including the presence or absence of recycling infrastructure, the viability of end markets for recovered resources (which exert a 'pull' on recycling), transport distances, information and awareness, social or cultural factors (such as contamination of recyclables with landfill waste, or vice versa) and policy settings. Differences in jurisdictional definitions and methods for measuring and/or calculating recycling can also be significant, so caution should be applied if undertaking comparisons.

Elements of current national generation and diversion of waste from landfill

Detailed breakdowns of waste generation and diversion rates for states and territories are set out in **Tables 2.1 to 2.4**. Information is presented for the three main solid waste streams—MSW, C&I and C&D.

There are large amounts of other wastes in Australia that are generally not included in these three waste streams. For example, liquid and gaseous wastes, agricultural wastes, some hazardous wastes, mining wastes, waste fly-ash from power stations and radioactive wastes are generally not included in the MSW, C&I and C&D streams.

There are also differences between jurisdictional definitions, classifications and methodologies for measuring waste data which may also cover different materials. For example, sewage sludge and biosolids are included in some jurisdictional tallies of MSW and C&I waste, but not in all. Figures are also influenced by collection arrangements—for example the inclusion of house renovation waste in the C&I sector or waste from small to medium enterprises in the MSW sector. For these reasons, comparisons among these data may be inappropriate and should only be made with caution.

Figure 2.7: Australia—percentage of each waste stream that is recycled, 2006–07

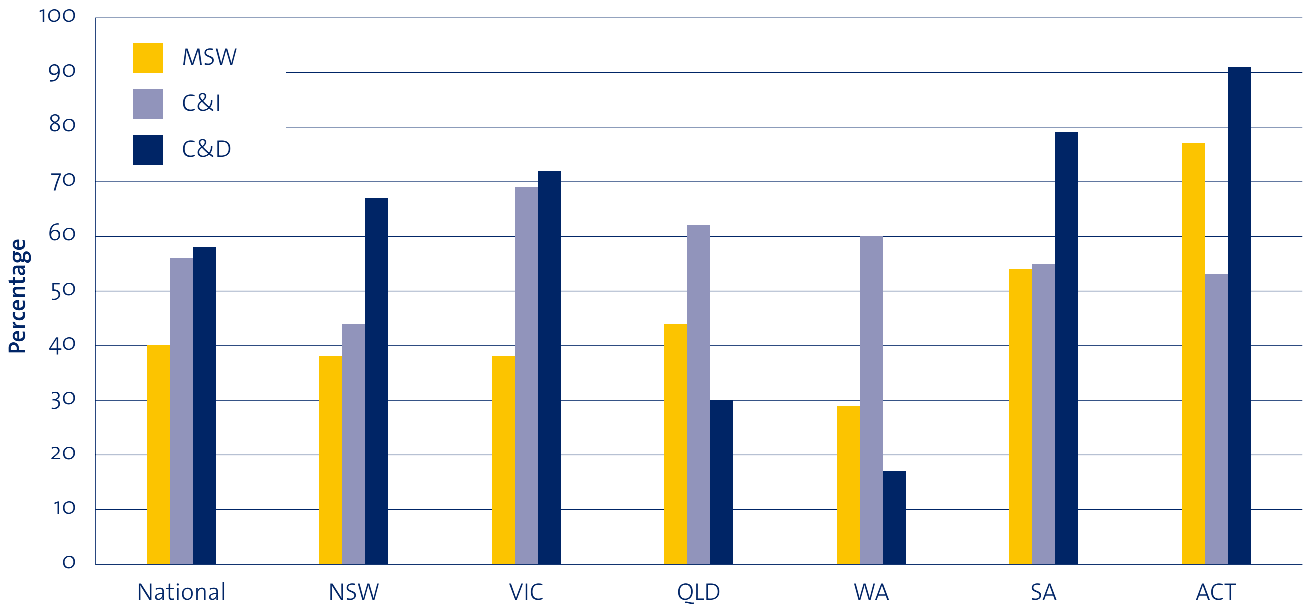


Table 2.1 shows that at a national level, Australia diverts around 52% of waste from landfill and that the diversion rate for individual states and territories varies considerably, from 33% in WA to 75% in the ACT.

Table 2.1: Estimated waste generation and diversion rates, 2006–07[3]

State/territory	Total generated	Recycled	Disposed	Diversion rate
NSW	15 360 000	7 995 000	7 365 000	52%
Vic	10 285 000	6 360 000	3 925 000	62%
Qld	8 081 000	3 779 000	4 302 000	47%
WA	5 247 000	1 708 000	3 539 000	33%
SA	3 318 000	2 173 000	1 144 000	66%
Tas	521 000	75 000	446 000	Unknown
ACT	784 000	587 000	197 000	75%
NT	181 000	30 000	151 000	Unknown
Total	43 777 000	22 707 000	21 069 000	52%

Note 1: Gaps in the Tasmanian and Northern Territory recycling data for MSW, C&I and C&D waste mean that it is not possible to provide diversion rates for these jurisdictions. NT data are for Darwin City Council's MSW, and the 30 000 recycling figure is the quantity of green waste generated in cubic metres.

Note 2: New data for the Northern Territory for the period 2006–07 were identified in November 2009 but time did not allow these data to be incorporated into this document. The new data show that total waste generated in the NT was 374 000 tonnes, waste disposed was 361 000 tonnes and waste recycled was 13 000 tonnes (all of which were derived from MSW and exclude listed wastes).

Note 3: Figures for Victoria represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. These figures from Victoria were calculated by taking the tonnes of material received at landfills (including cover material sourced off-site) and reducing this by 15% to allow for cover material. Likewise, data for cover fill are excluded from figures for Tasmania.

Note 4: Figures for the amount of waste disposed in ACT landfills includes municipal waste from Queanbeyan (NSW) and may include wastes from the surrounding region.

An examination of generation data (**Table 2.2**) reveals that C&D activities contribute the greatest overall amount of waste—16 517 000 tonnes or 38% of the national total. This pattern is not uniform amongst jurisdictions, with Queensland, the ACT, Tasmania and the NT each generating more MSW than C&D waste.

The C&D stream also makes the greatest contribution (42%) to the total amount of waste recycled (**Table 2.3**). Again, individual jurisdictions have divergent patterns, with NSW, Victoria and SA recycling most material from the C&D stream, Queensland and WA primarily recycling C&I materials and the ACT recycling more municipal solid waste than from other streams.† There are insufficient data to determine the recycling pattern for Tasmania or the NT.

By contrast, Australia disposed more waste to landfill from municipal activities than the other two waste streams (**Table 2.4**). This was also the case for Victoria, Queensland and Tasmania while NSW, SA, the ACT and the NT disposed of more C&I material to landfill. For WA, the greatest amount of material disposed to landfill was from the C&D stream.

† The ACT also has a high diversion rate (91%) of C&D waste from landfill, though it records a greater total weight of MSW diverted than of C&D waste.

Table 2.2: Amounts of waste generated, by jurisdiction and stream, 2006–07

	Generated (tonnes)			
Jurisdiction	MSW	C&I	C&D	Total
NSW	3 891 000	5 218 000	6 251 000	15 360 000
Vic	2 783 000	3 417 000	4 084 000	10 285 000
Qld	3 100 000	2 898 000	2 083 000	8 081 000
WA	1 424 000	1 476 000	2 348 000	5 247 000
SA	753 000	1 106 000	1 460 000	3 318 000
ACT	363 000	194 000	227 000	784 000
Tas	340 000	167 000	14 000	521 000
NT	74 000	57 000	51 000	181 000
Australia	12 727 000	14 532 000	16 517 000	43 777 000

Table 2.3: Amounts of waste recycled, by jurisdiction and stream, 2006–07

	Recycled (tonnes)			
Jurisdiction	MSW	C&I	C&D	Total
NSW	1 483 000	2 297 000	4 216 000	7 995 000
Vic	1 056 000	2 357 000	2 946 000	6 360 000
Qld	1 365 000	1 797 000	617 000	3 779 000
WA	408 000	891 000	409 000	1 708 000
SA	408 000	610 000	1 155 000	2 173 000
ACT	278 000	102 000	206 000	587 000
Tas	53 000	22 000	Unknown	75 000
NT	30 000	Unknown	Unknown	30 000
Australia	5 082 000	8 076 000	9 549 000	22 707 000

Note 1: NT data are for Darwin City Council's MSW and the 30 000 recycling figure is the quantity of green waste generated in cubic metres. A revised figure of 13 000 tonnes for recycled municipal waste for the NT as a whole was provided in November 2009.

Note 2: ACT data for recycling are not collected via waste streams. The relative contribution between streams is an estimate.

Table 2.4: Amounts of waste landfilled, by jurisdiction and stream, 2006–07

	Landfill (tonnes)			
Jurisdiction	MSW	C&I	C&D	Total
NSW	2 408 000	2 921 000	2 036 000	7 365 000
Vic	1 727 000	1 060 000	1 138 000	3 925 000
Qld	1 735 000	1 101 000	1 466 000	4 302 000
WA	1 015 000	585 000	1 939 000	3 539 000
SA	344 000	496 000	304 000	1 144 000
ACT	85 000	91 000	21 000	197 000
Tas	287 000	145 000	14 000	446 000
NT	44 000	57 000	51 000	151 000
Australia	7 645 000	6 456 000	6 968 000	21 069 000

Note: Figures for Victoria represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. These figures from Victoria were calculated by taking the tonnes of material received at landfills (including cover material sourced off site) and reducing this by 15% to allow for cover material.

Per capita waste generation, diversion and landfill disposal

As the states and territories have different population sizes, patterns of settlement and mixes of industry, taking a per capita approach can provide a clearer picture of waste generation, recycling and disposal to landfill. **Table 2.5** shows how much waste was generated, recycled and disposed per person in NSW, Victoria, Queensland, WA, SA and the ACT for 2006–07, in kilograms. Comparable data for Tasmania and the Northern Territory are not available. It illustrates that population is not an accurate indicator of generation or recycling rates.

Table 2.5: Australia—kilograms of waste generated, recycled and landfilled, per person, 2006–07

Jurisdiction	Total generated	Recycled	Disposed	Diversion rate	Population and % of total population
	Kilograms per capita				
NSW	2230	1160	1070	52%	6 888 000 (37%)
Vic	1980	1220	750	62%	5 205 000 (28%)
Qld	1930	900	1030	47%	4 181 000 (20%)
WA	2490	810	1680	33%	2 106 000 (10%)
SA	2090	1370	720	66%	1 584 000 (8%)
ACT	2310	1730	580	75%	340 000 (2%)
Tas		Unknown			493 000 (2%)
NT		Unknown			215 000 (1%)
National average	2080	1080	1000	52%	21 015 000

Note 1: Insufficient data on recycling and generation were available for Tasmania and the Northern Territory (NT) at the time the Hyder Report *Waste and Recycling in Australia* was compiled in 2008 and then revised in 2009. New data for the NT for the period 2006–07 were identified in November 2009 but time did not allow these data to be incorporated into this document. The new data show that per person total waste generated in the NT was 1740 kilograms with 1680 kg disposed to landfill and 60 kg recycled, giving a diversion rate of 3.5 per cent.

Note 2: Figures for Victoria represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. These figures from Victoria were calculated by taking the tonnes of material received at landfills (including cover material sourced off site) and reducing this by 15 per cent to allow for cover material.

Note 3: ACT waste generated and disposed includes municipal waste from Queanbeyan. If the Queanbeyan population is included, then per capita waste generation for the ACT would be less than 2310 kg per person.

Waste generation per person

Figure 2.8 shows the waste generated per person in NSW, Victoria, Queensland, WA, SA and the ACT for 2006–07, in kilograms. Comparable data for Tasmania and the NT are not available. A breakdown by waste stream is shown at **Figure 2.9**.

Recycling per capita

Figures 2.10 and **2.11** show how much material was recycled per person in NSW, Victoria, Queensland, WA, SA and the ACT for 2006–07, in kilograms. Comparable data for Tasmania and the NT are not available.

Figure 2.8: Kilograms of waste generated, per person, 2006–07

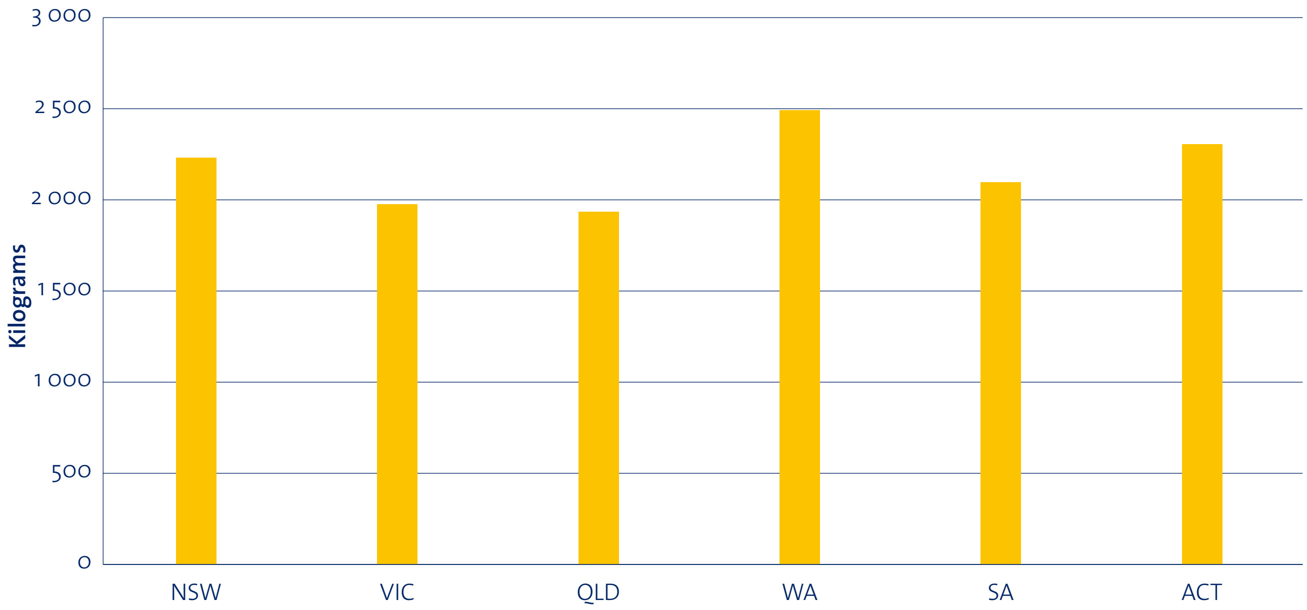


Figure 2.9: Kilograms of waste generated in each waste stream, per person, 2006–07

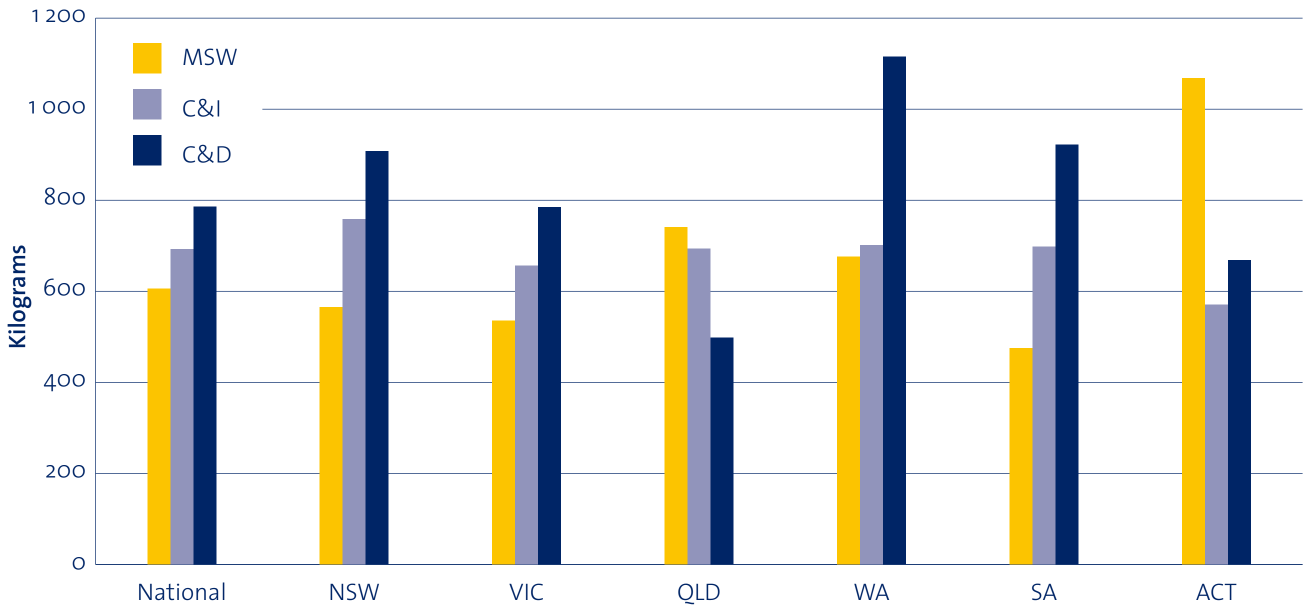


Figure 2.10: Kilograms of waste recycled, per person, 2006–07

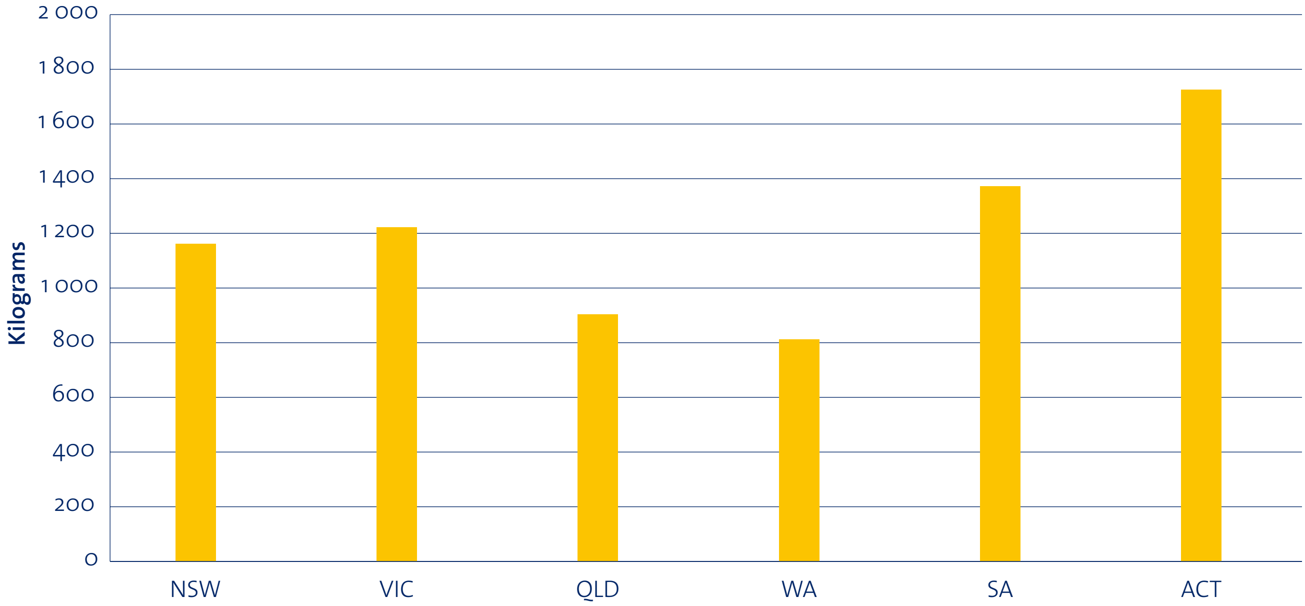
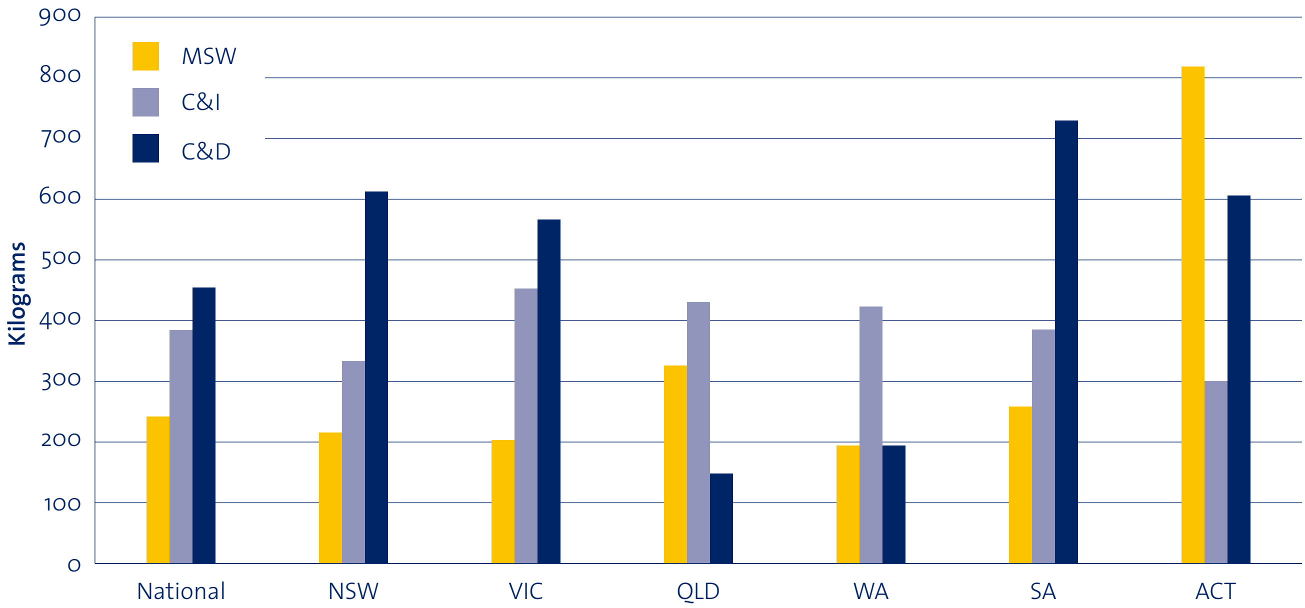


Figure 2.11: Kilograms of waste recycled from each waste stream, per person, 2006–07



Combining waste generation and recycling rates

Recycling activity is one of several key indicators used to highlight the interplay between different waste management strategies. Other possible indicators include waste generation and elements of the waste hierarchy, such as waste minimisation, re-use, resource recovery (particularly energy recovery) and landfill disposal.

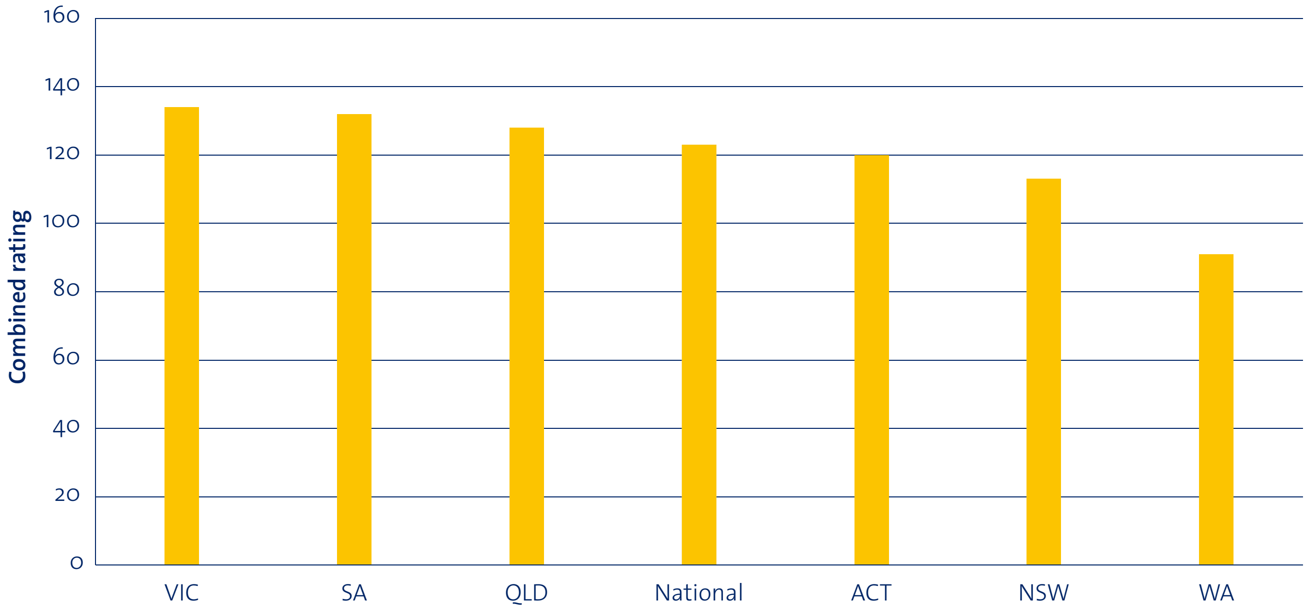
Figure 2.12 combines two possible indicators, waste generation and recycling, into a single indicator. To generate this combined rating, per capita annual waste generation in kilograms and jurisdictional recycling rates were each given a score. Generation rates were plotted in 100 kg bands across a 200 point scale, while recycling rates were plotted in bands of 5% on a 50 point scale.[‡] The resulting two scores were combined to produce a final rating. A larger number for a final rating reflects a better combined performance on waste generation and recycling. This is the first time such a rating has been developed. The results should not be used to compare jurisdictions especially given the variable robustness and lack of comparability of some of the source data.

This graph illustrates the dynamic between waste generation and recycling. For example, while the ACT had the highest recycling rate of the jurisdictions (75%) in 2006–07, it generated 2310 kg per year of waste, second only to WA.[§] Combining the waste generation and recycling indicators, provides a different perspective on waste management strategies. Tasmania and the NT have been excluded from these calculations, and from the chart, as sufficient generation and recycling data for these jurisdictions are not available. Further work and discussion of such an approach is needed to determine the validity of combined metrics such as the one described.

‡ The approach to weighting the reduction in waste generation more highly than recycling was taken on the basis of the rationale implicit in the Waste Hierarchy, that it is better to reduce waste generation than to simply continue generating more waste and seeking to divert or recycle that waste. The combined rating for waste generation and recycling was developed by the Department of the Environment, Water, Heritage and the Arts for the National Waste Report.

§ ACT waste generated and disposed includes municipal waste from Queanbeyan (NSW). If the Queanbeyan population is included, then per capita waste generation for the ACT would be less than 2310 kg per capita.

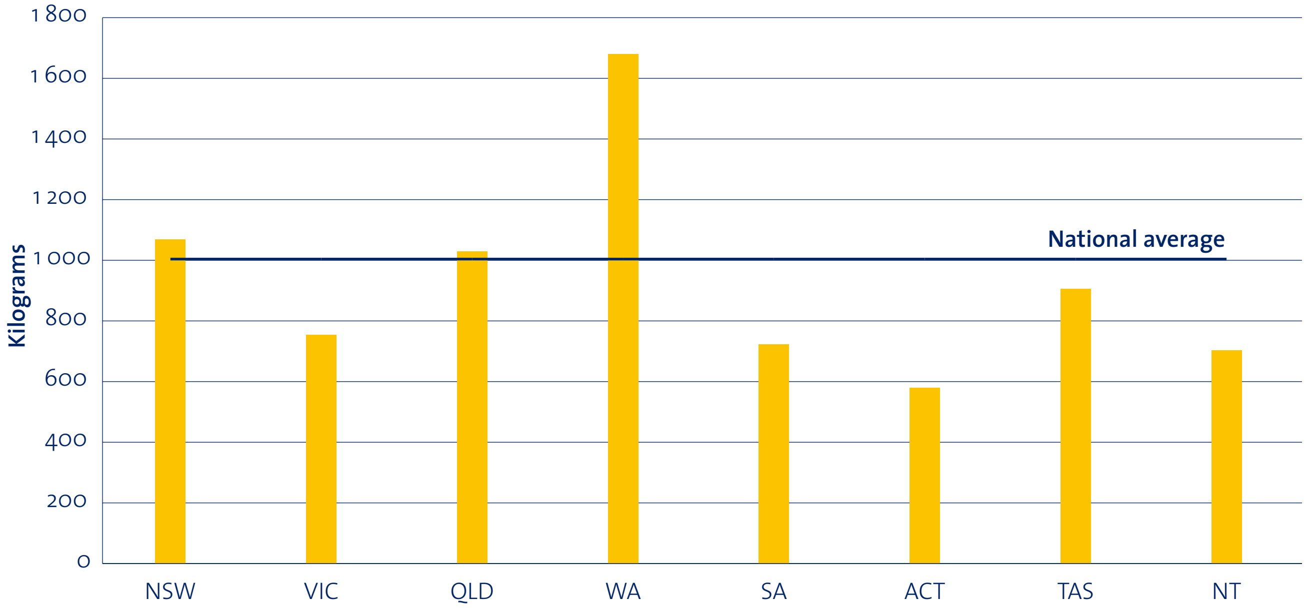
Figure 2.12: Combined waste generation and recycling rates, 2006–07



Landfill per person

Per capita amounts of waste sent to landfill for the 2006–07 year vary considerably across the states and territories. **Figure 2.13** shows the amount landfilled per capita in the jurisdictions, with the horizontal line indicating the national average of 1003 kg per capita per annum sent to landfill. **Figure 2.14** shows the per capita amount by source.

Figure 2.13: Kilograms of waste landfilled per person, 2006–07



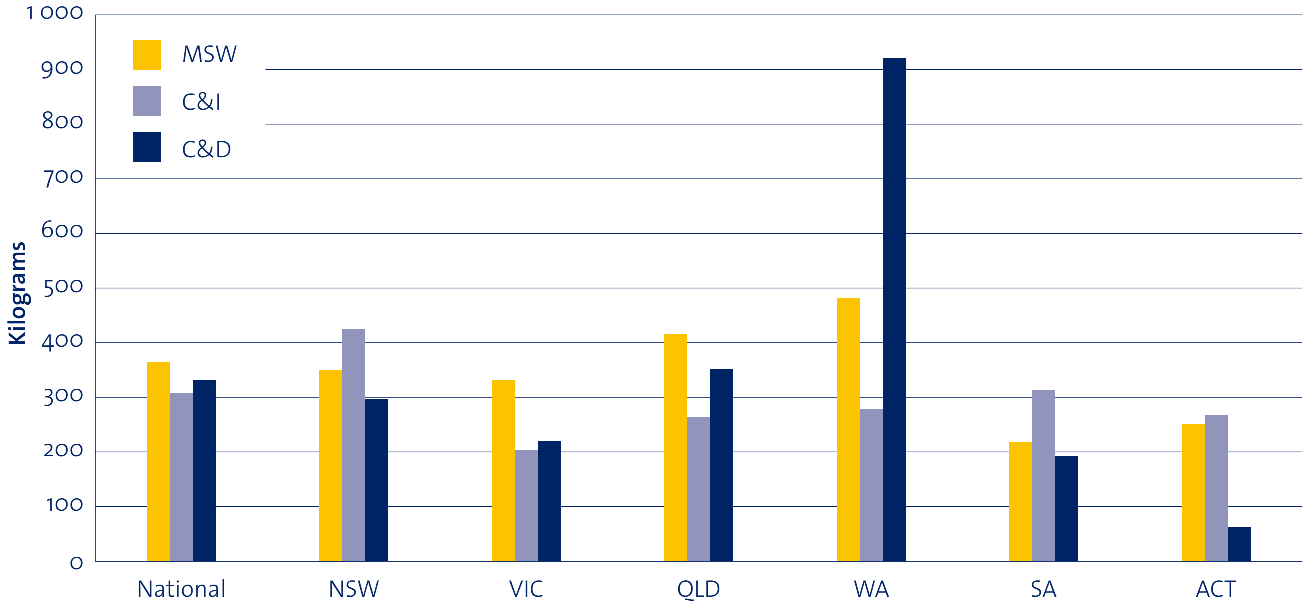
The jurisdiction sending the least amount of waste to landfill per capita was the ACT, with 579 kg per capita landfilled. The jurisdiction sending the most waste to landfill in per capita terms was WA, which landfilled 1680 kg of waste per person.

Factors influencing the ACT rate of landfill per person per year are:

- a relatively affluent and highly educated populace
- good levels of household recycling awareness and practice
- a very small industrial footprint
- established arrangements for collection and recycling of materials, including C&D wastes.

Western Australia data on waste-to-landfill per person are partly attributable to the greater flow of C&D wastes into WA landfills. C&D waste makes up 54% of the 2006–07 landfill disposal in WA, compared with a national average of 33%. The ACT recycling rate for C&D waste is 91%, while the national average is 58%, and WA's recycling rate is 17%.

Figure 2.14: Kilograms of waste landfilled from each waste stream, per person, 2006–07



Where are Australia's landfills?

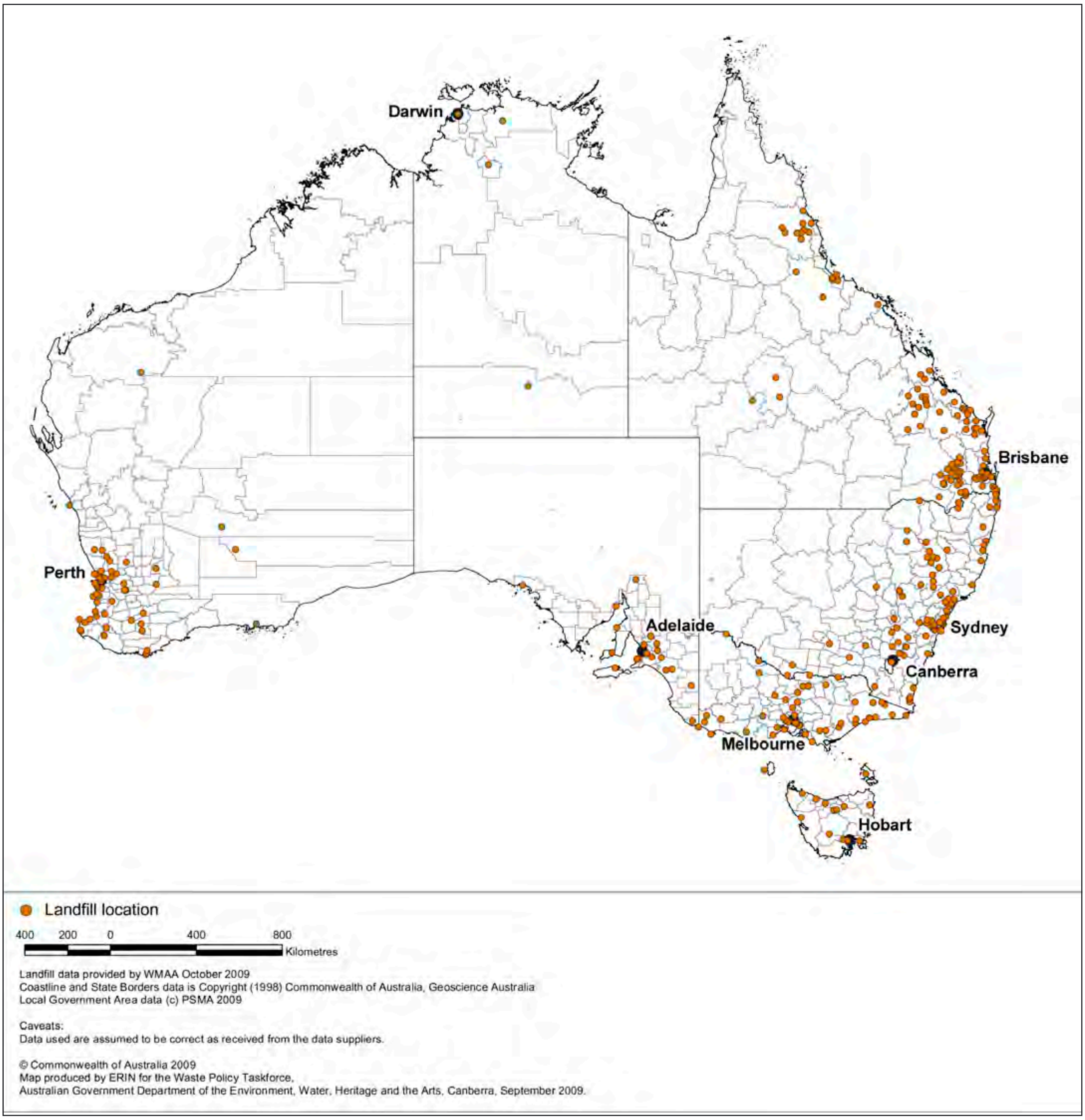
Using data from several sources, including surveys of landfills conducted by the Waste Management Association of Australia (WMAA), it is possible to map the location of operational landfill sites. **Figure 2.15** includes 282 of the estimated 665 operational landfills in Australia.

There is currently no set of comprehensive jurisdictional or national requirements for the public disclosure of landfill location, volumes, capacity, ownership, type, risk or operating performance. Only a small number of Australian landfill sites report to the National Pollutant Inventory (NPI), as many of them fall below NPI reporting thresholds.[¶] The landfill mapping contained in this report is mainly based on data voluntarily disclosed by landfill owners or managers.

In some jurisdictions, the public reporting of landfill data, including location, name, ownership, type and tonnage, is commercially sensitive and not disclosed publicly.

¶ The NPI is a national website that publicly reports substances emitted (such as to air and water) from facilities above particular threshold points. See www.npi.gov.au for more.

Figure 2.15: Australia—landfills operating in 2009—location map



National landfill gas and gas capture

As organic material decomposes in landfills, it releases methane, a greenhouse gas at least 21 times more potent than carbon dioxide. As well as avoiding putting organic wastes into landfills, several options exist to reduce or negate the environmental impact of landfill emissions of greenhouse gas. The main options involve landfill gas capture, from sites with liners and collection pipes, with collected gas being either flared (burnt) or used to generate electricity.

Table 2.6 sets out the national state of landfill gas capture in 2006–07, and projected performance in 2020–21. Further details on the sources, scope and methods used to produce these estimates of landfill gas production, collection and release to atmosphere can be found at **Appendix A**.

Table 2.6: Australia—landfill gas production, abatement and emissions, 2006–07 to 2019–20 (Mt CO_2-e)

	2006–07				2020–21			
	Landfill gas production	Landfill gas emissions to air	Abated	% Abated	Landfill gas production	Landfill gas emissions to air	Abated	% Abated
Australia	15 604	11 104	4500	29%	19 881	10 962	8919	45%
NSW/ACT	7034	4497	2537	36%	5800	3568	2232	38%
Vic	2602	2109	493	19%	4618	2706	1913	41%
Qld	2681	2503	178	7%	3824	2374	1450	38%
WA	2039	1094	945	46%	3893	1184	2709	70%
SA	820	594	226	28%	1181	781	399	34%
Tas	298	233	65	22%	391	234	157	40%
NT	131	74	57	43%	174	115	60	34%

Sources: NGGI and MMA analysis

Note: The abated amount is equal to methane recovered from flaring or landfill gas generation, plus methane avoided from waste diverted to waste-to-energy facilities (the latter applies to 2019–20 projections). The percentage abated is equal to the proportion of recovery from total methane emissions that would have occurred if there was no abatement.

As the table shows, there was a wide range of 2006–07 levels of abatement from capture of landfill gas. WA had the highest abatement, at 46%, with Queensland the least, at 7% abatement of landfill greenhouse gas emissions. The national rate was 29%. In considering the data for Queensland, recognition should be given to that state's focus on coal seam methane capture under greenhouse gas reduction targets and renewable energy certificate policies, which made investment in landfill gas less attractive.

The 2020–21 projections show the national landfill gas abatement rate lifting from 29% to 45%. This is due to both the increase in uptake of gas capture systems and the increasing shift of more waste flows into more recently-built landfill cells, which are more likely to have capture systems in place.

In 2006–07 Australia

- produced 743 kilograms per person of landfill gas emissions
- abated 214 kilograms per person (via gas capture, use in power generation, etc), and
- emitted 528 kilograms per person of landfill gas emissions to the atmosphere.

In comparison, 2007 production of landfill gas in the United States of America was 890 kilograms per person, abatement was 451 kilograms (51%), and emissions to atmosphere of landfill gas were at 439 kilograms per person (49%).

What can be recycled where?

While the national totals and the per capita recycling figures tell useful parts of Australia's waste story, it is important to note that within individual jurisdictions, including within capital cities, recycling arrangements are not uniform. Some Australians in some areas of major cities have less access to recycling than others, or can recycle through municipal collections a narrower range of materials than other residents living in different areas of the same city.

There are also considerable information gaps in relation to determining a national recycling picture, particularly for the C&I and C&D waste streams.

The following analysis focuses on MSW and uses data provided by Australian local governments to Planet Ark for the 'Recycling Near You' website and hotline.[**4] Industry and community-led initiatives are not included. National information is presented for a select group of recycled materials including paper and cardboard, plastics, glass, steel cans and batteries.

In South Australia, collection of beverage containers, including those made of plastic, glass, aluminium and liquid paperboard, is the subject of a legislated

** Planet Ark data identifies 673 local government areas. This figure differs from the current number of local governments due to recent amalgamations in some jurisdictions.

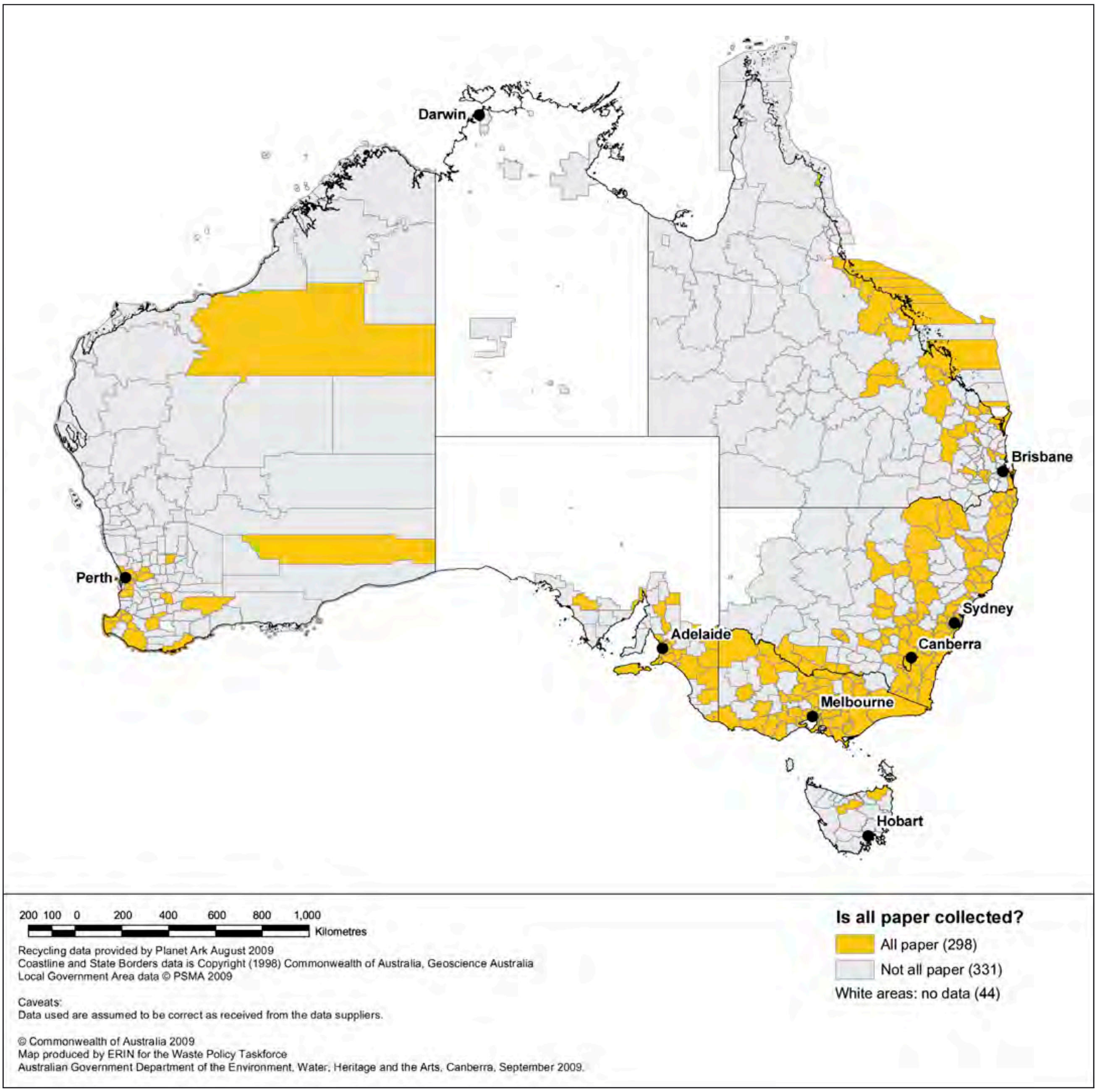
scheme and is less reliant on kerbside collections. **Figure 2.16** shows that of 673 local government authorities (LGAs) in Australia, 298 (44%) offer municipal recycling coverage of paper and cardboard, which can be considered best practice in municipal recycling materials coverage.

Figure 2.17 shows that of the 629 LGAs covered, 181 (29%) offer a municipal recycling service that can accept seven types of plastic (rigid, food-grade plastic types).

Figure 2.18 shows the extensive offering of municipal glass recycling services in Australia (63%).

Figure 2.19 shows the coverage of different steel can types in Australian municipal recycling services. Of 673 LGAs, 280 (42%) recycle the three main steel can types—food, paint and aerosol cans. There were 220 LGAs (33%) that reported no recycling of cans.

Figure 2.16: Australia—municipal recycling of paper and cardboard, by LGA



LGA collection of batteries (including drop-off services), shown in **Figure 2.20**, is scant in many parts of Australia. Types of batteries covered here include nickel cadmium, alkaline, nickel metal hydride, lithium, lithium-ion, carbon zinc and zinc chloride batteries. Of 629 LGAs, 76 or 12% offered a collection service for batteries. Batteries are one of several types of hazardous waste generated in Australia.

Figure 2.17: Australia—municipal recycling by types of plastic covered, by LGA

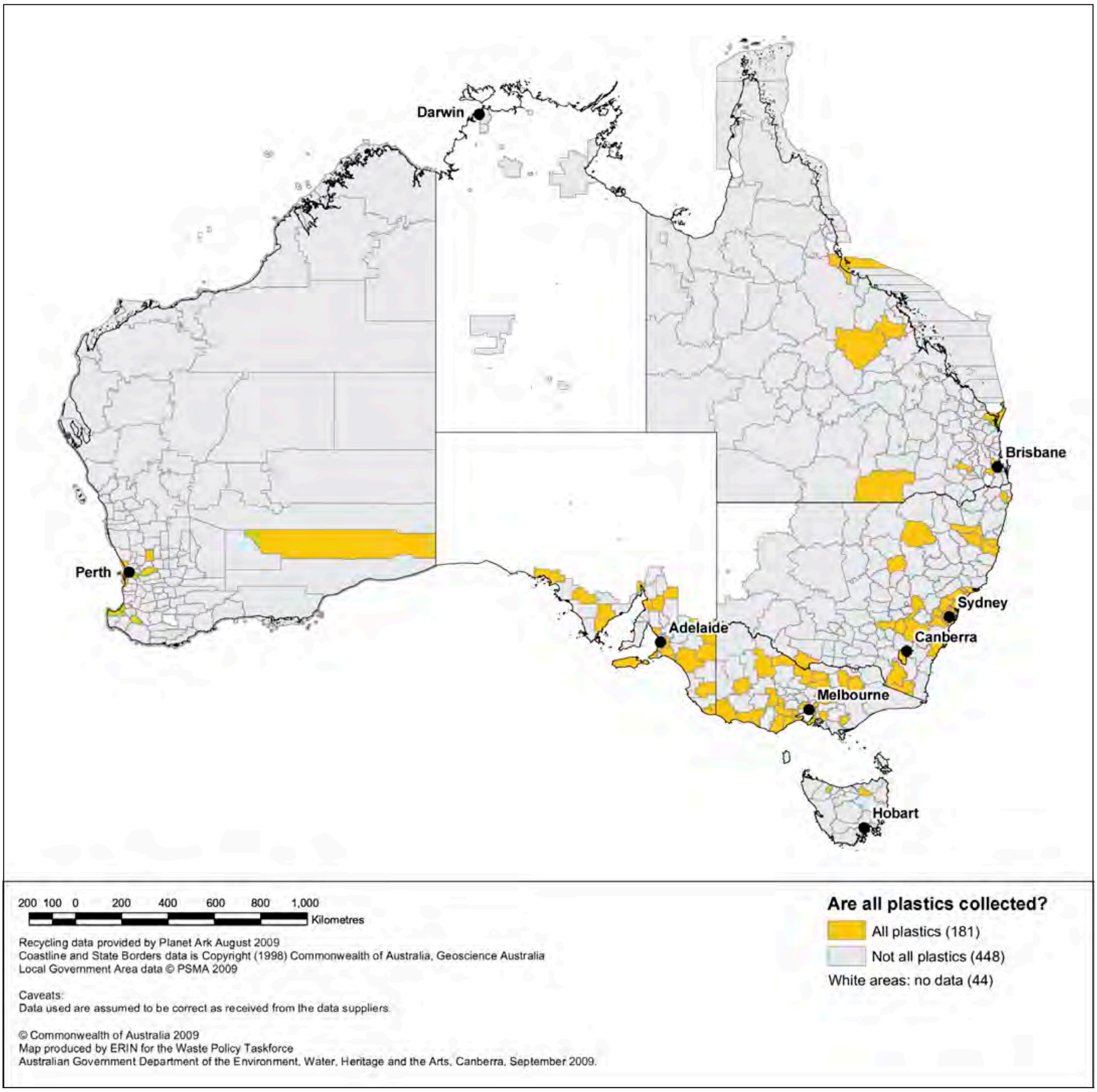


Figure 2.18: Australia—municipal recycling of glass, by LGA

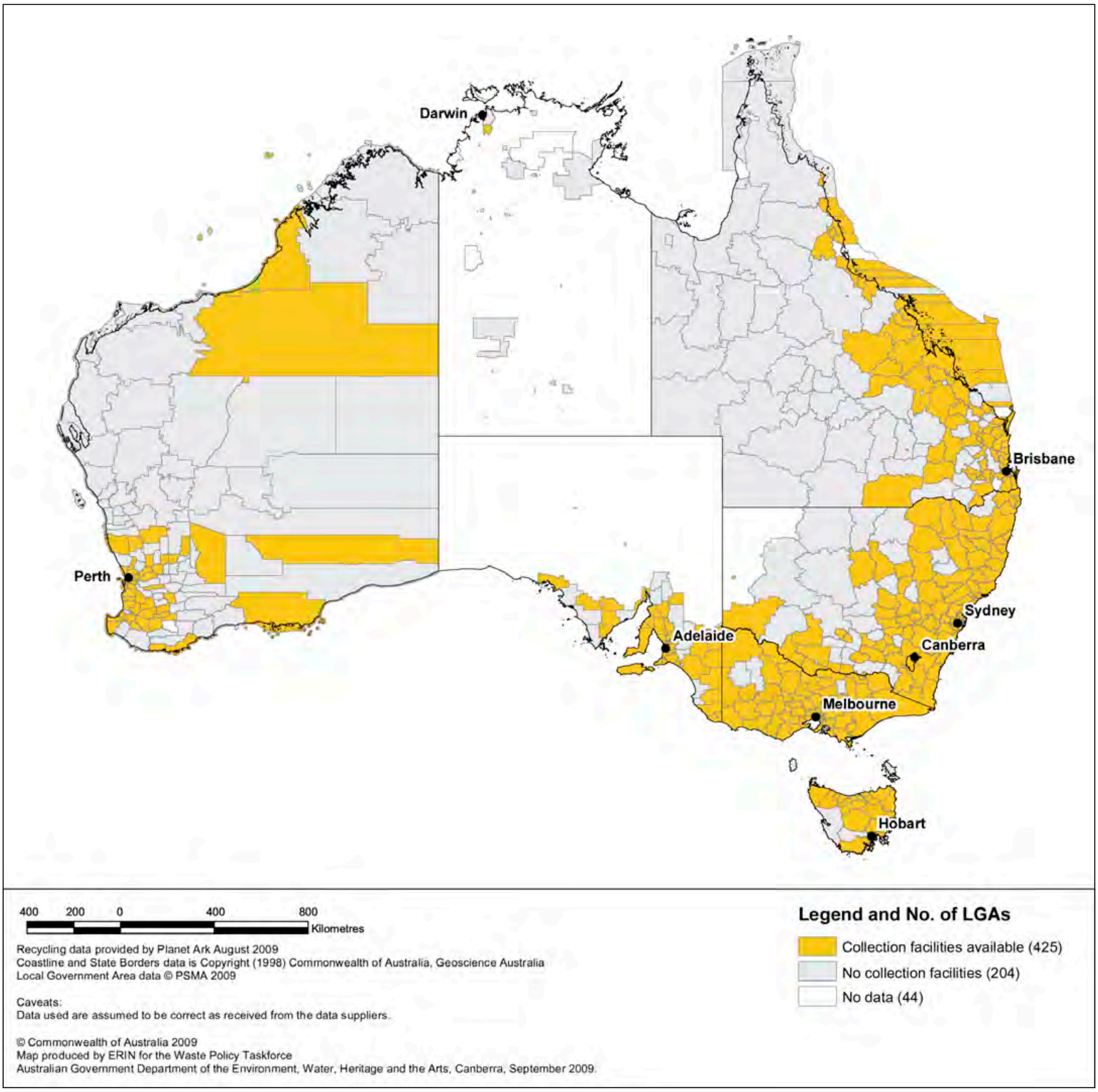


Figure 2.19: Australia—municipal recycling of steel cans, by LGA

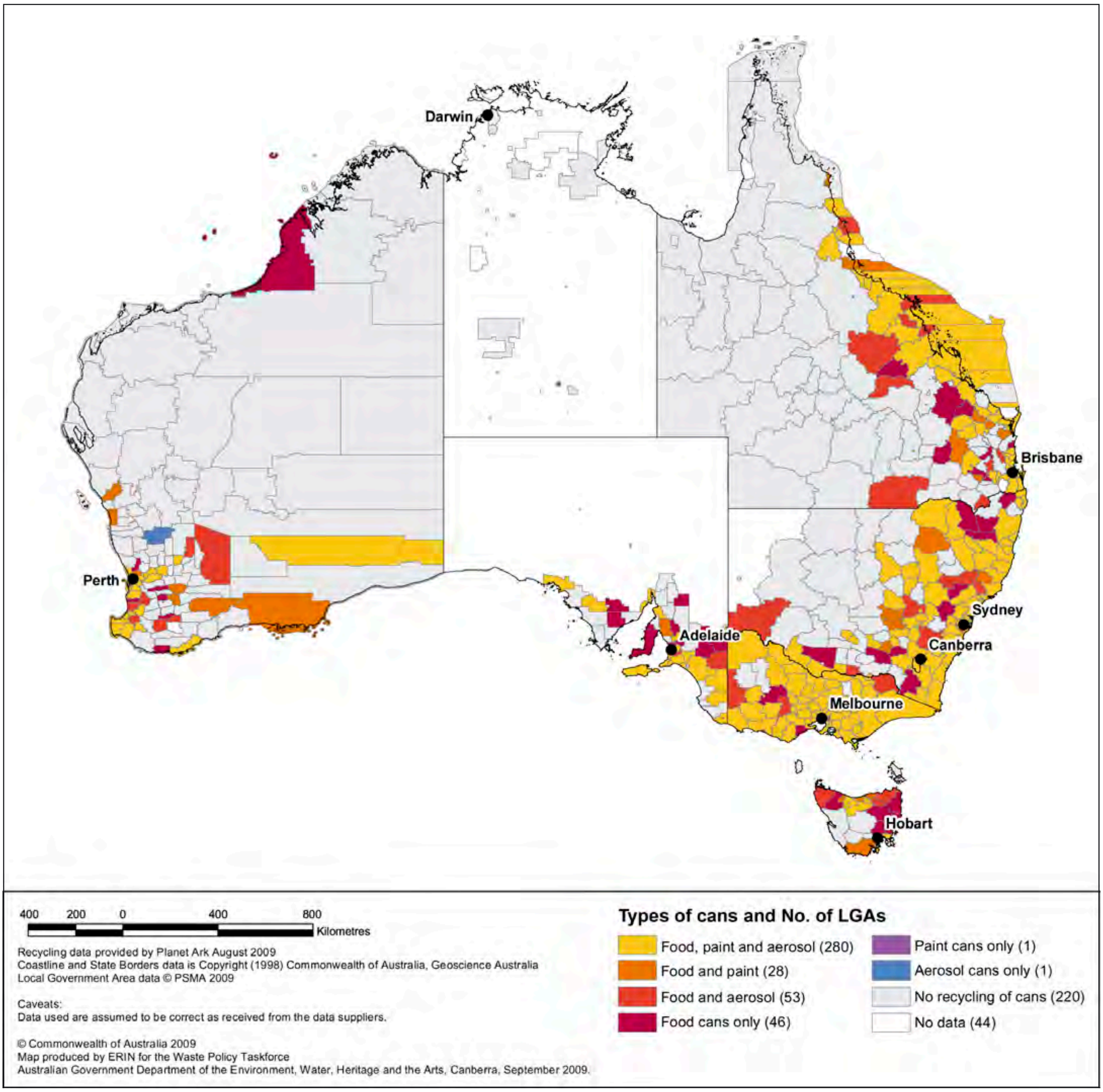
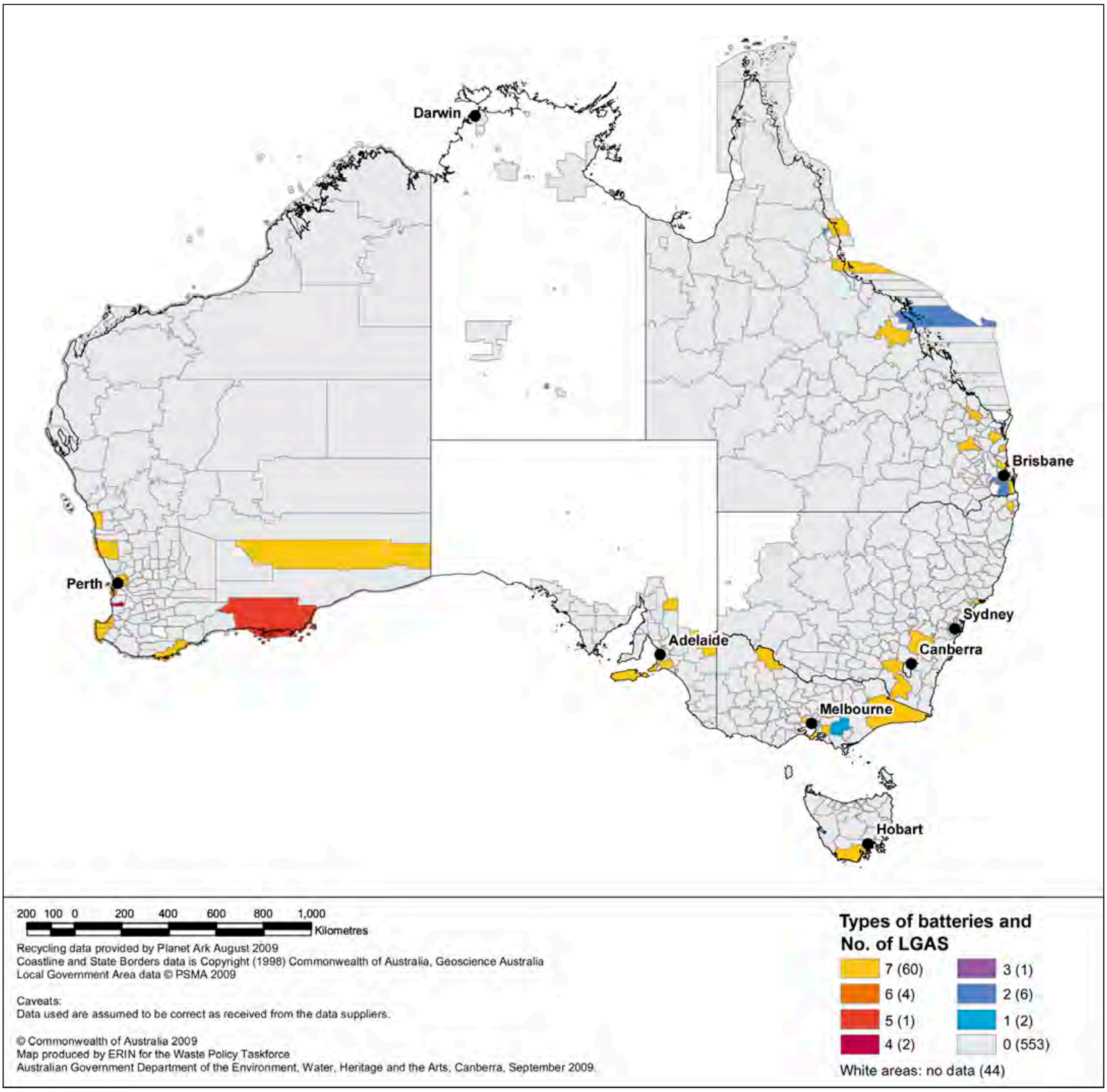


Figure 2.20: Australia—battery collection by councils



Endnotes

1 Council of Australian Governments, *National Strategy for Ecologically Sustainable Development*, part 3, chapter 19, 1992, <http://www.environment.gov.au/esd/national/nsesd/strategy/wastes.html>, accessed 1 February 2010.

2 Based on data in Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009.

3 Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009.

4 Data provided by Planet Ark to the Department of the Environment, Water, Heritage and the Arts, August 2009.

CHAPTER 2.2
NEW SOUTH WALES

New South Wales Government perspective

NSW has set ambitious resource recovery targets to be achieved by 2014, and recycling rates are increasing. The global financial crisis and its impact on recycling markets are expected to affect disposal and recovery rates. However, NSW still expects to achieve the targets. Targets and current performance are:

- a 66% target for municipal waste. Recovery increased from 30% in 2002–03 to 43% in 2007–08.
- a 63% target for commercial and industrial waste. Recovery increased from 34% in 2002–03 to 44% in 2006–07.
- a 76% target for construction and demolition waste. Recovery increased from 64% in 2002–03 to 67% in 2006–07.

These increases are being driven by a range of policies, regulations and programs, with the Waste and Environment Levy acting as a major driver of resource recovery investment in NSW. As the levy increases, it encourages waste generators to review their practices and makes recycling options more financially viable in comparison with landfill. Levy increases have driven, and continue to drive, significant investment in recycling infrastructure. The significant number of alternative waste treatment (AWT) facilities in NSW compared with other states demonstrates this fact. Currently, six facilities are operating in NSW, with 500 000 tonnes of processing capacity. Several additional facilities are being commissioned, or are at the planning or tendering stage. As these facilities become operational, recovery rates are expected to jump up, rather than progress in a slower, linear manner.

NSW collects waste and recycling data from a range of sources to inform policy and regulatory decisions, to enable evidence-based performance assessment and to meet state and federal reporting requirements. The data and the methodologies for collection are designed for NSW needs and fit NSW waste and recycling definitions and classifications, which are governed by legislation. These differ from the definitions, classifications and methodologies applied in other states. The resulting NSW waste generation, disposal and recycling rates are therefore not comparable to other jurisdictional rates, as they are measured in different ways and cover different materials.

Disposal data are collected under the authority of the *Protection of the Environment Operations (Waste) Regulation 2005*, with confidentiality ensured under the *Protection of the Environment Operations Act 1997* (s319). The NSW Waste and Environment Levy facilitates the collection of robust, accurate and timely data on tonnages disposed at landfill. The levy applies to over 80% of the tonnages of waste disposed to landfill in NSW. Data are reported to the Department of Environment, Climate Change and Water (DECCW) by levied landfill facilities on a monthly basis and are scrutinised for accuracy by internal auditors, who compare reported tonnages with weighbridge records. Facilities outside the levied area report disposal data annually.

Disposal data in this State include the following, which differ from some other jurisdictions:

- all material, except virgin excavated natural material (VENM) used for operational purposes, such as daily and intermediate cover, compost used for final capping, aggregate used for drainage layers during cell construction, or gas/leachate collection systems
- all non-leviable material that is disposed of to landfill including dredging spoil, and material received under a levy exemption (excluding VENM)
- stockpiles on site.

Recycling data in NSW are collected at a material level and are from two main sources: an annual survey of re-processors and an annual survey of councils. The data collected from both surveys are voluntarily disclosed and are not verified by auditing of facilities. The surveys do not capture recycling of every possible material, especially those that do not pass through a re-processor or council, such as with on-site composting, re-processing or re-use. Recycling tonnages are therefore under-reported.

Notable examples of the differences between NSW recovery data and other jurisdictions include:

- NSW organics data only include garden organics, food and wood/timber. Some other jurisdictions include data on sawdust and forestry residuals or other/mixed organics. Including these would increase the state's commercial and industrial waste recovery rate from 44% (2006–07) to approximately 52%. Overall the NSW recovery rate would increase from 52% to 55%.
- NSW does not include recycled fly-ash and foundry sands. If recovered fly-ash was included this would add 3 million tonnes (2003–04 figures) to the NSW recovery figures.
- NSW does not include biosolids. If it did, this would increase the state's recovery rate.

NSW uses litter data generated by the Keep Australia Beautiful National Litter Index, runs programs and provides funding to local councils to reduce littering and illegal dumping.

Outline of the chapter

This chapter provides a snapshot of the following:

- the amounts of waste generated, recycled and landfilled in total and by waste stream in NSW;
- what can be recycled through municipal collection services in NSW—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard;
- the location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in NSW.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- Internet sites, White Pages, Yellow Pages and Green Pages.

Amounts generated, recycled and disposed to landfill in NSW

In 2006–07, 15 360 000 tonnes of waste were generated in NSW. Of that, 7 995 000 tonnes were recycled (52%), with 7 365 000 tonnes (48%) sent to landfill. **Figure 2.21** shows the proportions from the municipal solid waste (MSW) stream, the commercial and industrial waste (C&I) stream and the construction and demolition (C&D) waste stream that went to each destination.

For **MSW**, total waste generation in NSW for 2006–07 was 3 891 000 tonnes, or 25% of all waste generated in the state. Of that, 1 483 000 tonnes were recycled in NSW—a recycling rate of 38%. MSW recycling was 19% of all NSW recycling (by weight). NSW sent 2 408 000 tonnes of MSW to landfill in 2006–07, which was 33% of total NSW landfill disposal.

For **C&I**, 5 218 000 tonnes were generated in NSW in 2006–07, or 34% of all waste generated in the state. Of that, 2 297 000 tonnes of C&I waste were recycled in NSW—a recycling rate of 44%. C&I recycling was 29% of total NSW recycling. NSW sent 2 921 000 tonnes of C&I waste to landfill, which was 40% of total NSW landfill disposal.

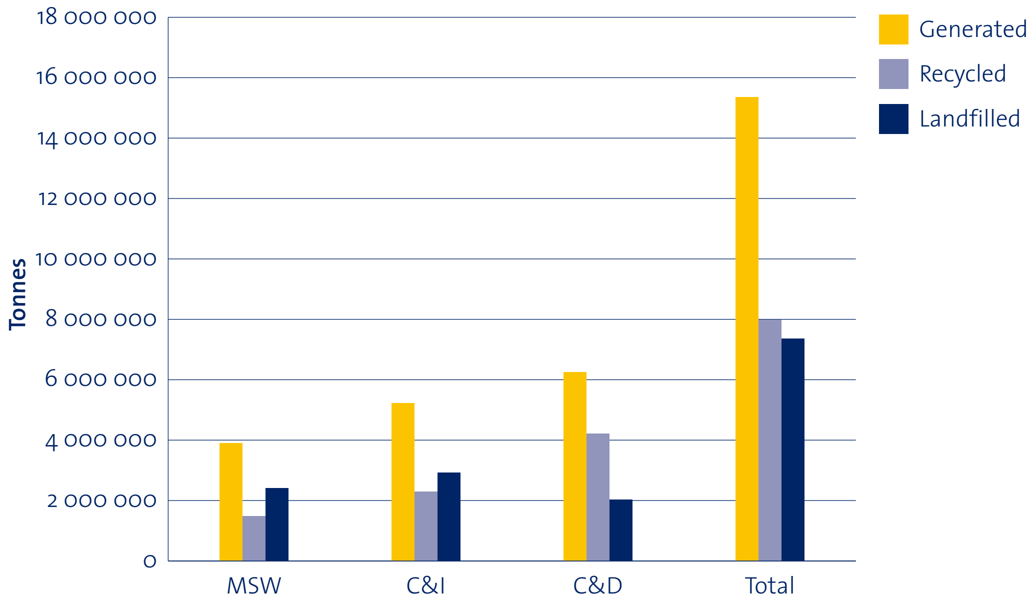
For **C&D**, 6 251 000 tonnes were generated in NSW for the 2006–07 year, or 41% of the NSW total generation. Of that, 4 216 000 tonnes of C&D waste were recycled in NSW—a recycling rate of 68%. C&D recycling made up 53% of total NSW recycling. NSW sent 2 036 000 tonnes of C&D waste to landfill in 2006–07, which was 28% of total NSW landfill disposal.

Waste generation for 2006–07 was 2230 kilograms per person, which is 7% above the national average of 2080 kilograms per person.†

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

† National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.21: NSW—amounts of waste generated, recycled and landfilled, 2006–07: by waste stream



NSW Recycling

Of the 7 995 000 tonnes of material recycled from the three streams in NSW for 2006–07, 52% (by weight) came from the C&D waste stream. The C&I stream produced 29% of the total and the MSW stream produced 19%.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available for reporting. Most MSW recycling occurs at the kerbside.

Municipal recycling services—what is collected and where

Around NSW, households are offered different kerbside recycling services, covering particular configurations of materials, depending on which local government area they are in. **Figures 2.22**, **2.23** and **2.24** show what municipal wastes can be recycled, and where.‡

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Sydney metropolitan area, this information is also presented.

‡ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service.

Figure 2.22: NSW—municipal recycling of plastics, paper and cardboard, by LGA

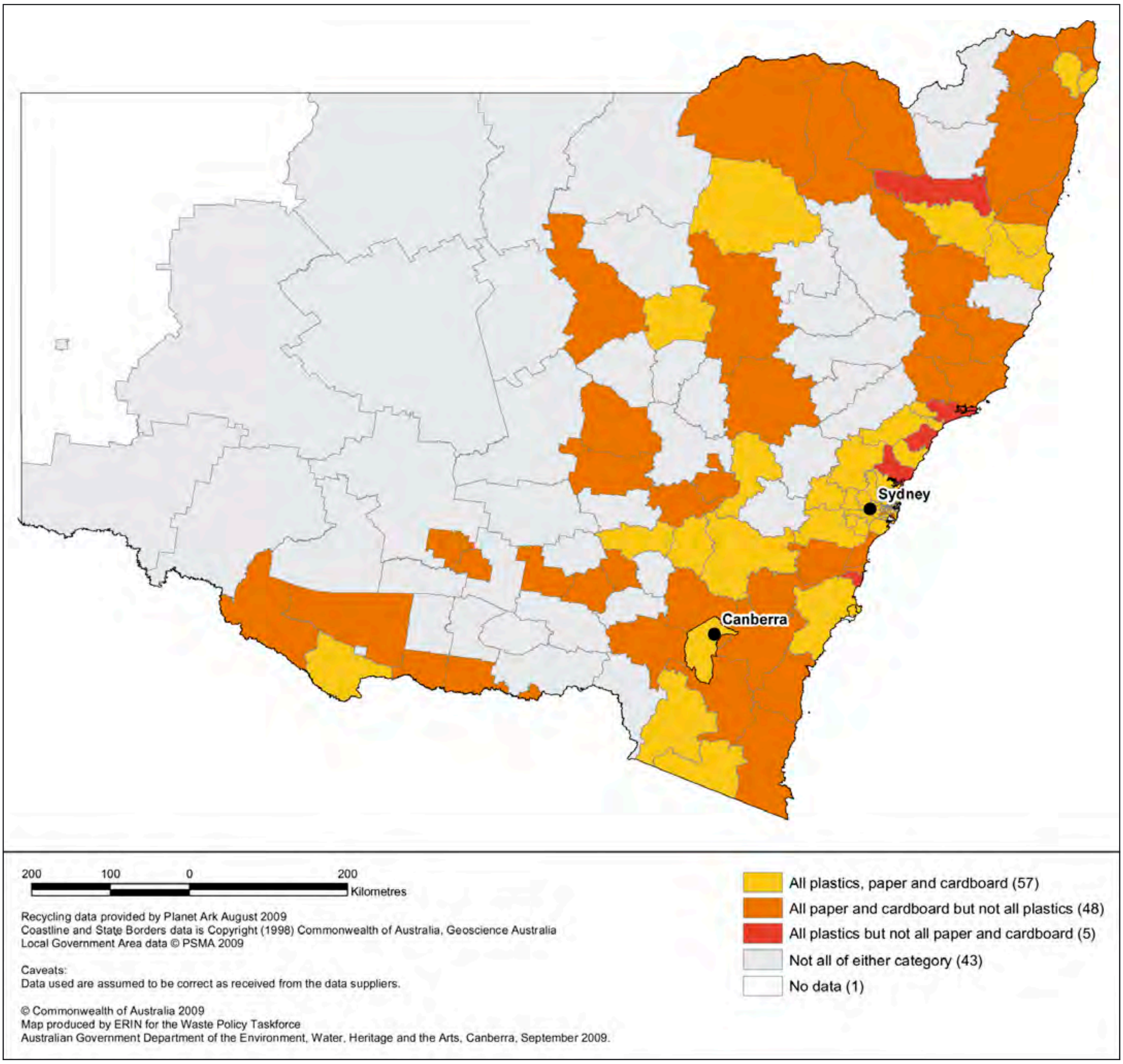


Figure 2.23: Greater Sydney—municipal recycling of plastics, paper and cardboard, by LGA

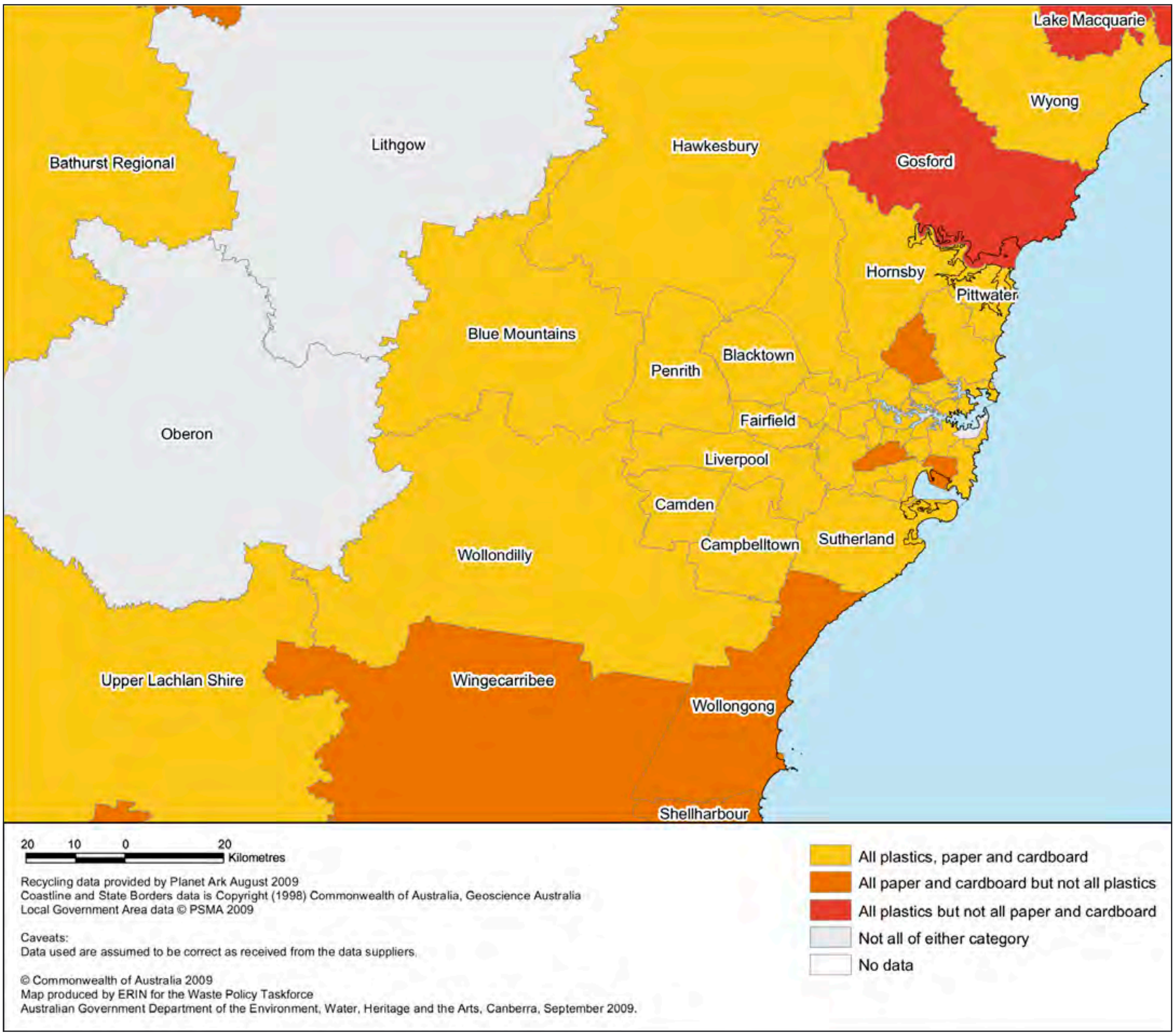
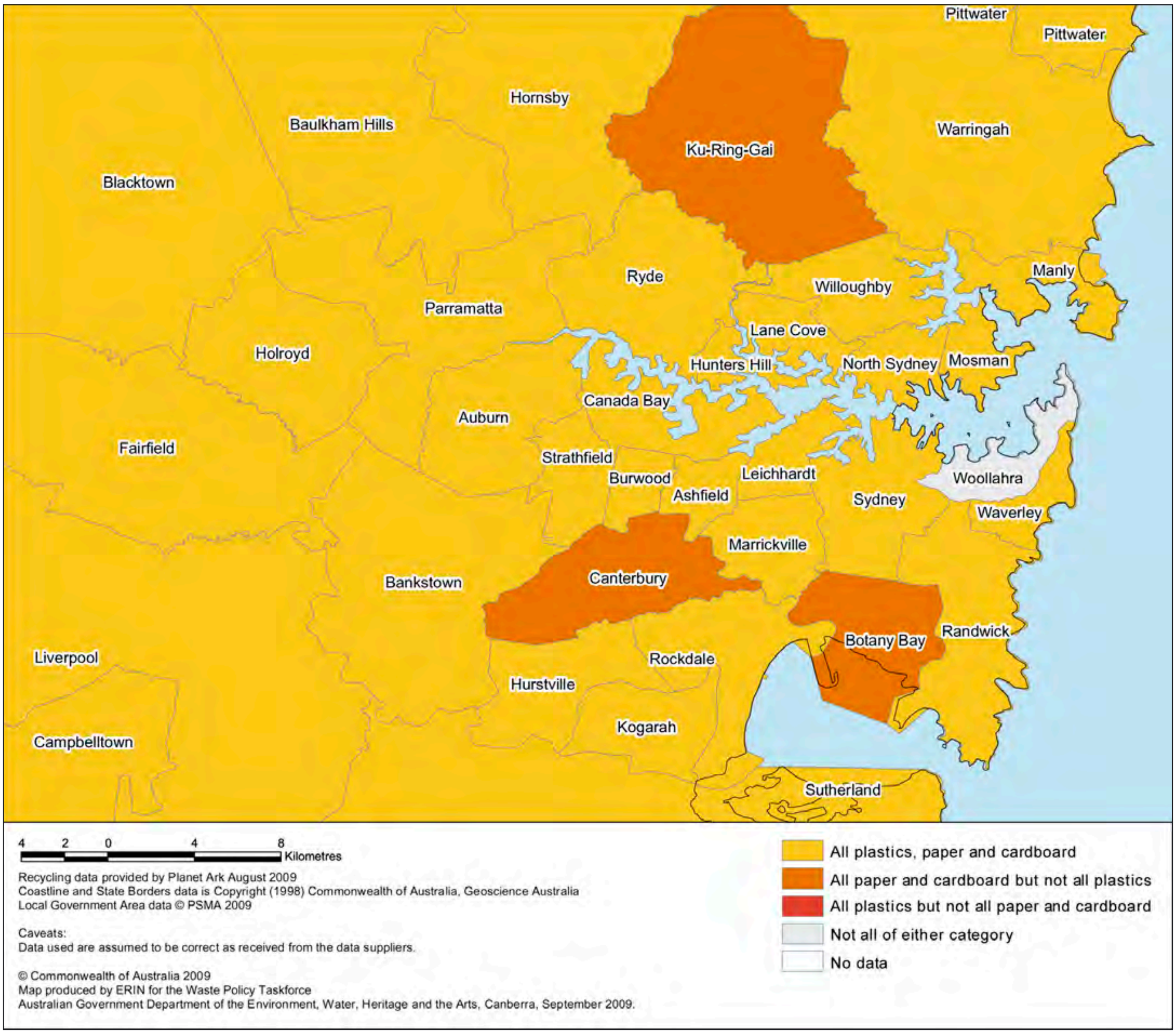


Figure 2.24: Inner Sydney—municipal recycling of plastics, paper and cardboard, by LGA

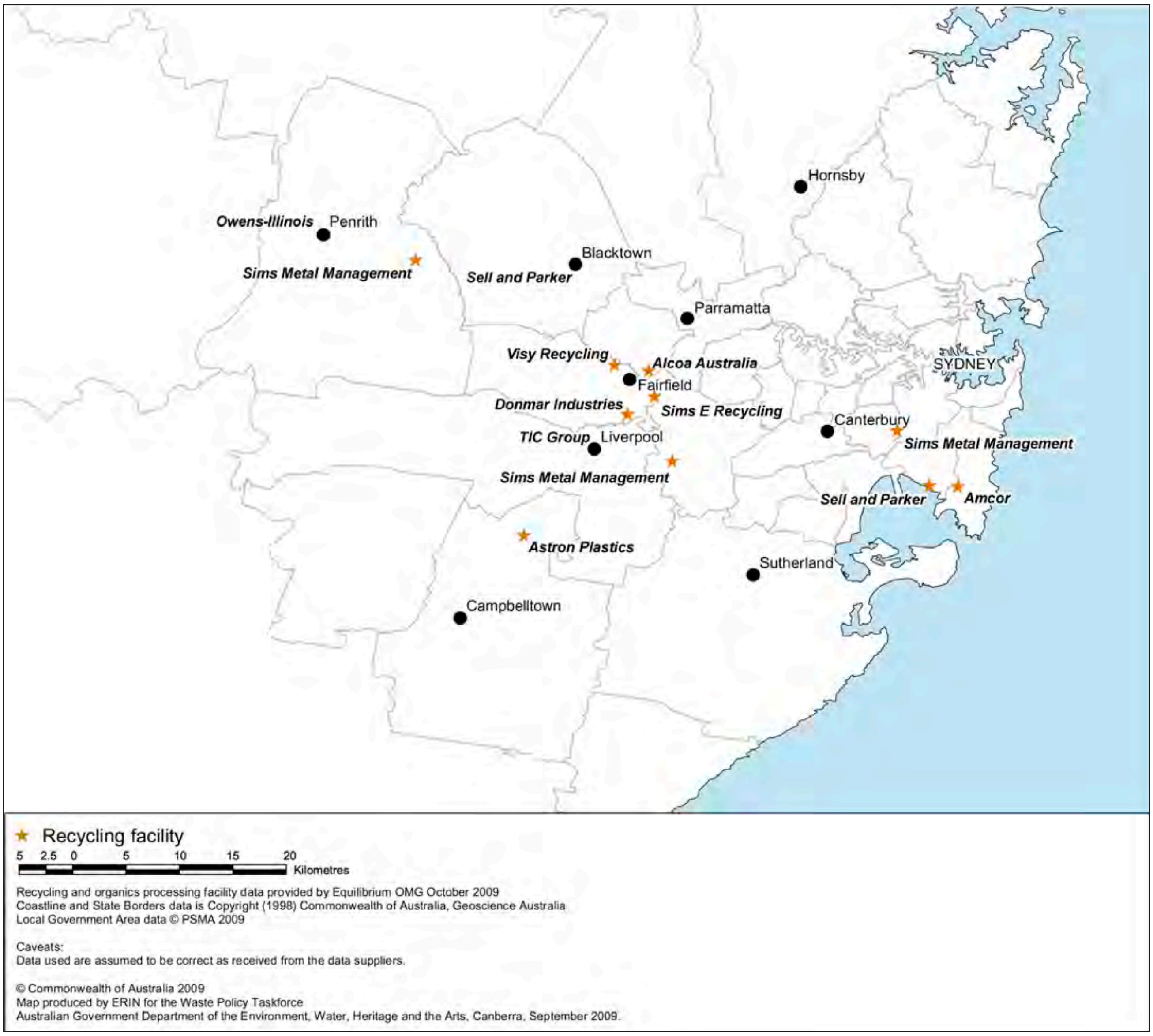


Location of recycling facilities

Figure 2.25 shows some of the largest recycling facilities in NSW, highlighting their range and spread within a particular area, Greater Sydney.[§] It is a sample rather than a comprehensive view of all facilities. Information about the sourcing of data used here appears at the beginning of this chapter.

§ Information about facilities beyond the Greater Sydney area was not available.

Figure 2.25: Sydney region—recycling facilities—location map



NSW facilities accept and process the following materials:

Table 2.7: NSW—recycling facilities—details

Name and location	Materials	Source of materials
Alcoa, Yennora	Aluminium	C&I, suburban collection depots
Amcor Paper Recycling, Matraville	Paper	MSW kerbside from material recovery facilities (MRFs), commercial and industrial and drop-off
Astron Plastics, Ingleburn	Plastic resin, clean industrial plastic scrap—LDPE, HDPE, PP and PS	Manufacturers, distributors, warehouses and other businesses that generate significant quantities of clean plastic scrap
Donmar Industries, Lansvale	Plastics—PET, DPE, PP, PVC, GPS, HIPS, EPS, PC, PA, ABS, Nylon, Noryl, Acrylics, Polycarbonate	C&I (purchase all types and quantities of plastics)
Owens-Illinois, Penrith	Glass	Local government MRFs, transfer stations
Remondis, St Marys and Telegraph Point	Solid waste	MSW and C&I
Sims e-Recycling, Villawood	e-waste	Businesses and collection centres
Sims Metal Management, St Marys	Metals, including aluminium and stainless steel	C&I
Sell and Parker, Banksmeadow	Metals—including aluminium and stainless steel	C&I
TIC Group, Liverpool	Re-usable retail accessories, such as hangers and security tags and e-waste	Businesses
Visy Recycling, Smithfield	Cardboard, paper, wastepaper, plastic grades—PET, HDPE, PVC, LDPE, LLDPE, aluminium and steel cans, glass	MSW Kerbside and businesses

NSW organic waste processing

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

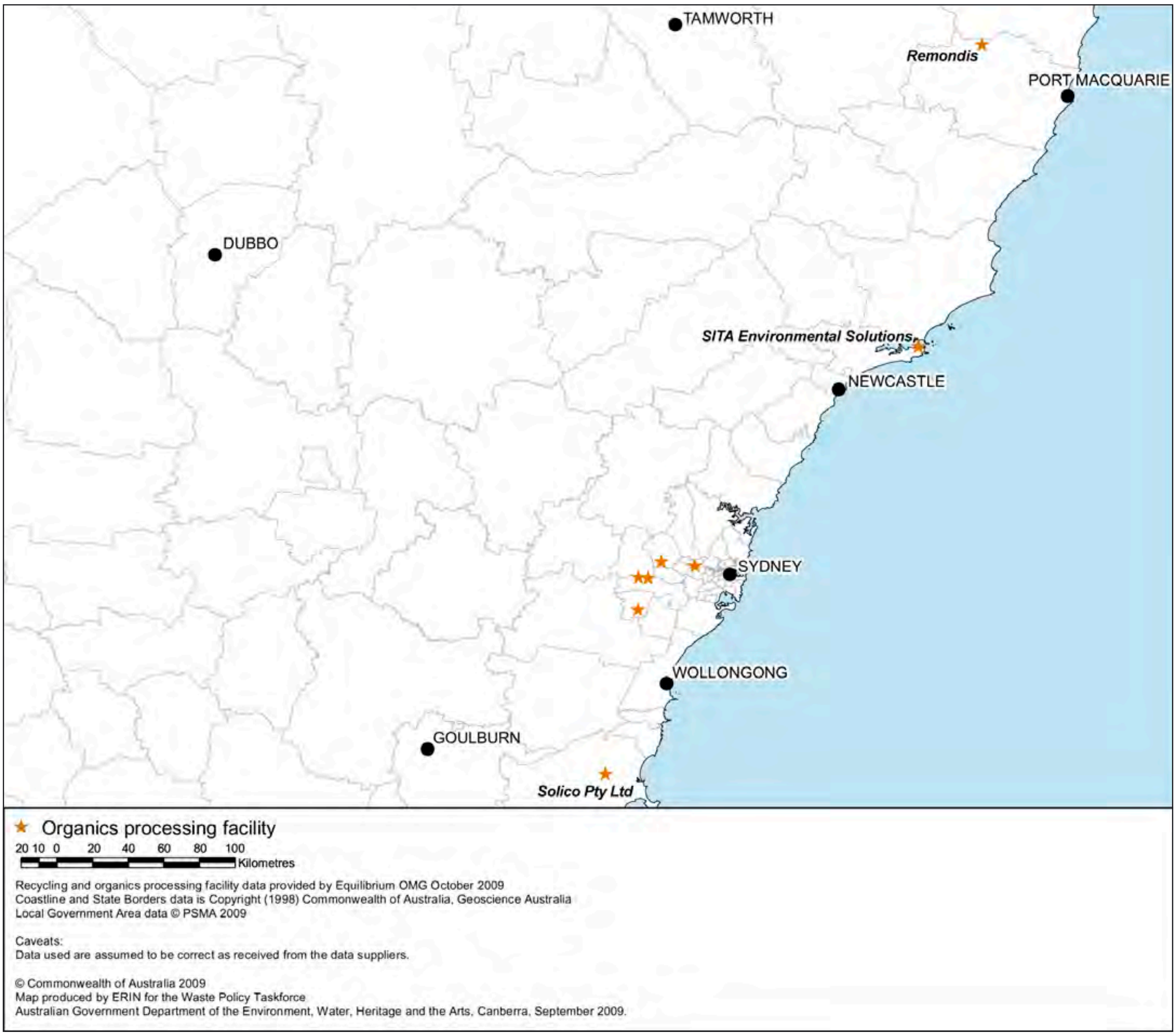
Figure 2.26 shows the range and spread of major facilities in NSW for processing organic wastes. It is presented as a snapshot rather than a comprehensive view of all facilities. Information about the sourcing of data used here appears at the beginning of this chapter.¶

Most of the major organics processing facilities** are located in the Greater Sydney area, and are shown in **Figure 2.27**.

¶ There is no comprehensive record of all waste and recycling stakeholders and facilities.

** For the purposes of this mapping, the focus has been on facilities processing organics from the MSW, C&I and C&D waste streams. There are additional organics processing facilities outside the Greater Sydney area that handle different streams of organics wastes, such as plant at Tumut for processing residues from timber and forestry operations.

Figure 2.26: NSW—organics processing facilities—location map

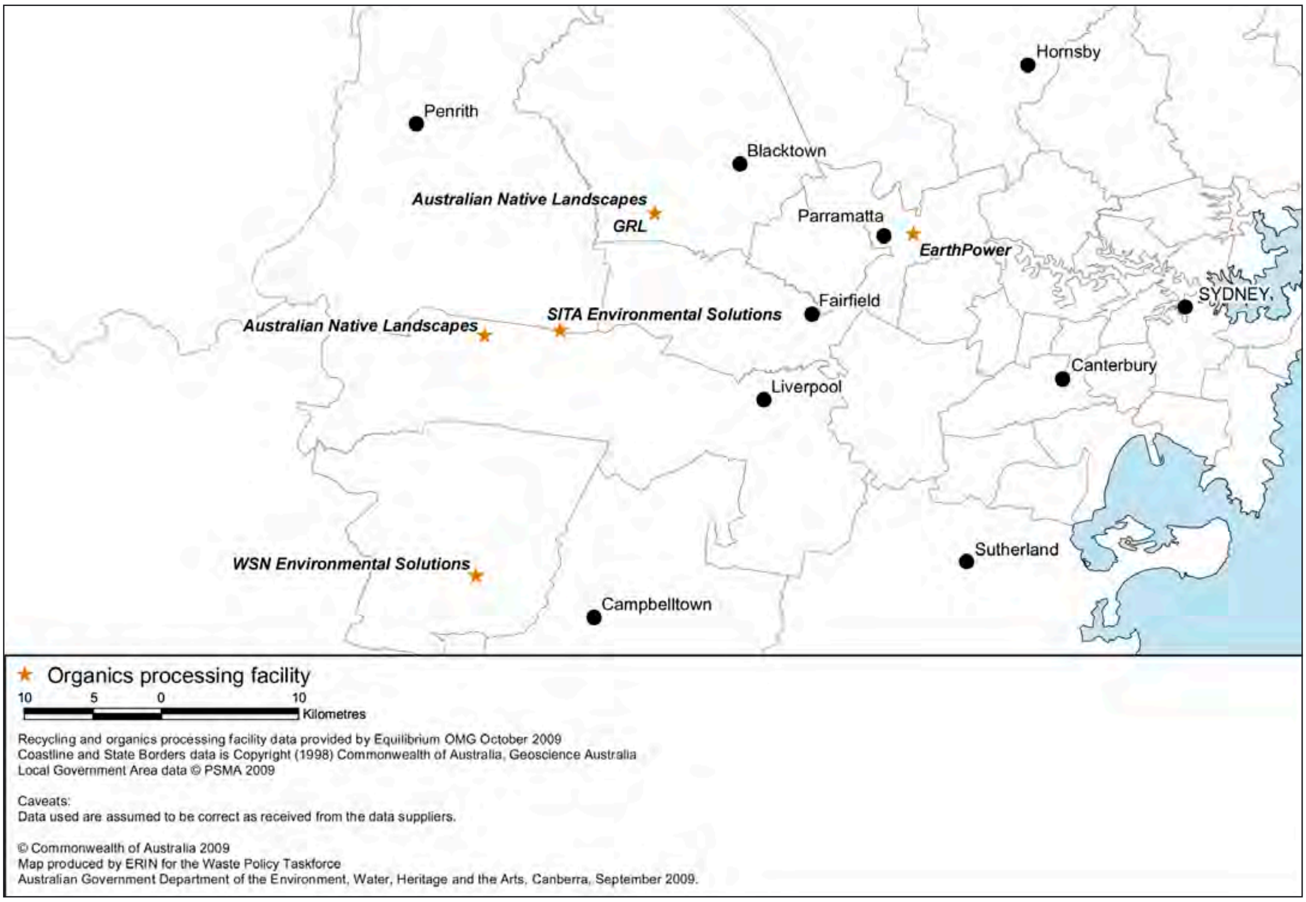


NSW facilities accept and process the following materials:

Table 2.8: NSW—organics processing facilities—details

Name and location	Materials	Source of materials
Australian Native Landscapes, Eastern Creek	Organic/garden waste	Local government kerbside green waste collection
EarthPower, Camellia	Segregated solid and liquid organic wastes of all types from food and food-processing activities. Includes all source-segregated foods and putrescible organic materials from a range of domestic, commercial and industrial food preparation, processing and consumer activities	Commercial and consumer/ households
Global Renewables Ltd, Eastern Creek	Mechanical biological treatment for energy recovery and compost	Kerbside MSW processing
Remondis Organic Resource Recovery Facility, Telegraph Point (in Port Macquarie Hastings Council facility)	Organics	MSW, C&I
SITA Environmental Solutions, Raymond Tce	Organics/garden matter for recycling	Kerbside MSW processing and green waste collection
Solico, Nowra	Organics matter for compost	Kerbside green waste collection
WSN Environmental Solutions, Narellan	Energy recovery, green waste processing for compost	Kerbside MSW processing and green waste collection

Figure 2.27: Sydney area—organics processing facilities—location map

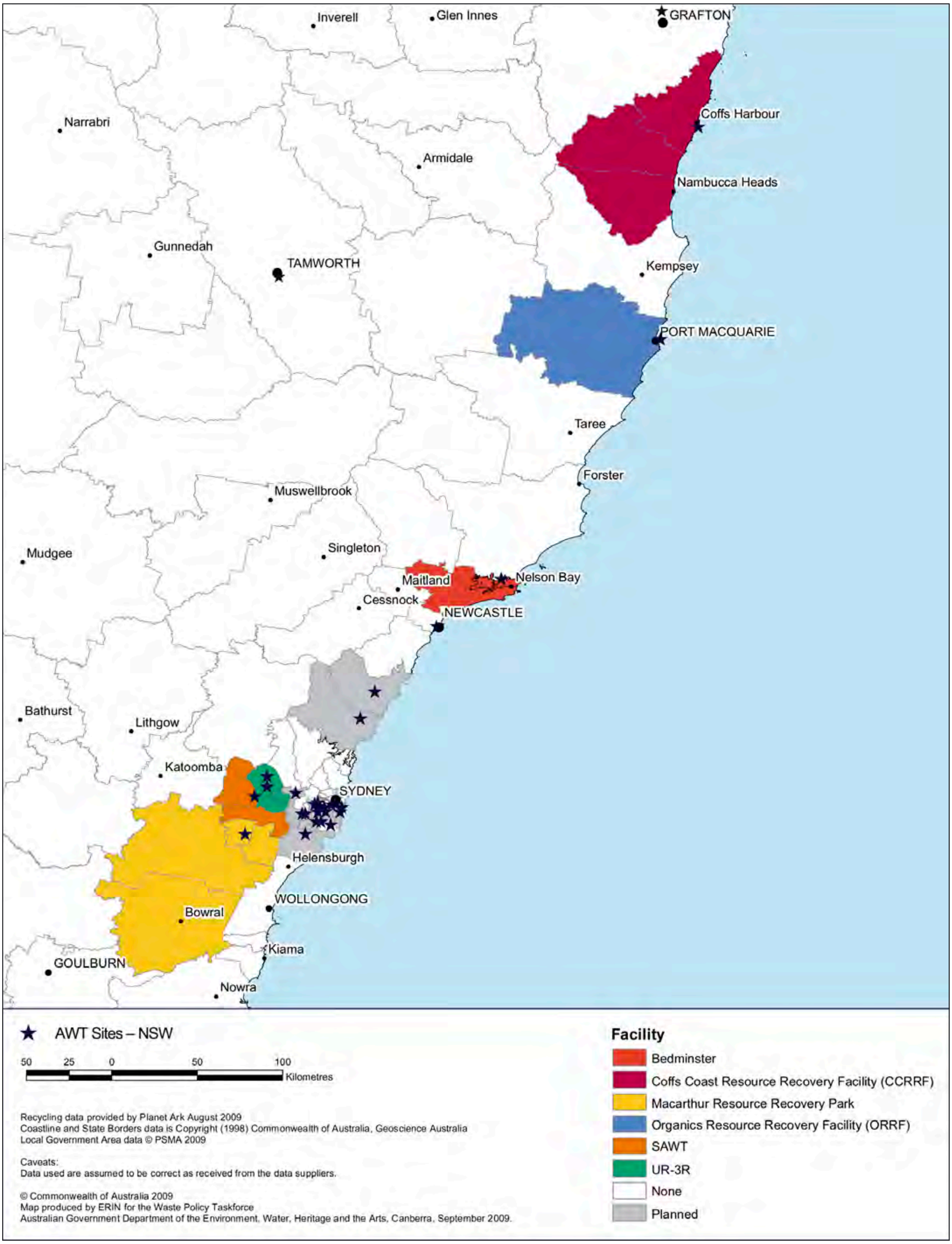


NSW alternative waste treatment (AWT) facilities

Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill, including organic wastes from the municipal mixed waste to landfill stream. Their functions are described more fully in **Chapter 4.7**.

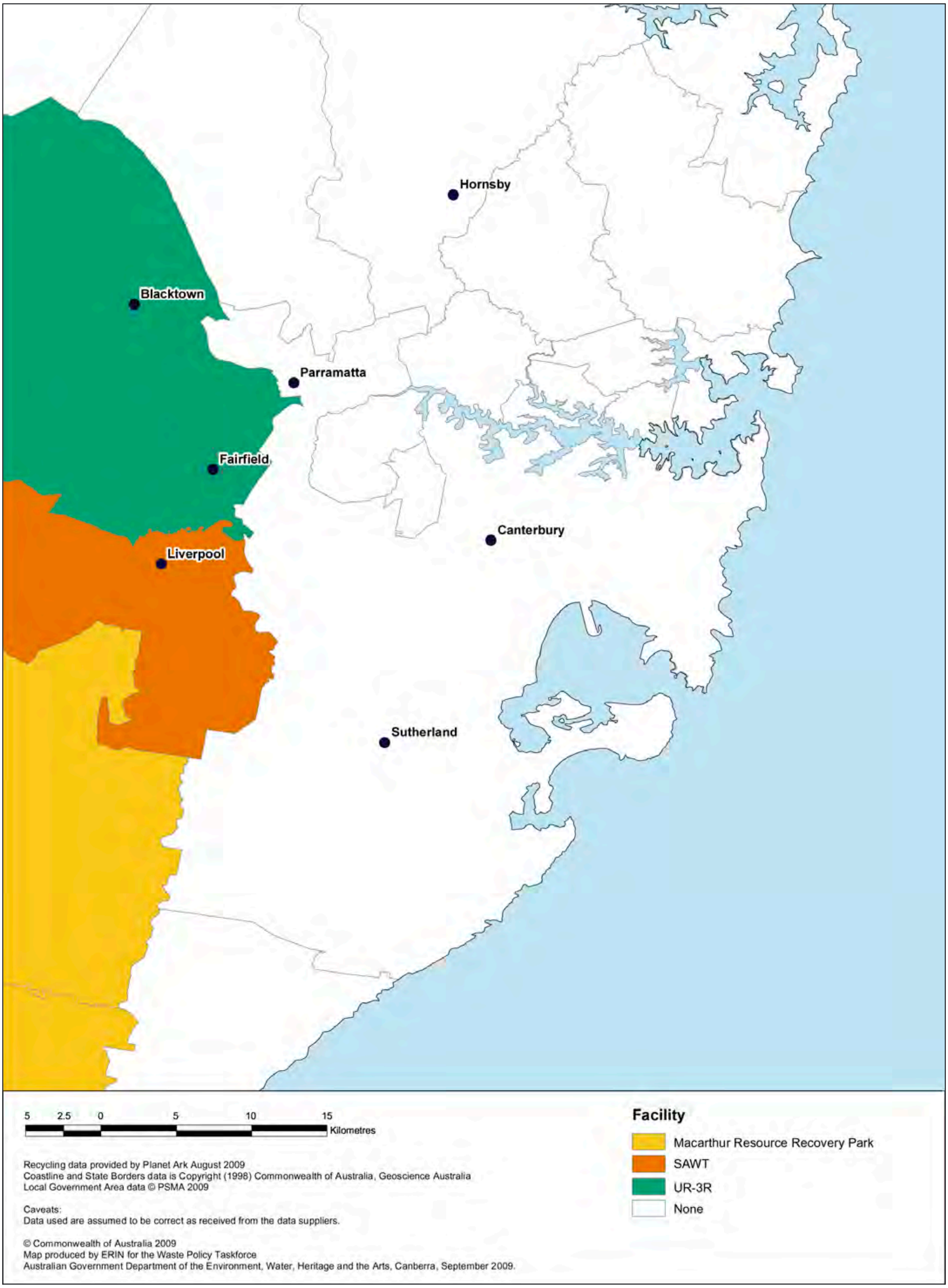
AWT facilities provide opportunities to make significant reductions in the volumes of organic waste currently being sent to landfill. NSW has had a strong uptake of AWT plants, driven by increasing landfill levies. **Figure 2.28** shows areas of NSW covered by existing and planned AWT plants, while **Figure 2.29** focuses on existing and planned facilities in the Sydney area.

Figure 2.28: NSW—sites and coverage of AWT facilities, existing and planned, by LGA



Note: Coverage details for planned facilities at Tamworth and Grafton are not available.

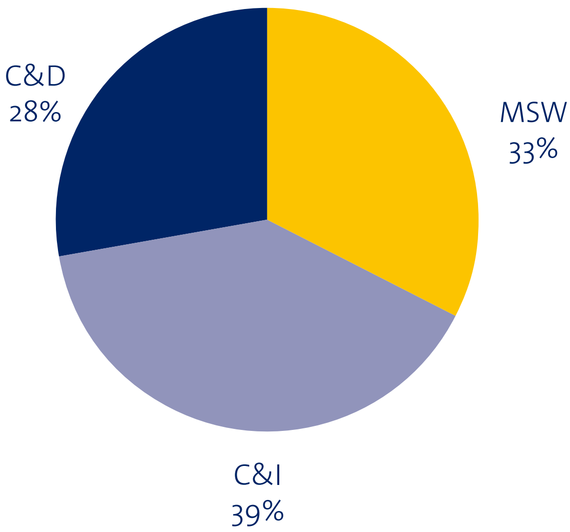
Figure 2.29: Sydney Area—AWT facilities, existing and planned, by LGA



NSW landfill

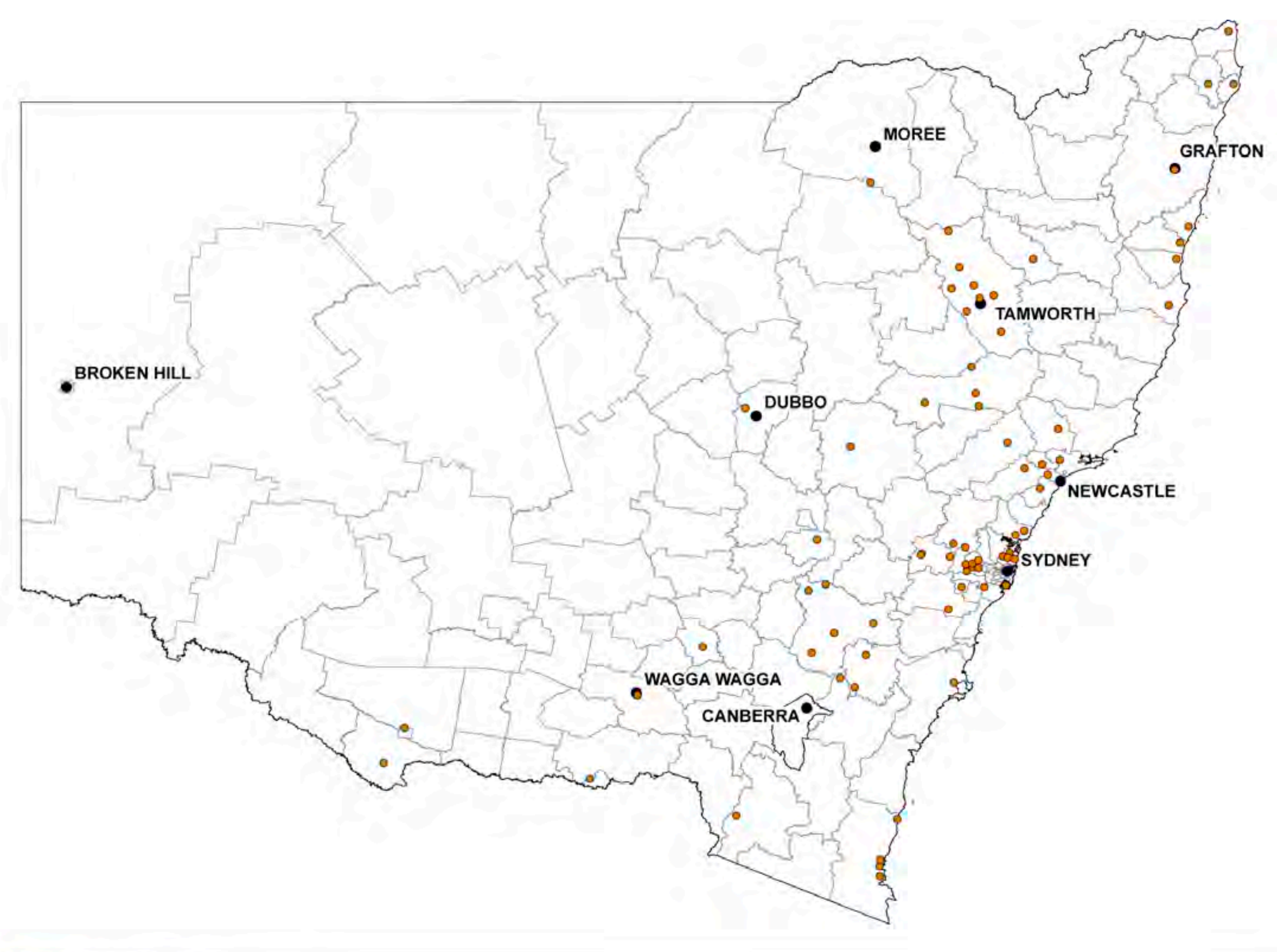
Commercial and industrial waste was the largest component of the 7 365 000 tonnes of waste sent to landfill in NSW for 2006–07, at 2 921 000 tonnes or 39%.

Figure 2.30: NSW—waste to landfill by source, 2006–07



Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3**), **Figure 2.31** maps the location of many of these landfills.

Figure 2.31: NSW—landfill locations



Landfill location

100 50 0 100 200 Kilometres

Landfill data provided by WMAA October 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data (c) PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce,
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

The ten largest operating landfill facilities for NSW are shown in **Table 2.9** and the location of other major landfills is in **Table 2.10**. This information was provided by the NSW Government.

Disclosure of individual facility tonnage data is forbidden under the *Protection of the Environment Operations Act, 1997* S.319(1)(a) without consent from the data provider. The DECCW has gained consent from the organisations operating the top ten facilities within NSW to provide only aggregate tonnage information.

The top ten facilities in NSW disposed 3 850 000 tonnes in 2008–09.

Annual tonnage information for these landfills was not publicly available.

Further detail on some licensed landfill sites in NSW is available at <http://www.environment.nsw.gov.au/prpoeo/licences.htm>.[††]

NSW landfill gas

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

†† Look under 'Fee based activities' category 'Waste disposal (application to land)'. This does not cover all licensed landfills, and does not give details about all non-licensed facilities.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from landfills in NSW were 4 497 000 tonnes of CO_2-e. Estimated gas capture (by flaring and energy generation) in that year was 2 537 000 tonnes of CO_2-e, or 36% of estimated total production of landfill gas. These figures include Australian Capital Territory landfill sites.[‡‡]

Key points

- Landfill levy arrangements in NSW have driven investment in AWT facilities, which are likely to deliver further improvements in the diversion of organic wastes from landfill.
- In 2006–07, 15 360 000 tonnes of waste were generated in NSW. Of that, 7 995 000 tonnes or 52% were recycled, with 7 365 000 tonnes (48%) being disposed of in landfill.
- NSW data on recycling are mainly collected by two voluntary surveys and represent an under-reporting of actual recycling activity.
- Waste generation for 2006–07 was 2230 kilograms per person, which is 7% above the national average of 2080 kilograms per person.

‡‡ These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are in Appendix A of this report.

Table 2.9: NSW—major landfills—details

Facility name	EPA Licence Number
Buttonderry Waste Management Facility	5955
Eastern Creek Waste Management Centre	5272
Elizabeth Drive Landfill Facility	4068
Erskine Park Landfill	4865
Horsley Park Waste Management Facility	11584
Huntley Colliery	10997
Lucas Heights Waste & Recycling Centre	5065
Marsden Park Landfill	11497
Summerhill Waste Management Facility	5897
Woodlawn Landfill	11436

Please note that these facilities appear in alphabetical order

Note: this is not a comprehensive list of all licenced landfills in NSW

Table 2.10: NSW—additional landfill—details

Entity and location	Name
Albury City Council, Albury	Albury Landfill
Blue Mountains City Council, Katoomba	Katoomba Waste Management Facility
Dubbo City Council, Dubbo	Whylandra Waste Disposal Depot
Mid-Western Regional Council, Mudgee	Mudgee Waste Facility
SITA Australia Pty Ltd, Wetherill park	Elizabeth Drive Landfill
SITA Australia Pty Ltd, Port Stephens	
Snowy River Shire Council	Jindabyne Landfill
Tamworth Regional Council, Tamworth	Forest Road Landfill
Thiess Services Pty Ltd, Blacktown	Blaxland Waste Management Facility
Tweed Shire Council/Solo Resource Recovery, Murwillumbah	Stotts Creek Landfill
Veolia Environmental Services (Australia) Pty Ltd, Horsley Park	Horsley Park Waste Management Facility
Veolia Environmental Services (Australia) Pty Ltd, Tarago	Woodlawn Landfill
Warringah Council, Dee Why	Kimbriki Recycling & Waste Disposal Centre
WSN Environmental Solutions, Belrose	Belrose Waste And Recycling Centre
WSN Environmental Solutions, Lucas Heights	Lucas Heights Waste & Recycling Centre
WSN Environmental Solutions, Jacks Gully	Jacks Gully Waste & Recycling Centre
WSN Environmental Solutions, Eastern Creek	Eastern Creek Waste Management Centre

The table was sourced from

- a review of state and territory public registers of licensed landfills
- searches of government and industry websites, and
- internet and directory searches including White Pages, Yellow Pages and Green Pages.

CHAPTER 2.3 VICTORIA

Victoria Government perspective

Victoria's Waste and Recycling Performance—Successes, Challenges and Priorities

Over the past decade, Victoria has been successful in stabilising and slightly reducing the amount of waste deposited in landfill, despite a strong economy and growing population. However, more than 4 million tonnes of waste were still deposited to landfill in 2007–08.*

Key reasons for this success have been the widespread adoption of best practice kerbside recycling practices, and the growth of recycling in the commercial and industrial sector.

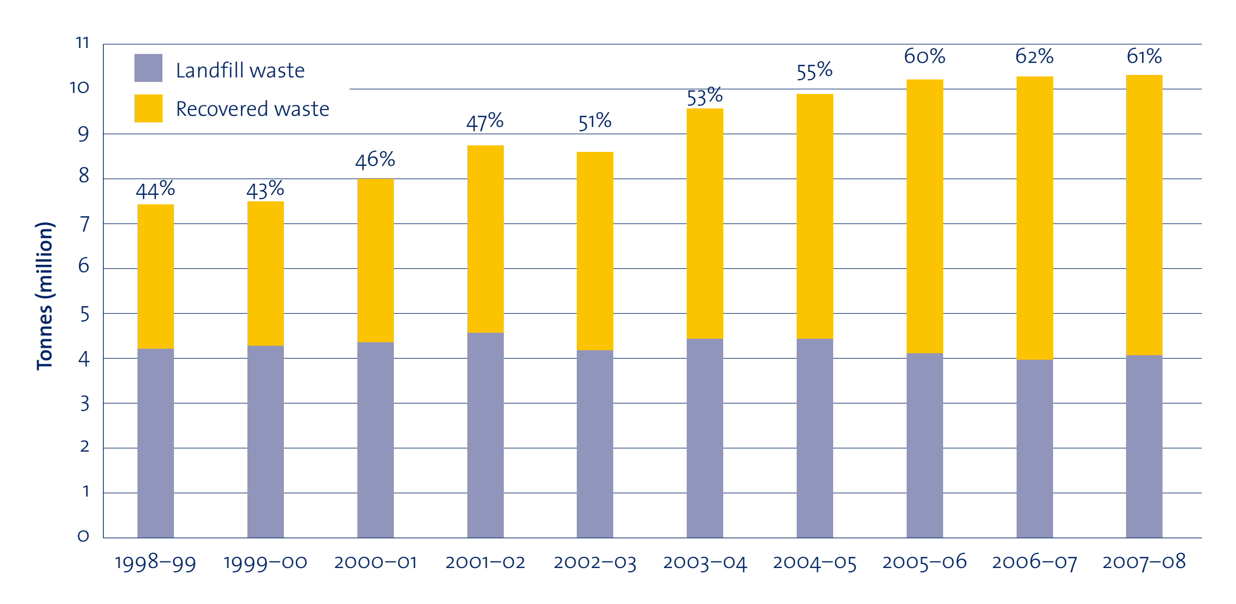
* In Victoria the *Environment Protection Act 1970* provides a rebate for cover material of 15% for each tonne of waste deposited at a landfill. Published figures for the amount of waste landfilled are calculated by taking the amount of material received at landfills and reducing this by 15% to allow for cover material.

Victoria has a well-developed institutional framework for waste reduction, with a system of regional waste management groups that cover the state working with local government and state-level bodies to achieve the state's waste management goals.

Key challenges for Victoria as it seeks to reduce waste further are to reduce the generation of waste, which has grown significantly, and to reduce landfilling of organic waste, given its contribution to Victoria's greenhouse gas emissions.

Current priorities for Victoria are examining the feasibility of introducing alternative waste treatment technologies into the state, working to further improve recycling rates, particularly in the away-from-home sector, and working with other governments at a national level to develop workable product stewardship arrangements with various industry sectors.

Figure 2.32: Amount of waste landfilled and recovered in Victoria 2007–08



Outline of the chapter

This chapter provides a snapshot of the following:

- the amounts of waste generated, recycled and landfilled in total and by waste stream in Victoria;
- what can be recycled through municipal collection services in Victoria—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard;
- the location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in Victoria.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from:

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities[†]
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- internet sites, White Pages, Yellow Pages and Green Pages.

† Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

Amounts generated, recycled and disposed to landfill in Victoria

In 2006–07, 10 285 000 tonnes of waste were generated in Victoria. Of that, 6 360 000 tonnes (62%) were recycled, with 3 925 000 tonnes (38%) being sent to landfill.[‡]

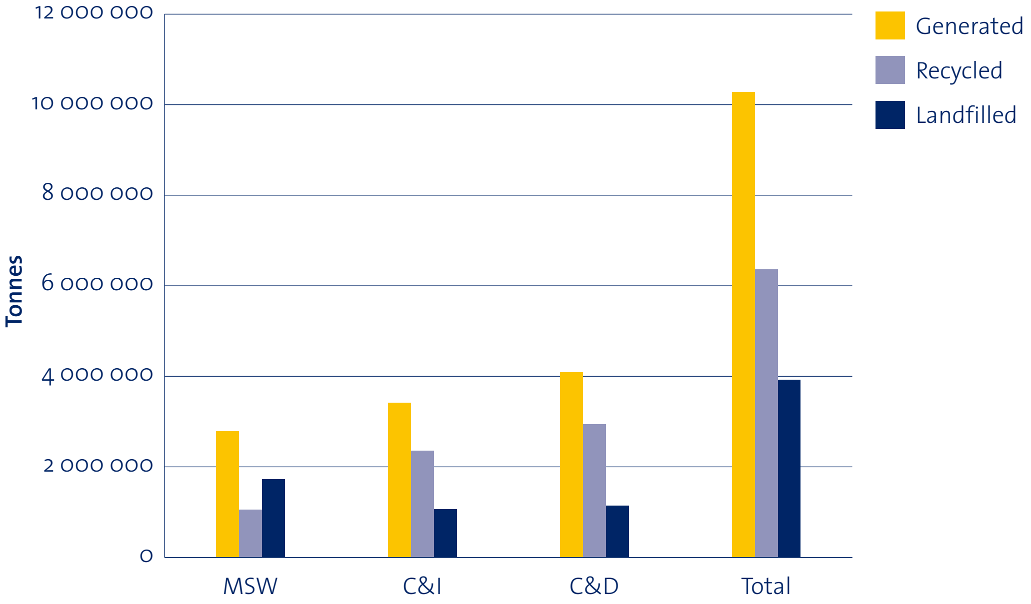
For **municipal solid waste (MSW)**, total waste generation in Victoria for 2006–07 was 2 783 000 tonnes, or 27% of all waste generated in the state. Victoria recycled 1 056 000 tonnes of MSW waste. This is a recycling rate of 38%. MSW recycling made up 36% of total Victorian recycling (by tonnage). Victoria sent 1 727 000 tonnes of MSW to landfill in 2006–07, which was 44% of total Victorian landfill disposal.

For **commercial and industrial waste (C&I)**, there were 3 417 000 tonnes generated, which was 33% of total generation in Victoria. There were 2 357 000 tonnes of C&I waste recycled, or 37% of total Victorian recycling. This was a recycling rate of 69%. Victoria disposed of 1 060 000 tonnes of C&I waste to landfill (27% of total landfilling in the state).

For **construction and demolition waste (C&D)**, total generation was 4 084 000 tonnes in Victoria for the 2006–07 year. This was 40% of total waste generated in the state. There were 2 946 000 tonnes of C&D waste recycled, which was 46% of total Victorian recycling, and represents a recycling rate of 29%. Victoria sent 1 138 000 tonnes of C&D waste to landfill in 2006–07, which was 29% of total landfill disposal in the state.

‡ The figures represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. The *Environment Protection Act 1970* provides a rebate for cover material of 15% (at the relevant municipal rate) for each tonne of waste deposited at a landfill. The figures shown above were calculated by taking the tonnes of material received at landfills (including cover material sourced off site) and reducing this by 15% to allow for cover material. It is noted that some landfills source cover material on-site (e.g. from quarrying activities) and that this is not measured in the tonnes of waste received at landfills. Where landfills have claimed a recycling rebate, this has also been subtracted from the figures. Prescribed waste (including low level contaminated soil) deposited to landfill, including where used as cover, is not included in the above figures.

Figure 2.33: Victoria—amounts of waste generated, recycled and landfilled, 2006–07



Waste generation in Victoria for 2006–07 was 1980 kilograms per capita, which is 5% below the national average of 2080 kilograms per capita.§

Victorian recycling

Of the 6 360 000 tonnes of material recycled out of the MSW, C&I and C&D streams in Victoria for 2006–07, 46% of the material (by weight) came from the C&D stream. The MSW stream produced 17% of total recycling, and the C&I stream 37%.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available for reporting. Most of MSW recycling is at the kerbside.

Municipal recycling services—what is collected and where

Around Victoria, households are offered different municipal recycling services, covering particular configurations of materials, depending on which Local Government Area (LGA) they are in. **Figures 2.34, 2.35** and **2.36** show what wastes can be recycled and where.¶

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Melbourne area, this information is also presented.

§ National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

¶ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service.

Figure 2.34: Victoria—municipal recycling of plastics, paper and cardboard, by LGA

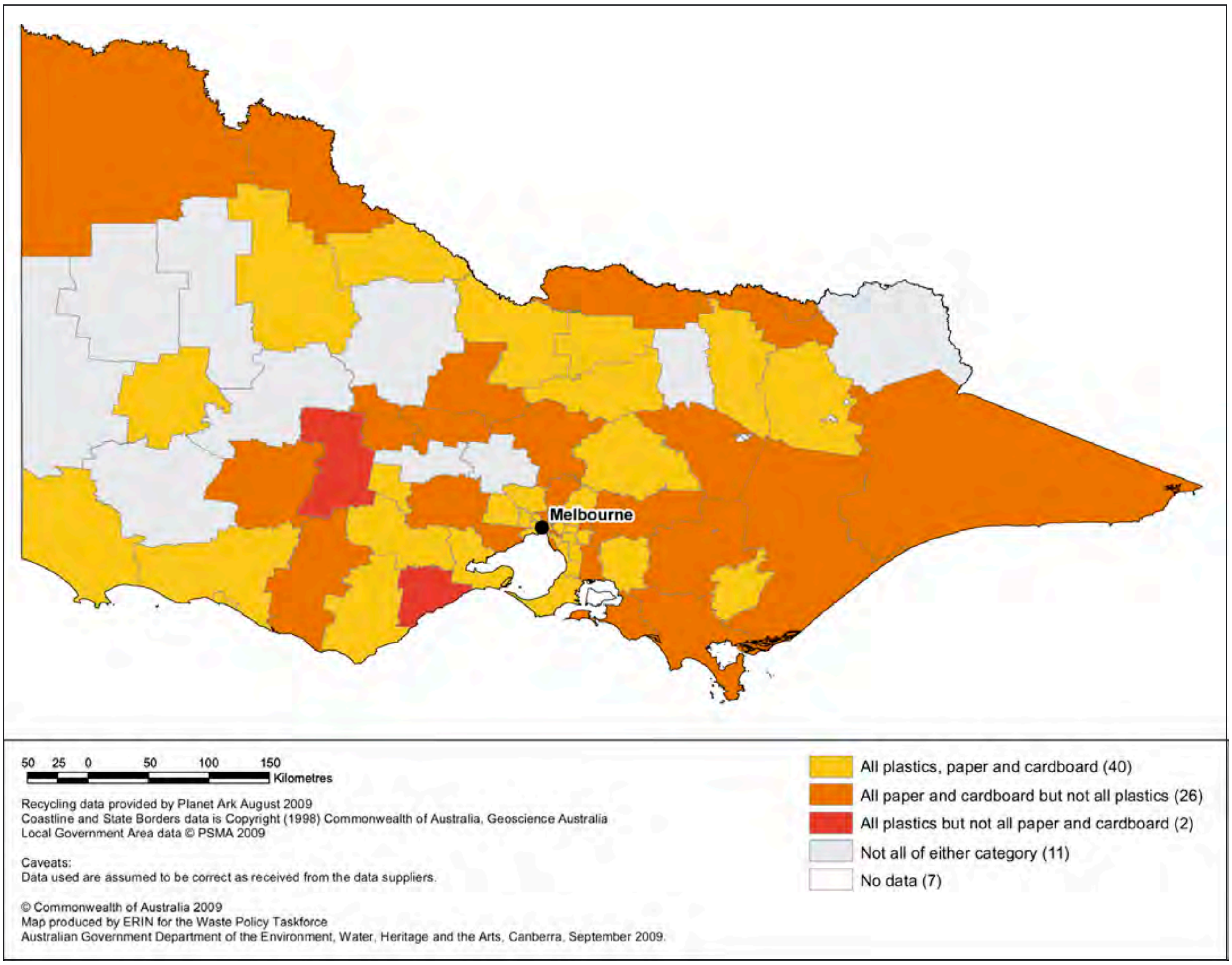
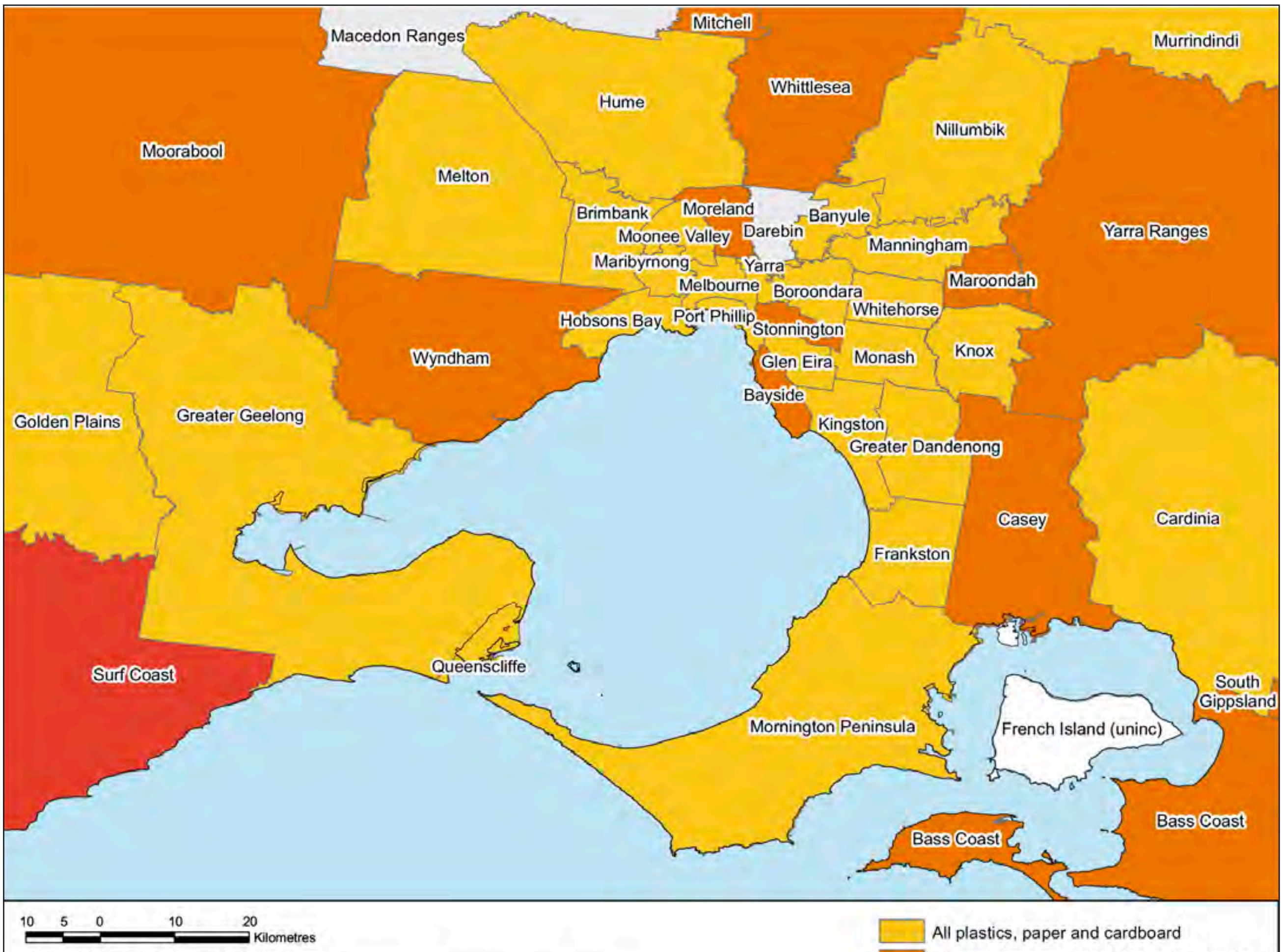


Figure 2.35: Melbourne—municipal recycling of plastics, paper and cardboard, by LGA

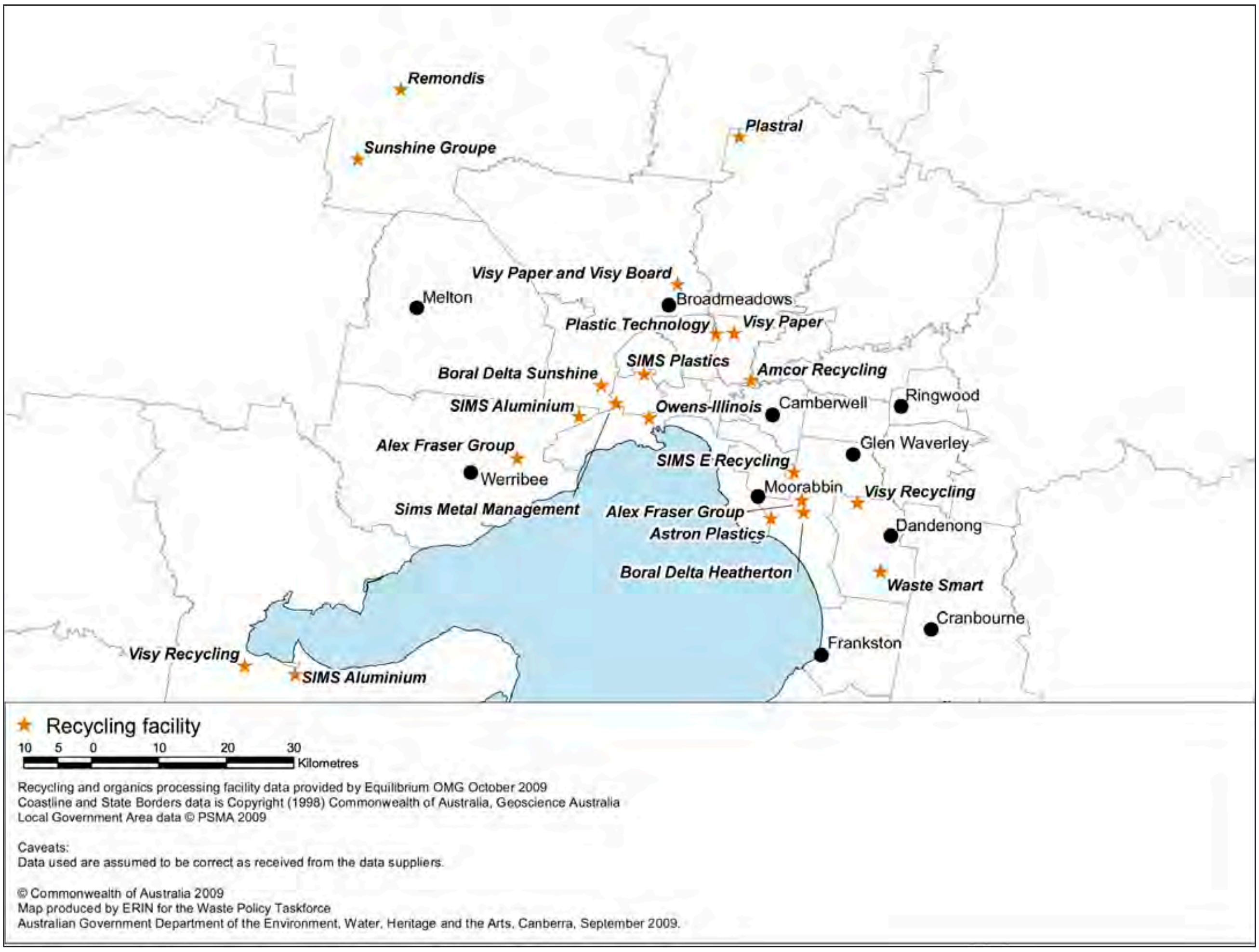


Recycling data provided by Planet Ark August 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data © PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

Figure 2.36: Victoria—recycling facilities—location map



Location of recycling facilities

Figure 2.36 shows some of the largest recycling facilities in Victoria, highlighting their range and spread within a particular area, Greater Melbourne. It is a sample rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in the figure below and **Table 2.11**.**

** Information about facilities beyond the Greater Melbourne area was not available. There is no comprehensive listing of all facilities and stakeholders available.

Victorian facilities accept and process the following materials:

Table 2.11: Victoria—recycling facilities—details

Name	Materials	Source of materials
Alex Fraser, Clarinda	Concrete, brick, steel, rubble	C&D
Alex Fraser, Laverton North	C&D waste, concrete, metals, timber, asphalt	Building and demolition industry, local government, transfer stations
Amcor Paper Recycling, Alphington	Paper	MSW kerbside, Material Recovery Facilities (MRFs), C&I and drop-off
Astron Plastics, Cheltenham	Plastic resin, clean industrial plastic scrap—LDPE, HDPE, PP and PS	Manufacturers, distributors, warehouses and other businesses (that generate significant quantities of clean plastic scrap)
Boral/Delta, Heatherton	C&D waste, concrete, metal, timber	Builders, local government, transfer stations
Owens-Illinois, Spotswood	Glass	Local government, MRFs, transfer stations
Plastic Technology, Reservoir	Plastic film	C&I, C&D
Plastral, Thornbury	Plastic	C&I, C&D
Remondis, Coolaroo	Solid waste	MSW, C&I, C&D
Sims Aluminium, Geelong	Aluminium	C&I, C&D
Sims Aluminium, Laverton North	Aluminium	C&I—collection network throughout Australia
Sims Metal Management, Brooklyn	Ferrous and non-ferrous metals	C&I, C&D and MSW MRFs
Sims Plastics, Maribyrnong	Plastic, resin, clean industrial plastic scrap—LDPE, HDPE, PP and PS	C&I—collection network throughout Australia
Sims E Recycling, Oakleigh South	e-waste	Businesses and collection centres
Sunshine Group, Brooklyn	C&D	C&D
Visy Recycling Materials Recovery Facility, South Geelong	MSW kerbside recyclables	Households in Geelong, Surf Coasts Shire and the Barwon region
Waste Smart, Dandenong South	Brick rubble, C&D materials, crushed concrete aggregate	Building and demolition industry, local government, transfer stations

Victorian organic waste processing

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.37 shows the range and spread of major facilities in Victoria for processing organic wastes. It is presented as a snapshot rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in the figure below and **Table 2.12**.[††]

†† There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.37: Victoria—organics processing facilities—location map

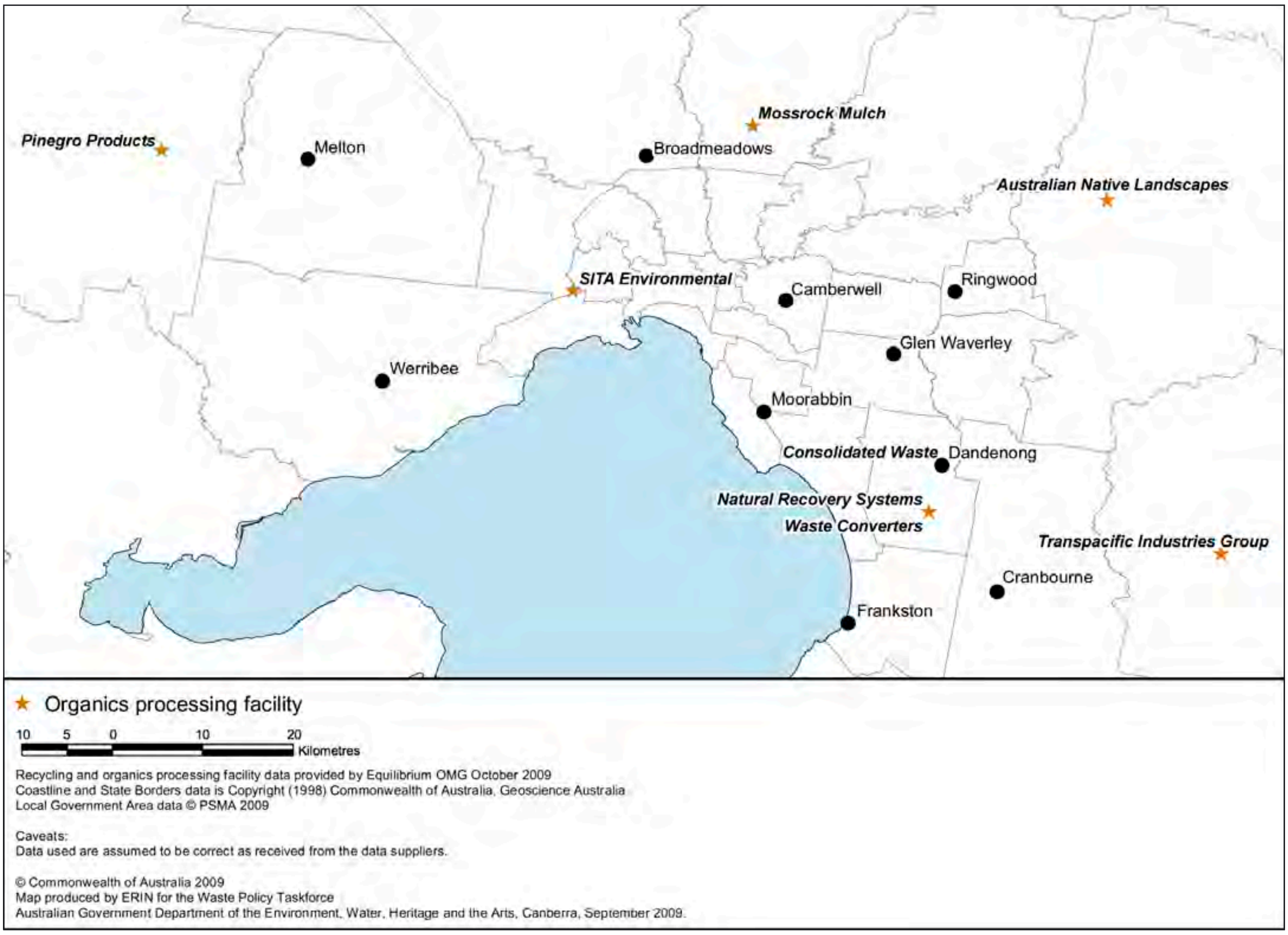


Table 2.12: Victoria—organics processing facilities—details

Name	Materials	Source of materials
Argus Recycling, Dandenong	Organics	C&I
Australian Native Landscapes, Coldstream	Organic/garden matter	Local government kerbside green waste collection—transfer stations
Consolidated Waste, Dandenong	Organic/garden matter	Local government kerbside green waste collection—transfer stations
Mossrock Mulch, Epping	Organic/garden matter/wood waste	Local government kerbside green waste collection—transfer stations
Natural Recovery Systems, Dandenong South	Organic/garden matter	Local government kerbside green waste collection—transfer stations
Pinegro Products, Bacchus Marsh	Organic/garden matter	Local government kerbside green waste collection—transfer stations
SITA Environmental, Brooklyn	Organic/garden matter	Local government kerbside green waste collection—transfer stations
Transpacific Industries Group, Pakenham	Organic/garden matter	Local government kerbside green waste collection
Waste Converters, Dandenong South	Organic/garden matter	Local government kerbside green waste collection—transfer stations

Victorian alternative waste treatment (AWT) facilities

Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic wastes from the municipal mixed waste to landfill stream. Their functions are described more fully in **Chapter 4.7**.

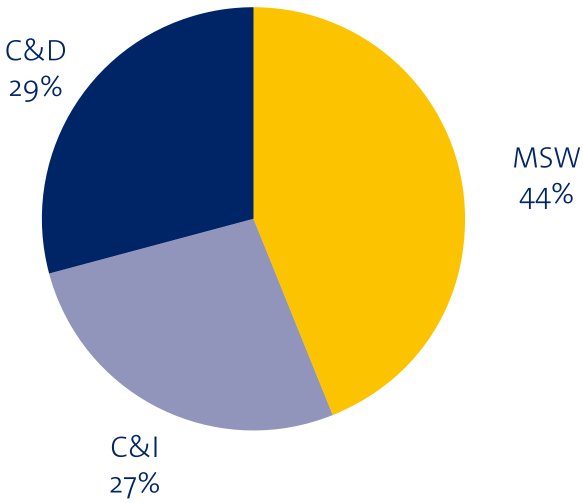
Victoria has one alternative waste treatment plant. The Natural Recovery Systems plant in Dandenong is an in-vessel composting facility. It has been operating since 2001. Located in the City of Greater Dandenong, it services that city and surrounding municipalities. All other Victorian composting facilities are of the open windrow type.

The Victorian Advance Resource Recovery Initiative (VARRI) has been established to facilitate the establishment of AWT facilities in metropolitan Melbourne. It is likely that multiple plants to handle residual and organic wastes will be established in Victoria over coming years. Further information on this initiative is available at <http://www.mwmg.vic.gov.au/varri/>.

Victorian landfill

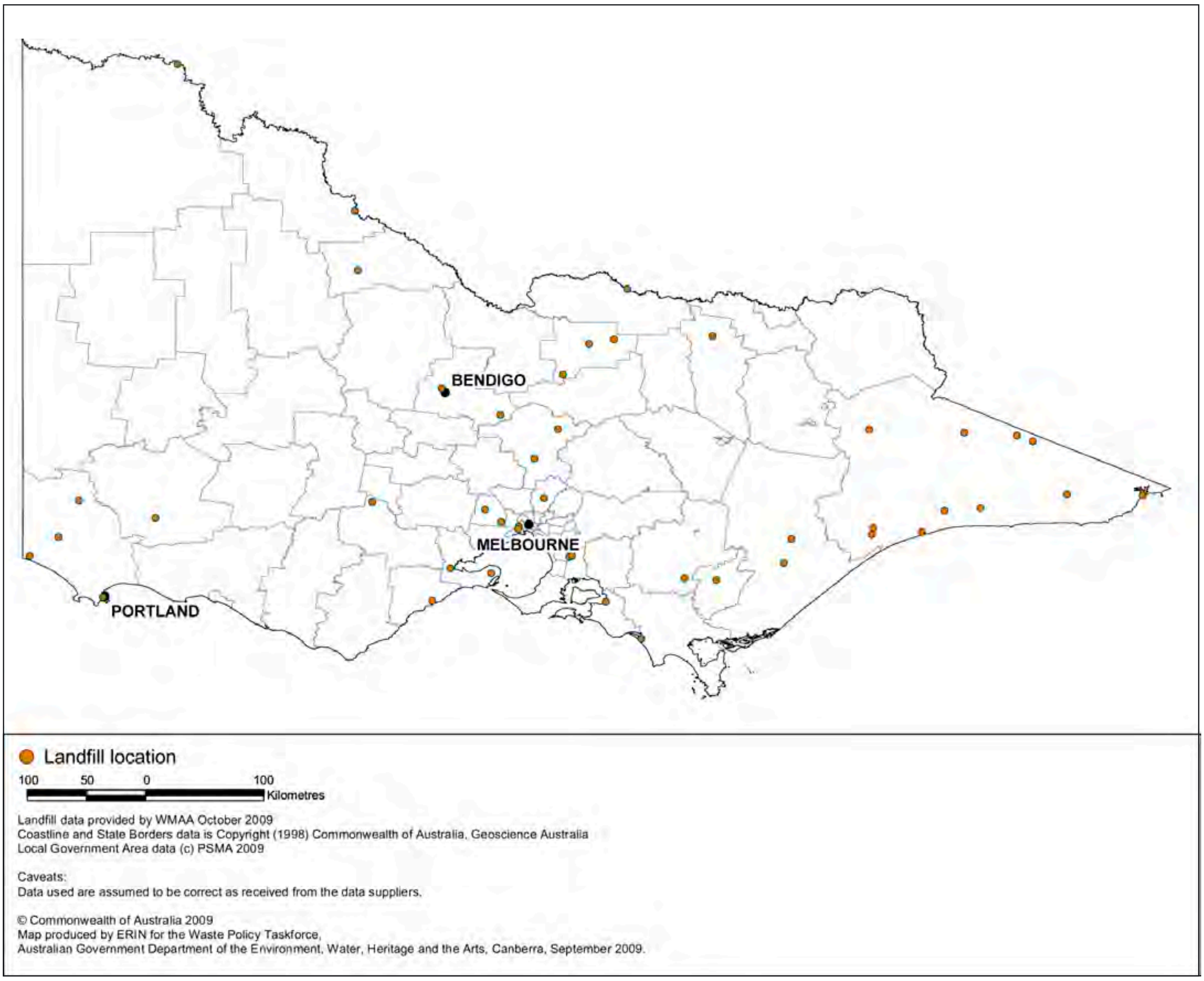
Of the 3 925 000 tonnes of waste sent to landfill in Victoria in 2006–07, municipal waste was the largest component at 44%, or 1 727 000 tonnes.

Figure 2.38: Victoria—waste to landfill apportioned by source, 2006–07



Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1**), **Figure 2.39** shows the location of many of these landfills.

Figure 2.39: Victoria—landfill locations



The ten largest operating landfill facilities for Victoria are detailed in **Table 2.13**. This information was provided by the Victorian Government. The contents of this table are listed in alphabetical order, not by size of landfill. The total municipal and industrial amount of waste (net of cover) sent to these landfills in 2006–07 was 2 521 000 tonnes.

Table 2.13: Victoria—major landfills—details

Current legal name of responsible entity	Landfill location
A J Baxter P/L	Clayton South
A J Baxter P/L	Clayton South
Boral Recycling P/L	Truganina
Hanson Landfill Services P/L	Wollert
Maddingley Brown Coal P/L	Bacchus Marsh
SITA AUST P/L	Hampton Park
SITA AUST P/L	Lyndhurst
Transpacific Cleanaway P/L	Brooklyn
Transpacific Waste Management P/L	Moorabbin
Wyndham City Council	Werribee

Table 2.14: Victoria—other landfills—details

Entity	Name
City of Greater Shepparton, Shepparton	Cosgrove landfill
Corangamite Shire, Naroghid	Corangamite Regional landfill
Latrobe City Council, Morwell	Morwell landfill
Mildura Rural City Council, Mildura	Mildura landfill, transfer station and recycling facility
Moltoni Waste Management, Fyansford	Fyansford landfill
Moltoni Waste Management, Trafalgar	Trafalgar landfill
Moltoni Waste Management, Bairnsdale	Bairnsdale landfill
Shire of Melton, Melton	Melton recycling centre
SITA Environmental, Lyndhurst	Stotts Creek landfill
Swan Hill Rural City, Swan Hill	Swan Hill landfill
Transpacific Industries/Cleanaway, Brooklyn	Brooklyn landfill and recycling
Transpacific Industries/Cleanaway, Clarinda	Clarinda landfill
Transpacific Industries/Cleanaway, Clayton	Clayton landfill

Details of these licences (and all other licences for landfills) are available from EPA Victoria. Individual tonnages cannot be provided for reasons of commercial confidentiality.

Additional landfills in Victoria include some detailed in **Table 2.14**. The identification of additional landfill sites was undertaken as a public domain search. The identification was based on a review of state and territory public registers of licensed landfills and supplemented with searches of government and industry websites. Cross-checking and further investigation was done by wide ranging general searches across the internet and directories including White Pages, Yellow Pages and Green Pages.

Victorian landfill gas

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from Victorian landfills are 2 109 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year is 493 000 tonnes of CO_2-e, or 19% of estimated total production of landfill gas.[‡‡]

Key points

- Over the past decade, Victoria has stabilised and slightly reduced the amount of waste deposited in landfill.
- Most kerbside services collect and recycle paper, plastic and cardboard and there has been growth in recycling in the commercial and industrial sector.
- In 2006–07, 10 285 000 tonnes of waste were generated in Victoria.
- Of that, 6 360 000 tonnes (62%) were recycled and 3 925 000 tonnes (38%) landfilled.[§§]
- Waste generation in Victoria for 2006–07 was 1980 kilograms per person, which is 5% below the national average of 2080 kilograms per person.

‡‡ These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

§§ The figures represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. The *Environment Protection Act 1970* provides for a rebate for cover material of 15% (at the relevant municipal rate) for each tonne of waste deposited at a landfill. The above figures were calculated by taking the tonnes of material received at landfills (including cover material sourced off-site) and reducing this by 15% to allow for cover material. Some landfills source cover material on-site (e.g. from quarrying activities) which are not measured in the tonnes of waste received at landfills. Where landfills have claimed a recycling rebate, this has also been subtracted from the figures. Figures do not include prescribed waste (including low level contaminated soil) deposited to landfill, including where used as cover.

CHAPTER 2.4 QUEENSLAND

Queensland Government perspective

Our methodology

Waste data for the 2006–07 financial year covers the domestic, commercial and industrial (including biosolids), and construction and demolition waste streams sourced from the main sectors of the waste industry. This includes local governments, recyclers, compost manufacturers and landfill operators. The data reported does not include mine tailings, self managed agricultural and domestic wastes, fly-ash, red mud or illegally disposed wastes.

The Department of Environment and Resource Management (DERM) sought information from the (then) 157 local governments and Aboriginal Torres Strait Island (ATSI) councils. One hundred and thirty-two of the councils provided substantial information while a further 11 provided limited information. Seventy-two councils provided information on waste water.

Activity-specific questionnaires were sent to recyclers, waste treatment and incinerator operators, commercial landfill operators and industrial monofils. Responses were received from a number of these operators. DERM also funded the Recycled Organics Unit (ROU) to conduct a survey of the Queensland compost manufacturing industry.

Enquiries were made to ascertain where waste was handled by a number of operators to reduce the potential for double counting. As weights and volumes of some of the wastes (particularly biosolids and organic wastes) can change over time as they decompose and/or dry out, some anomalies may occur.

Our successes

Queensland councils provide kerbside waste collection services to 1 493 000 households (approximately 94% of all households). They also provide 85% of these households with kerbside recycling services. In addition, some local governments and private commercial operations provided limited collection facilities/programs for organic materials (such as green waste and biosolids), concrete, timber, end-of-life computers and used tyres and scrap metals.

In Queensland, both the private waste management industry and local governments provide waste collection, transport, processing, and treatment and disposal services to the commercial sector and residents.

Our challenges

The 16 material recovery facilities (MRFs) currently located in Queensland recover glass, paper and cardboard, plastics, aluminium and steel. Paper, cardboard and glass are re-processed locally while metals and plastics are sent interstate or overseas. Used oil collection facilities can be found in almost all local government areas across the state, with two major re-processing facilities located in Townsville and Brisbane.

Waste concrete is re-processed at facilities in south east Queensland. Tyres are transported to south east Queensland where they are shredded. Some shredded material is recovered for re-processing; however, the majority of used tyres are currently shredded and landfilled.

Currently the costs of waste disposal in Queensland are comparatively low and, as a result, sending waste to landfill is often more financially attractive than resource recovery.

Our priorities

Queensland's waste future lies in applying the principles of the waste hierarchy: prevention; re-use and refurbishment; recycling and composting; waste-to-energy and other recovery; and, as a last resort, disposal to landfill. To instil these principles, Queensland is giving priority to establishing an effective policy framework, increased data collection and analysis, programs that reduce waste volumes and optimise resource recovery, and fostering partnerships and sustainable behaviours.

Outline of the chapter

This chapter provides a snapshot of the following:

- The amounts of waste generated, recycled and landfilled in total and by waste stream in Queensland.
- What can be recycled through municipal collection services in Queensland—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard.*
- The location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in Queensland.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities†
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments
- internet sites, White Pages, Yellow Pages and Green Pages
- *The State of Waste and Recycling in Queensland 2007—Technical Report*, the Department of Environment and Resource Management 2008, and
- *Queensland Waste and Recycling—Report Card 2007*, the Department of Environment and Resource Management 2008.

Amounts generated, recycled and disposed to landfill in Queensland

In 2006–07, 8 081 000 tonnes of waste were generated in Queensland. Of that, 3 779 000 tonnes (47%) were recycled, with 4 302 000 tonnes (53%) being disposed of in landfill. **Figure 2.40** shows the proportions from the municipal solid waste (MSW) stream, the commercial and industrial waste (C&I) stream and the construction and demolition waste (C&D) stream that went to each destination.

For **MSW** total waste generation in Queensland for 2006–07 was 3 100 000 tonnes, or 38% of all waste generated in the state. Queensland recycled 1 365 000 tonnes of MSW. This is a recycling rate of 44%. MSW recycling made up 36% of total Queensland recycling (by tonnage). Queensland sent 1 735 000 tonnes of MSW to landfill in 2006–07, which was 40% of total Queensland landfill disposal.

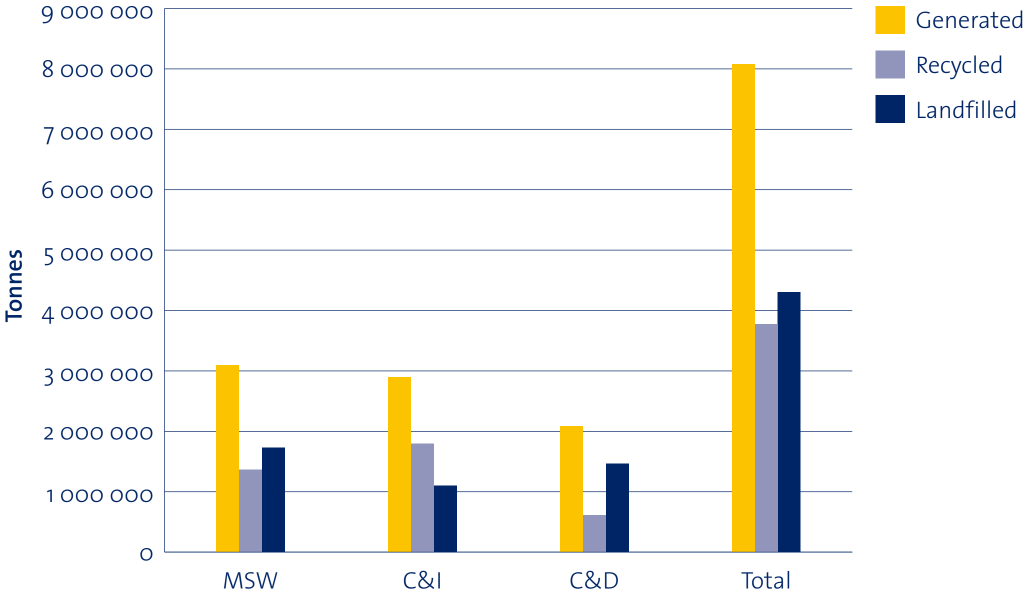
For **C&I**, there were 2 898 000 tonnes generated, which was 36% of total generation in Queensland. There were 1 797 000 tonnes of C&I waste recycled, or 48% of total Queensland recycling. This was a recycling rate of 62%. Queensland disposed of 1 101 000 tonnes of C&I waste to landfill (26% of total landfilling in the state).

For **C&D**, total generation was 2 083 000 tonnes in Queensland for the 2006–07 year. This was 26% of total waste generated in the state. There were 617 000 tonnes of C&D waste recycled, which was 16% of total Queensland recycling, and represents a recycling rate of 30%. Queensland sent 1 466 000 tonnes of C&D waste to landfill in 2006–07, which was 34% of total Queensland landfill disposal.

* Metals and glass also form a significant part of the recovery stream.

† Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

Figure 2.40: Queensland—amounts of waste generated, recycled and landfilled, 2006–07



Waste generation in Queensland for 2006–07 was 1930 kilograms per capita, which is 7% below the national average generation of 2080 kilograms per capita.[‡]

Queensland recycling

Of the 3 779 000 tonnes of material recycled out of the MSW, C&I and C&D streams in Queensland for 2006–07, 48% of the material (by weight) came from the C&I waste stream. The MSW stream produced 36% of total recycling, and the C&D stream 16%.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available. Most of MSW recycling is at the kerbside.

Municipal recycling services—what is collected and where

Around Queensland, households are offered different kerbside recycling services, covering particular configurations of materials, depending on which local government area (LGA) they are in. **Figures 2.41** and **2.42** show what municipal wastes can be recycled, and where.[§]

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Brisbane metropolitan area, this information is also presented.

§ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service.

‡ National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.41: Queensland—municipal recycling of plastics, paper and cardboard, by LGA

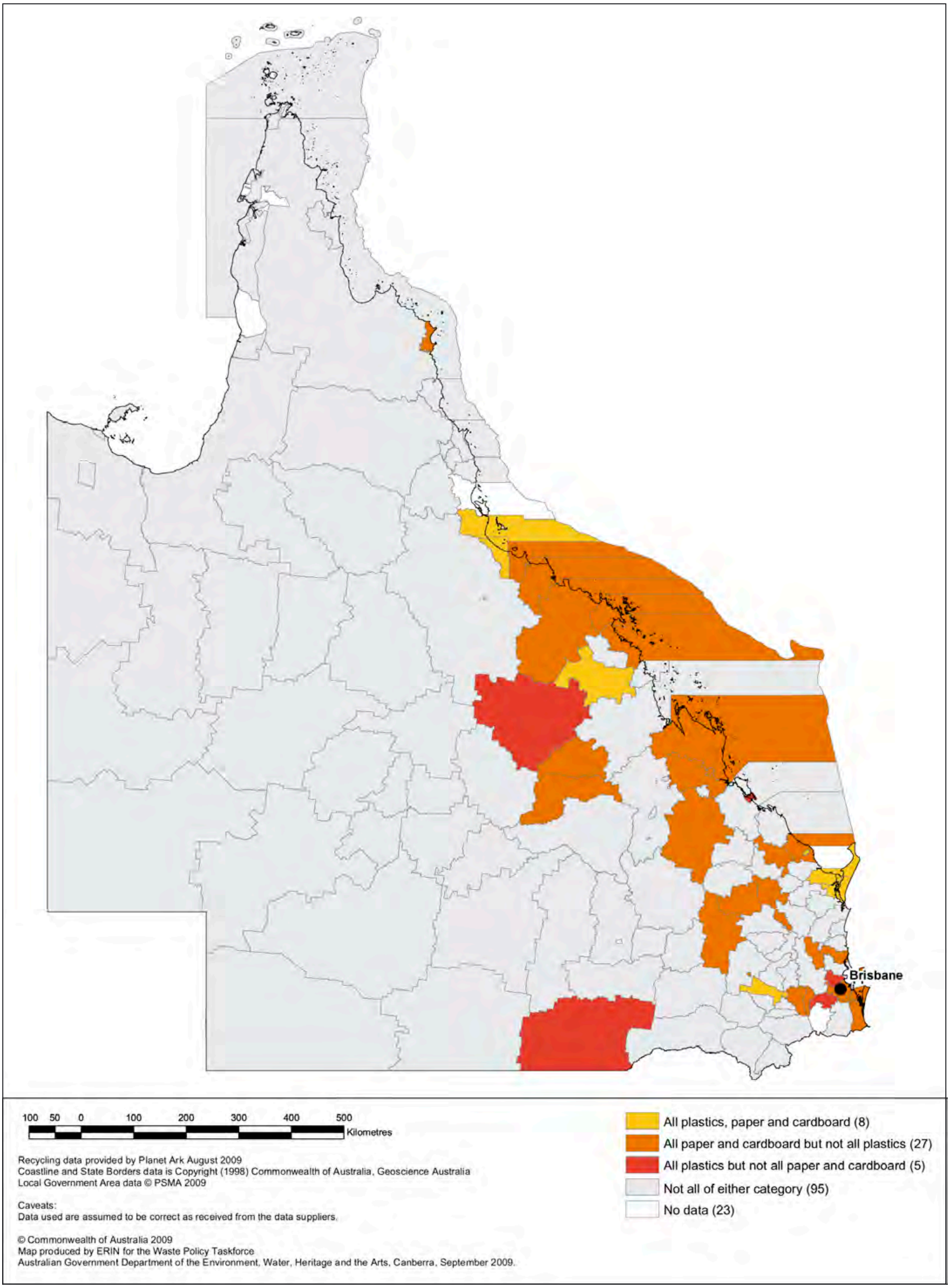
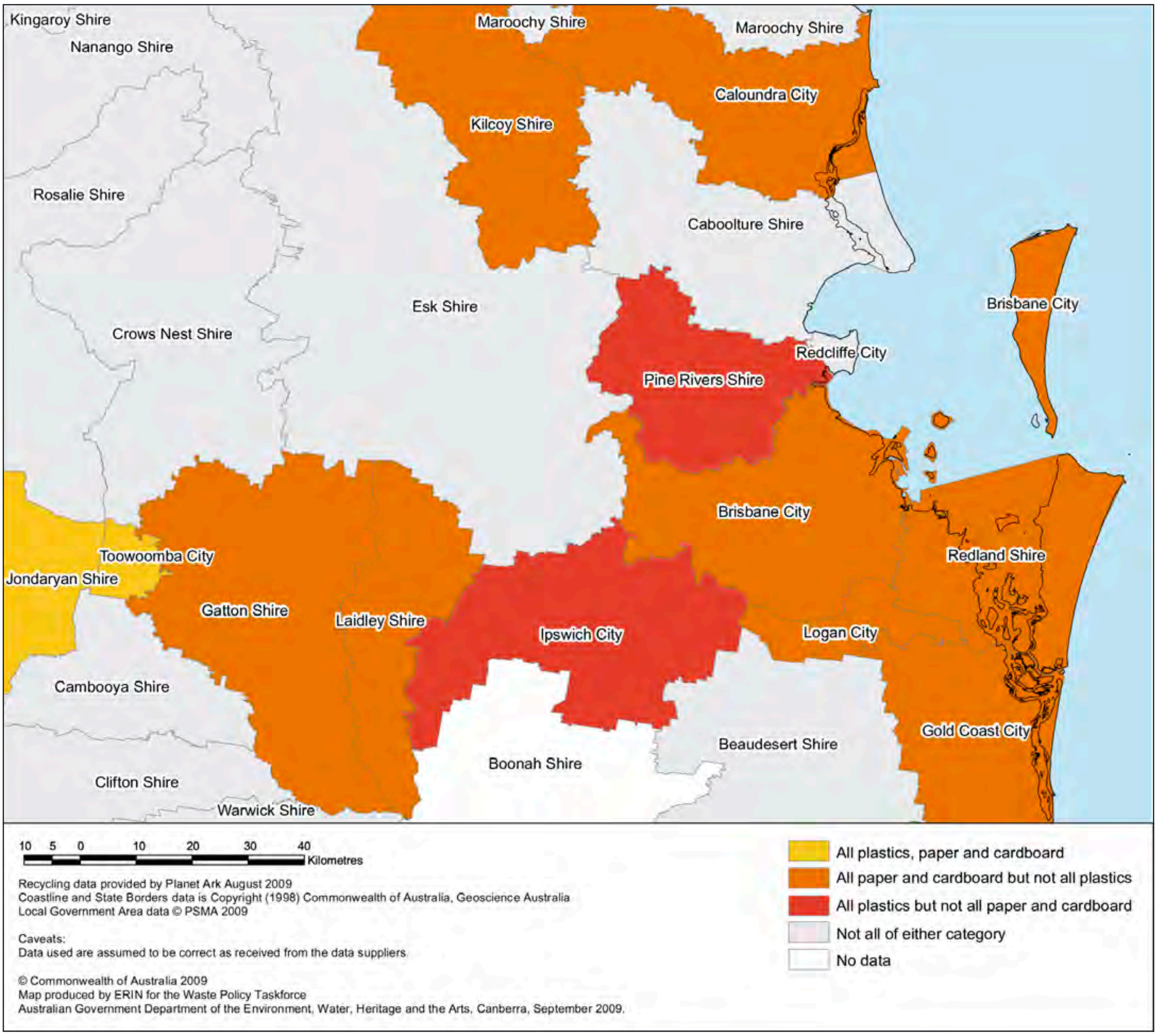


Figure 2.42: Greater Brisbane—municipal recycling of plastics, paper and cardboard, by LGA



Location of recycling facilities

Figure 2.43 shows some of the largest recycling facilities in Queensland, with **Figure 2.44** showing those in the Brisbane area. It is a sample rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in the figures below and **Table 2.15**.

Figure 2.43: Queensland—recycling facilities—location map

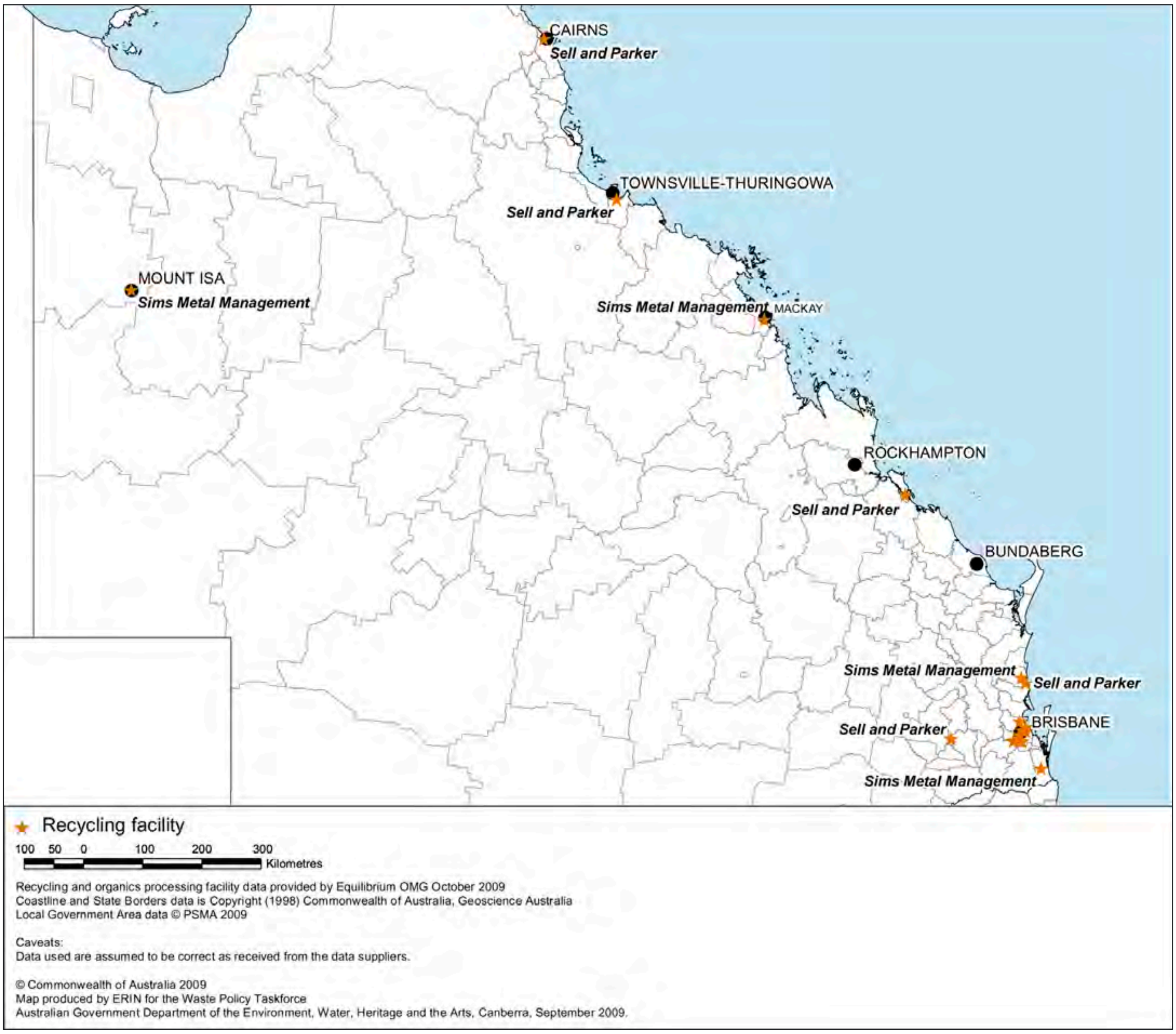
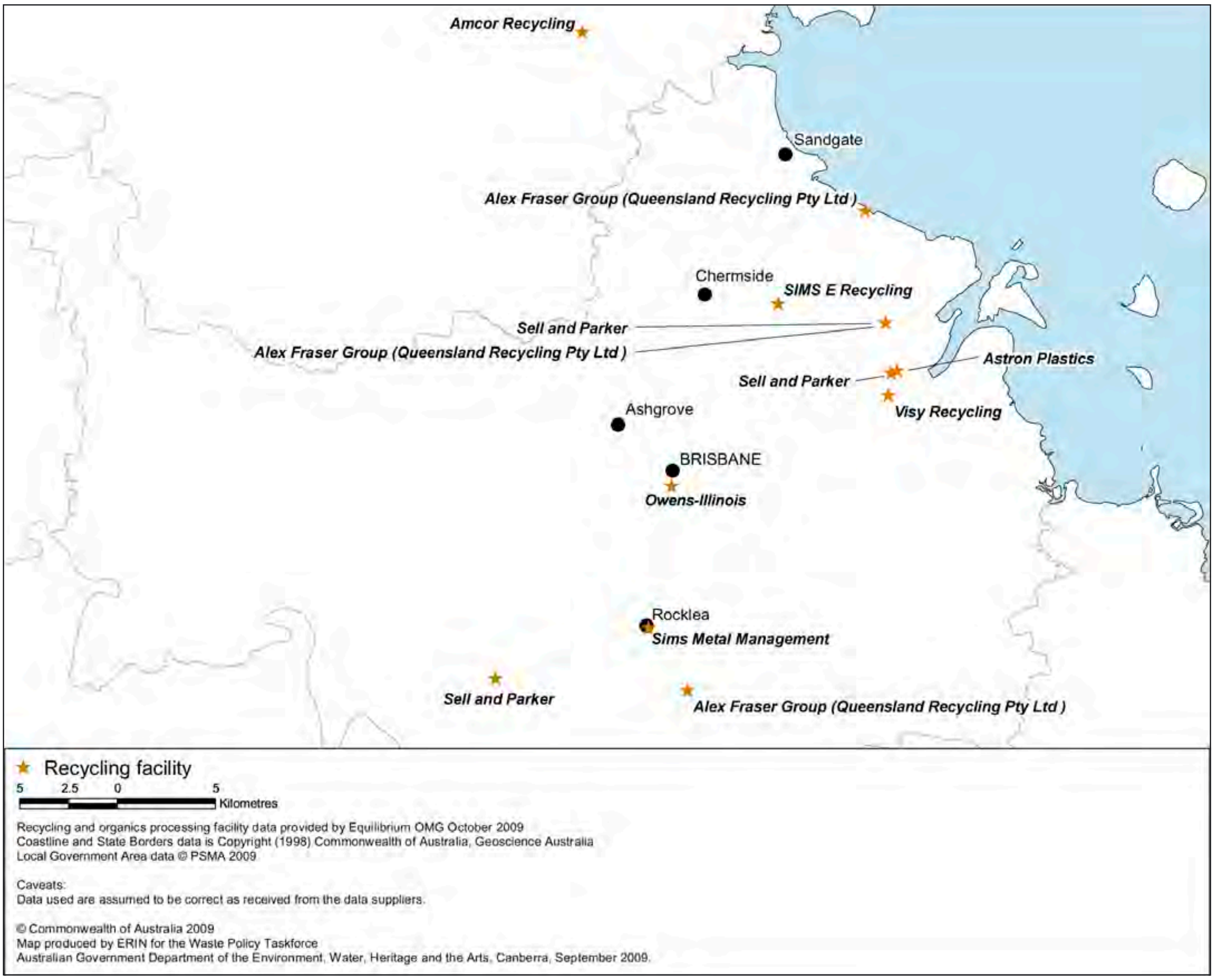


Figure 2.44: Brisbane—recycling facilities—location map



Queensland facilities accept and process the following materials:

Table 2.15: Queensland—recycling facilities—details

Name	Materials	Source of materials
Amcor Paper Recycling, Petrie	Paper	Households, commercial and industrial
Astron Plastics, Pinkenba	Plastic resin clean industrial plastic scrap—LDPE, HDPE, PP and PS	Collection from manufacturers, distributors, warehouses and other businesses that generate significant quantities of clean plastic scrap
Bundaberg Paper & Cardboard, Bundaberg	Paper and cardboard	Businesses, households
North Coast Paper and Cardboard Recycling, Kunda Park	Paper and cardboard	Businesses, households
Owens-Illinois	Glass	Local government, MRFs, transfer stations
Queensland Recycling Pty Ltd, Eagle Farm	C&D waste, concrete, metals, timber, asphalt	Building and demolition industry, local government, transfer stations
Recyclers Australia, Yatala	Metals and plastics	Businesses and households
Sell and Parker, Sumner Park	Metals—including aluminium and stainless steel	Commercial and industrial
SIMS E Recycling, Northgate	e-waste	Businesses and collection centres
Sims Metal Management, Mount Isa	Metal—including aluminium and stainless steel	Commercial and industrial
Veolia Environmental Services, Paget	Cardboard, office paper and printers wastepaper, plastic grades—PET, HDPE, PVC, LDPE, LLDPE, aluminium and steel cans, glass	MSW kerbside and businesses
Visy Recycling, Gibson Island	Cardboard, paper, wastepaper, plastic grades—PET, HDPE, PVC, LDPE, LLDPE, aluminium and steel cans, glass	MSW kerbside and businesses
Yatala Environmental Solutions, Stapylton	Scrap metal, timber, green waste, cardboard & paper, glass, plastics, concrete	Households, commercial and industrial

NOTE: The table does not include additional recycling facilities located in Toowoomba, Cairns, Mackay and Brendale.

Queensland organics processing facilities

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figures 2.45 and **2.46** shows the range and location of major facilities in Queensland for processing organic wastes. They present a snapshot rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in the figures below and **Table 2.16**.¶

¶ There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.45: Queensland—organics processing facilities—location map

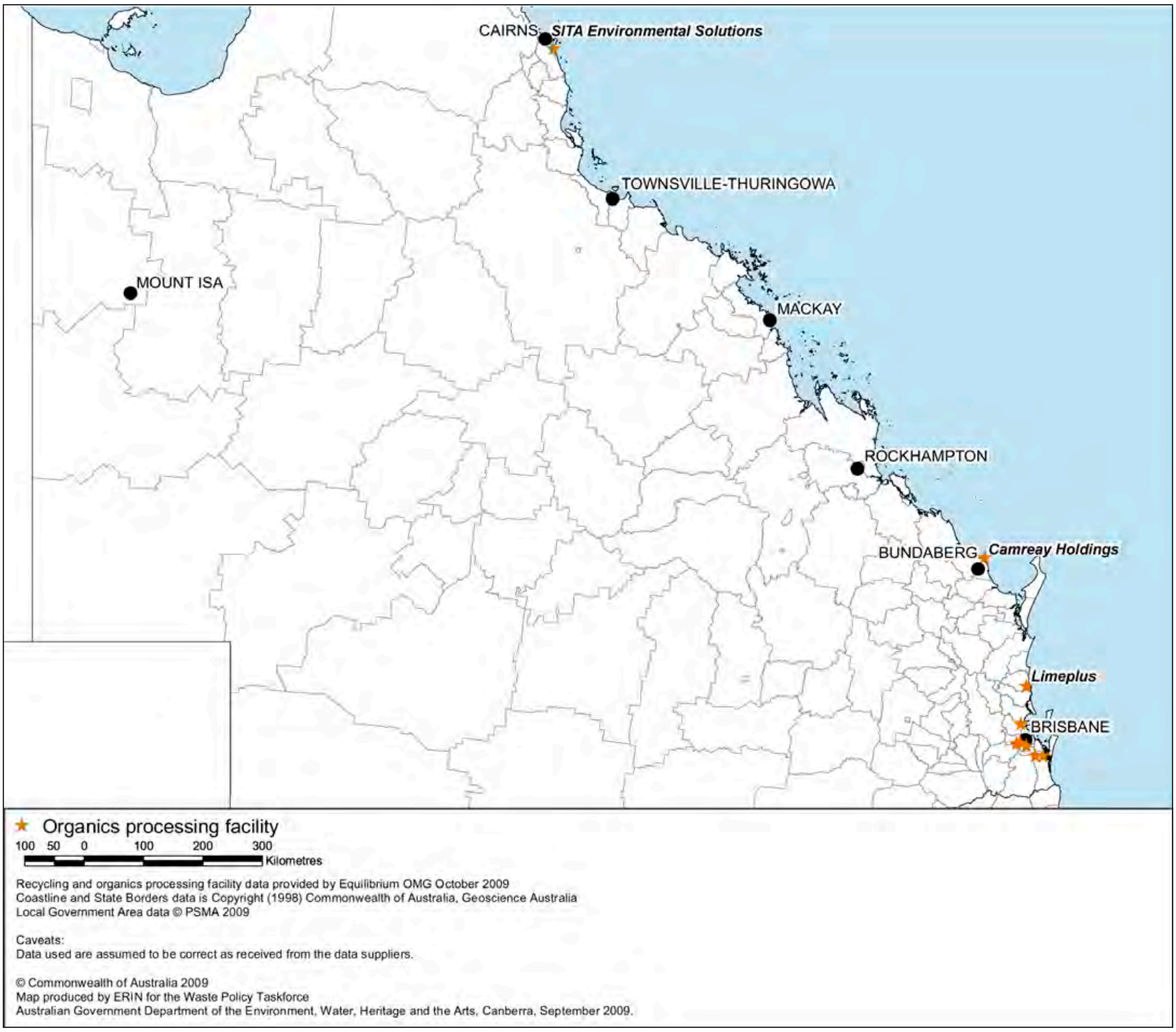
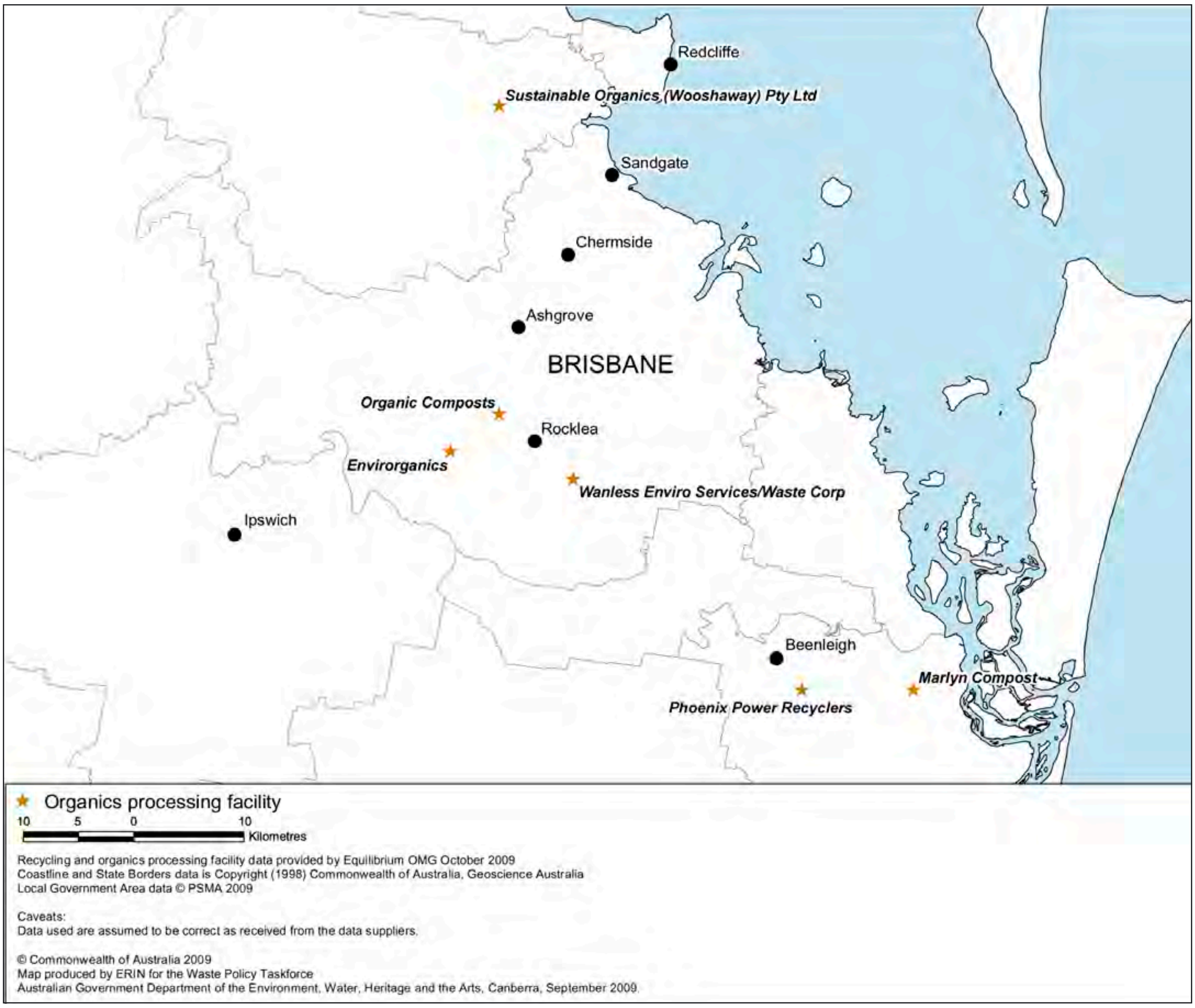


Figure 2.46: Brisbane—organics processing facilities—location map



Queensland facilities accept and process the following materials:

Table 2.16: Queensland—organics processing facilities—details

Name	Materials	Source of materials
Camreay Holdings, Bundaberg	Biosolids mixed with sugar cane	Bundaberg East Treatment Plant
Envirorganics, Mount Ommaney	Organic fertilisers and soil conditioners	Organic by-products from intensive agricultural fertilisers
Limeplus, Buderim	Recycled gypsum, organic fertilisers	
Marlyn Compost, Woongoolba	Compost	Households
Organic Composts, Chelmer	Organic waste	Households
Phoenix Power Recyclers, Yatala	Garden and organic material	Households and businesses
SITA Environmental Solutions, Cairns	Organic material (composting)	Households and businesses
Sustainable Organics, Petrie	Organic material	Households and businesses
Wanless Enviro Services/Waste Corp, Coopers Plains	Organic liquid waste	Businesses

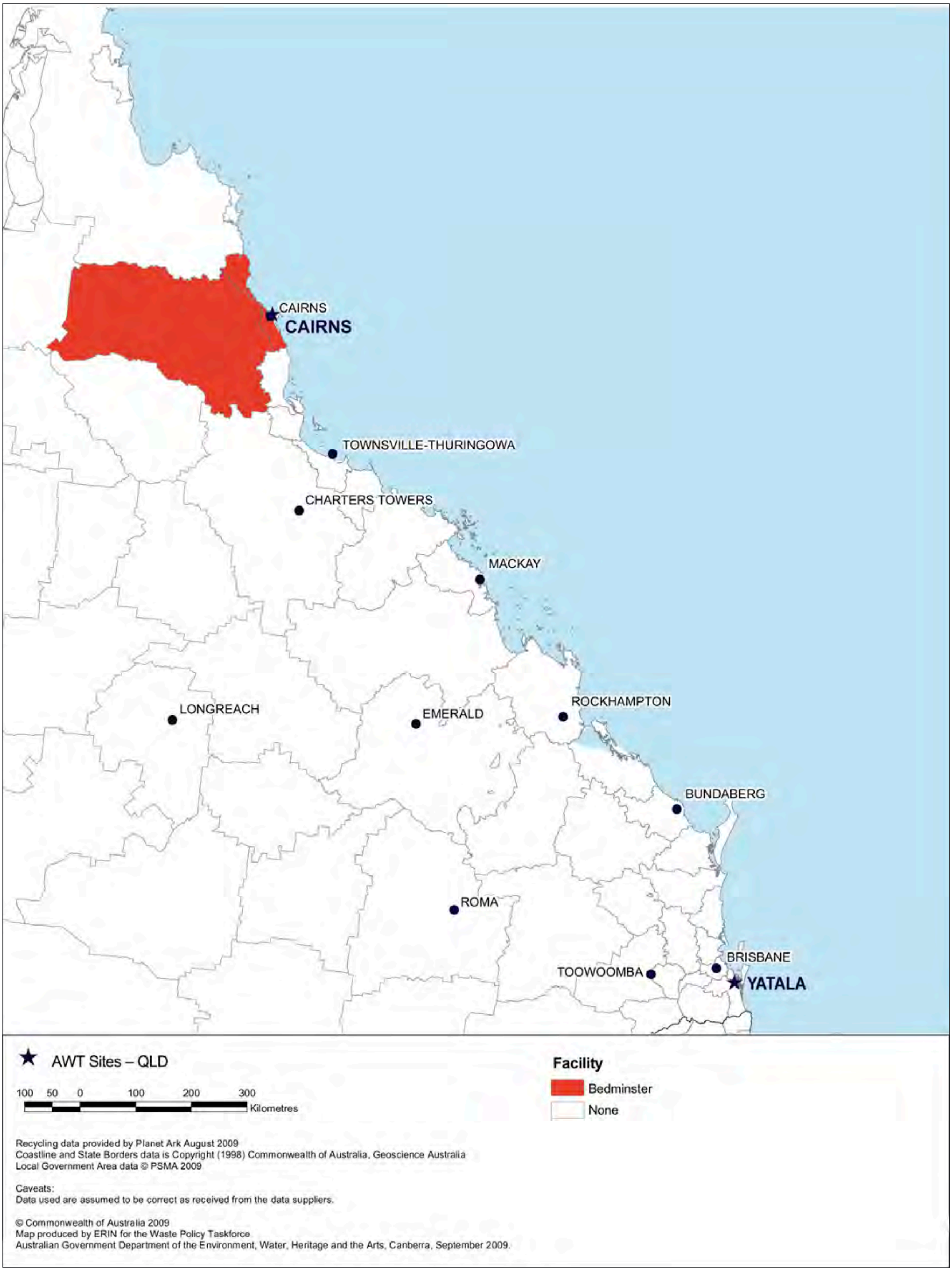
Queensland alternative waste treatment (AWT) facilities

Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic waste from the municipal mixed waste to landfill stream. Their functions are described more fully in **Chapter 4.7**.

Figure 2.47 shows Queensland's two major alternative waste treatment facilities. A plant in Cairns uses the Bedminster process for aerobic in-vessel composting of organic materials. It accepts commingled C&I waste and MSW (after recycling). The facility commenced operation in 2002 and is operated by SITA. It services the Cairns Regional Council and what was the ex-Mareeba Shire Council area of the Tablelands Regional Council.

The Rocky Point Green Power plant at Yatala in south-east Queensland is a 30 megawatt biomass cogeneration plant. It commenced cogeneration in 2001, having been an operating sugar mill. The plant takes municipal green waste, bagasse and construction timber waste from across the south east region of Queensland. Queensland also has several sugar mills generating energy solely from bagasse.

Figure 2.47: Queensland—AWT facilities—location map



Queensland landfill

Municipal waste was the largest component of the 4 302 000 tonnes of waste sent to landfill in Queensland for 2006–07, 1 735 000 tonnes or 40%.

The data in the map are derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1** of this Report).

The ten largest operating landfills for Queensland are detailed in **Table 2.17**. This information was provided by the Queensland Government.

The Queensland Government has data on the total amount of waste that local governments landfill, but not the amount that is deposited in individual landfills. Data for the private sector landfills are commercial-in-confidence. For these reasons, it is not possible to supply individual tonnages or tonnage ranges.

A number of facilities landfill volumes of the order of a million tonnes of material (including clean fill, contaminated soil, acid sulphate soil and other regulated wastes) per annum.

Some additional operating landfills in Queensland are listed in **Table 2.18**. The identification of additional landfill sites was undertaken as a public domain search.

Annual tonnage information for these landfills was not publicly available.

Figure 2.48: Queensland—waste to landfill apportioned by source, 2006–07

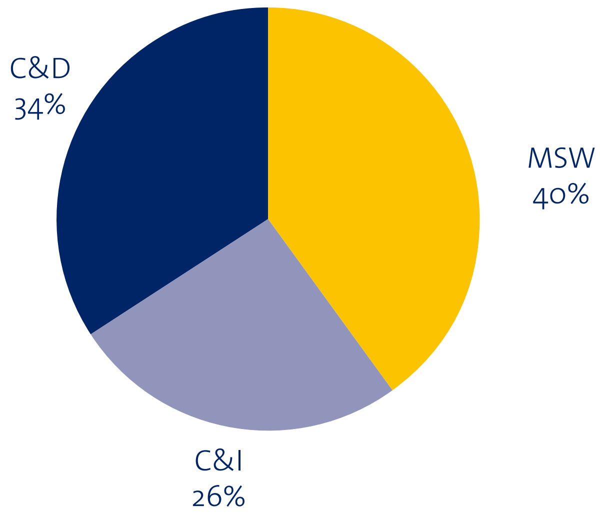
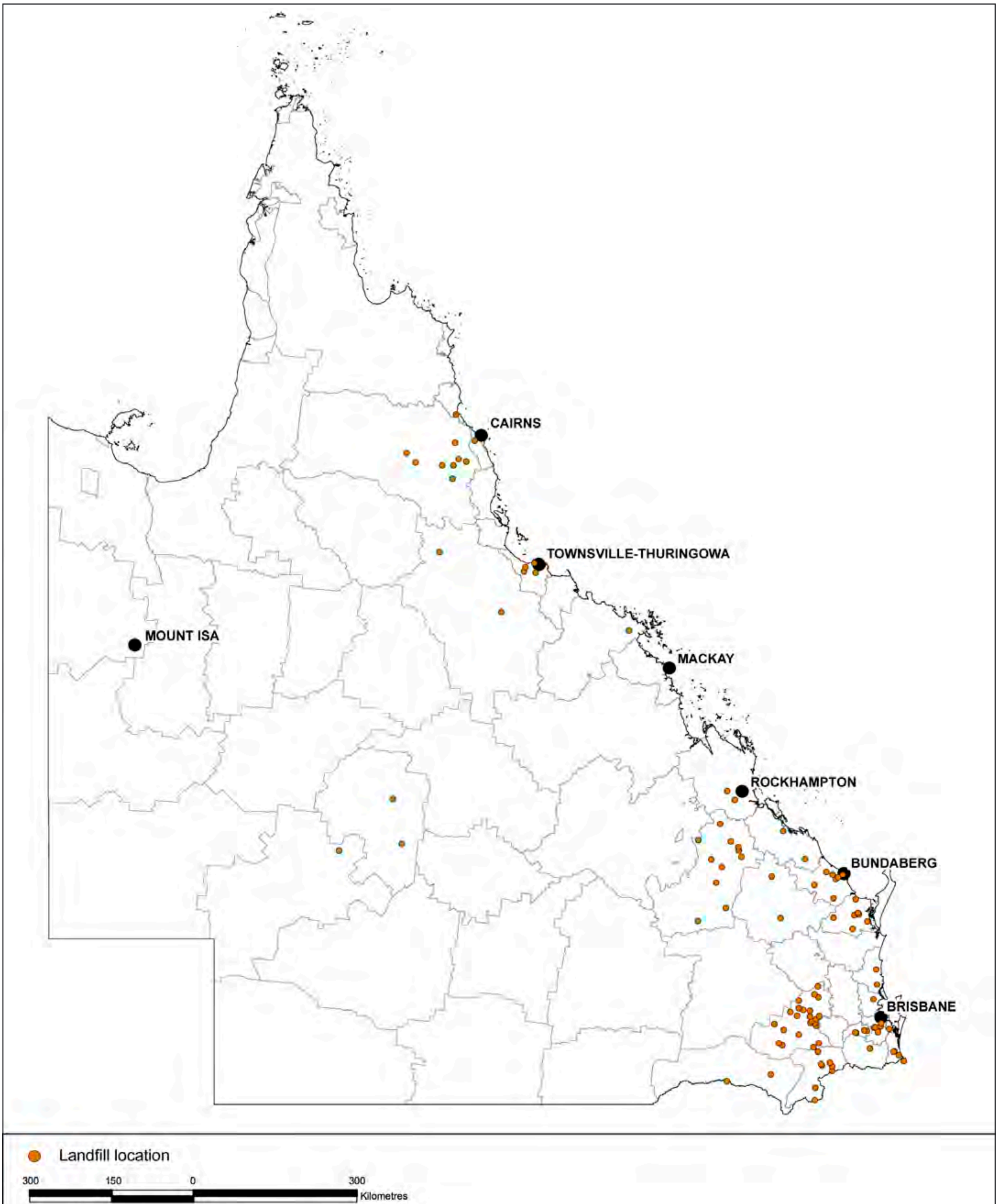


Figure 2.49: Queensland—landfill locations



Landfill data provided by WMAA October 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data (c) PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce,
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

Table 2.17: Queensland—major landfills—details

Operator (private/local government)	Location	Service area (LGAs covered)	Landfill type
Private	Willowbank, Ipswich	SEQ	Inert and putrescible
Private	Swanbank, Ipswich	SEQ	Inert and putrescible
Private	New Chum, Ipswich	SEQ	Inert
Local Government	Rochedale, Brisbane	BCC	Inert and putrescible
Local Government	Staplyton, Gold Coast	GCCC	Inert and putrescible
Local Government	Nambour	SCRC	Inert and putrescible
Local Government	Stuart, Townsville	Nth Qld	Inert and putrescible
Private	Swanbank, Ipswich	SEQ	Inert
Private	Acacia Ridge, Brisbane	SEQ	Inert and C&D
Private	Smithfield, Cairns	FNQ	Inert

Table 2.18: Queensland—additional landfills—details

Entity	Name
Veolia Environmental Services (Australia) Pty Ltd, Redbank Plains	Wattle Glen landfill site
Transpacific Industries Group, Willawong	Willawong landfill
Veolia Environmental Services (Australia) Pty Ltd, Carrara	City Links landfill site
Veolia Environmental Services (Australia) Pty Ltd, Willowbank	Ti-tree landfill site

The table was sourced from:

- a review of state and territory public registers of licensed landfills
- searches of Government and industry websites, and
- internet and directory searches including White Pages, Yellow Pages and Green Pages.

Greenhouse emissions and gas capture

Organic materials can decompose in landfills and produce methane, a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to the atmosphere for 2006–07 of greenhouse gases from Queensland landfills were 2 503 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year was 178 000 tonnes of CO_2-e, or 7% of estimated total production of landfill gas.**

** These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this Report.

Key points

- Queensland councils provide kerbside waste collection services to 1 493 000 households (approximately 94% of all households). They also provide 85% of these households with kerbside recycling services.
- Queensland has several plants that generate energy from biomass and in particular from bagasse.
- In 2006–07, 8 081 000 tonnes of waste were generated in Queensland.
- Of that, 3 779 000 tonnes (47%) were recycled, with 4 302 000 tonnes (53%) being disposed of in landfill.
- Waste generation in Queensland for 2006–07 was 1930 kilograms per person, which is 7% below the national average generation of 2080 kilograms per person.

CHAPTER 2.5
WESTERN AUSTRALIA

Western Australia Government perspective

1. Perspective on waste/recycling data and overall performance:

The recycling throughput for many inert sites has increased since mid 2008, and after the announcement by the State Government that the landfill levy will increase by 300% for both putrescible and inert landfills, the volume landfilled has dropped 50% in 12 months.

2. Description of factors within resource recovery and waste management that inform interpretation of Western Australia's waste performance and data:

The data used in this report are extrapolated for the whole state from the per person disposal rate within the metropolitan area. Information about the amount of waste diversion from landfilling (i.e. recycling) can be provided across the State based on the local government data in this period as a complete set. However, the Department of Environment and Conservation is unable to provide an estimate of landfill data in all localities because regulatory reporting is restricted to solid waste disposal data within the metropolitan area only. As a consequence, an estimate of overall resource recovery for the whole state reflects local governments located within the Perth metro area and relates to the Perth metropolitan landfilling statistics only.

3. Challenges:

Currently the Department of Environment and Conservation (DEC) collates and manages solid waste to landfill data and resource recovery statistics, limited to the Perth metropolitan area.

In the 2006–07 statewide survey undertaken by DEC, only 130 of the 143 local governments in WA responded. Following the removal of financial incentives, the 2007–08 return was less successful, with 102 out of 144 local governments providing information.

The extrapolation of metropolitan waste and recycling statistics into statewide data in this report does not convey the individual achievements or challenges of different regions of Western Australia. A notable difference is that the landfill levy does not apply in non-metropolitan areas. The Perth metropolitan area's recovery rate is therefore reduced when considered in this statewide context. The municipal solid waste recovery rate for the Perth metropolitan area alone is conservatively estimated at 31% in 2007–08.

4. Western Australia's priorities:

The Waste Authority of Western Australia's Draft Waste Strategy, which informs the State's waste minimisation, recovery, recycling and disposal policies is currently out for public comment.

An overview of proposed waste management and resource recovery targets detailed in the Draft Waste Strategy is provided below.

Resource recovery targets:

- In metropolitan Perth, at least a 70% recovery rate for municipal waste by 2015 (up from approximately 45%).
- In non-metropolitan regional centres with a population greater than 25 000, at least a 45% recovery rate for municipal waste by 2015.
- The contamination rate of kerbside recyclables collections will be reduced from approximately 25% to 10% by 2015.
- The recovery rate for construction and demolition waste will increase from 14% in 2006–07 to 50% by 2015 and to 70% by 2019.
- The recovery rate for commercial and industrial waste will continuously increase over the lifespan of the strategy. At least one facility for processing commercial and industrial waste will be established by 2015 and a second by 2019.

Outline of the chapter

The chapter provides a snapshot of the following:

- the amounts of waste generated, recycled and landfilled in total and by waste stream in Western Australia
- what can be recycled through municipal collection services in WA—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard, and
- the location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in WA.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time, it may be possible to show the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to show additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from

- Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- internet sites, White Pages, Yellow Pages and Green Pages.

Amounts generated, recycled and disposed to landfill in WA

In 2006–07, 5 247 000 tonnes of waste were generated in WA. Of that, 33% or 1 708 000 tonnes were recycled, with 3 539 000 tonnes (67%) being disposed of in landfill. **Figure 2.50** shows the proportions from the three waste streams that went to each destination.

For **municipal solid waste (MSW)**, total waste generation in WA for 2006–07 was 1 424 000 tonnes, or 27% of all waste generated in the state. WA recycled 408 000 tonnes of MSW waste. This is a recycling rate of 29%. MSW recycling made up 24% of total WA recycling (by tonnage). WA sent 1 015 000 tonnes of MSW to landfill in 2006–07, which was 29% of total WA landfill disposal.

For **commercial and industrial waste (C&I)**, there were 1 476 000 tonnes generated, which was 28% of total generation in WA. There were 891 000 tonnes of C&I waste recycled, or 52% of total WA recycling. This was a recycling rate of 60%. WA disposed of 585 000 tonnes of C&I waste to landfill (17% of total landfilling in the state).

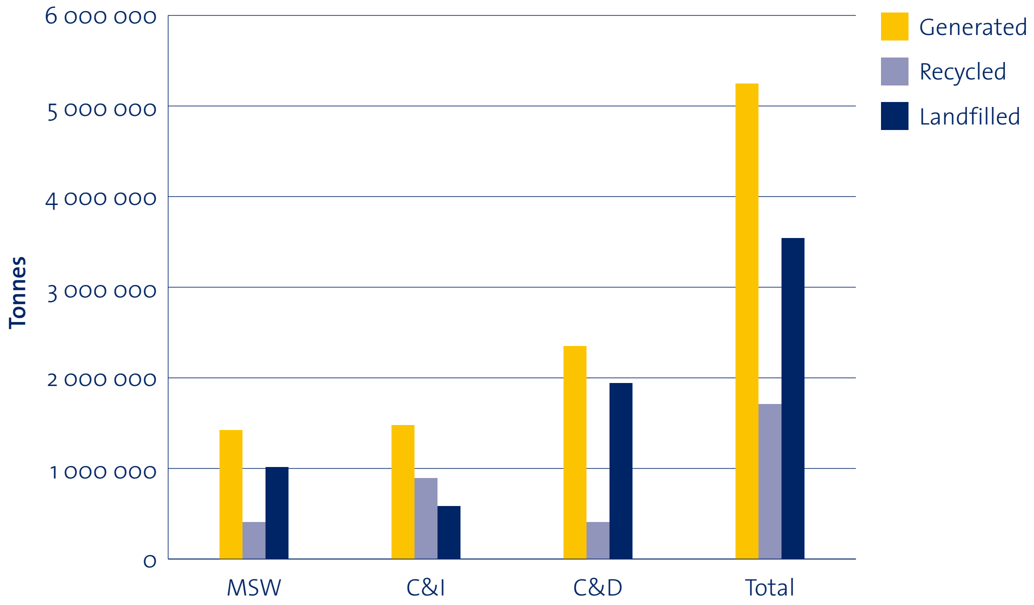
For **construction and demolition waste (C&D)**, total generation was 2 348 000 tonnes in WA for the 2006–07 year. This was 45% of total waste generated in the state. There were 409 000 tonnes of C&D waste recycled, which was 24% of total WA recycling, and represents a recycling rate of 17%.

Waste generation in WA for 2006–07 was 2490 kilograms per person, which is 20% above the national average generation of 2080 kilograms per person.†

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

† National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.50: WA—amounts of waste generated, recycled and landfilled, 2006–07



Western Australia recycling

Of the 1 708 000 tonnes of material recycled out of the MSW, C&I and C&D streams in WA for 2006–07, 52% (by weight) came from the C&I waste stream. The MSW stream produced 24% of total recycling, and the C&D stream also 24%.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available for reporting. Most of MSW recycling is at the kerbside.

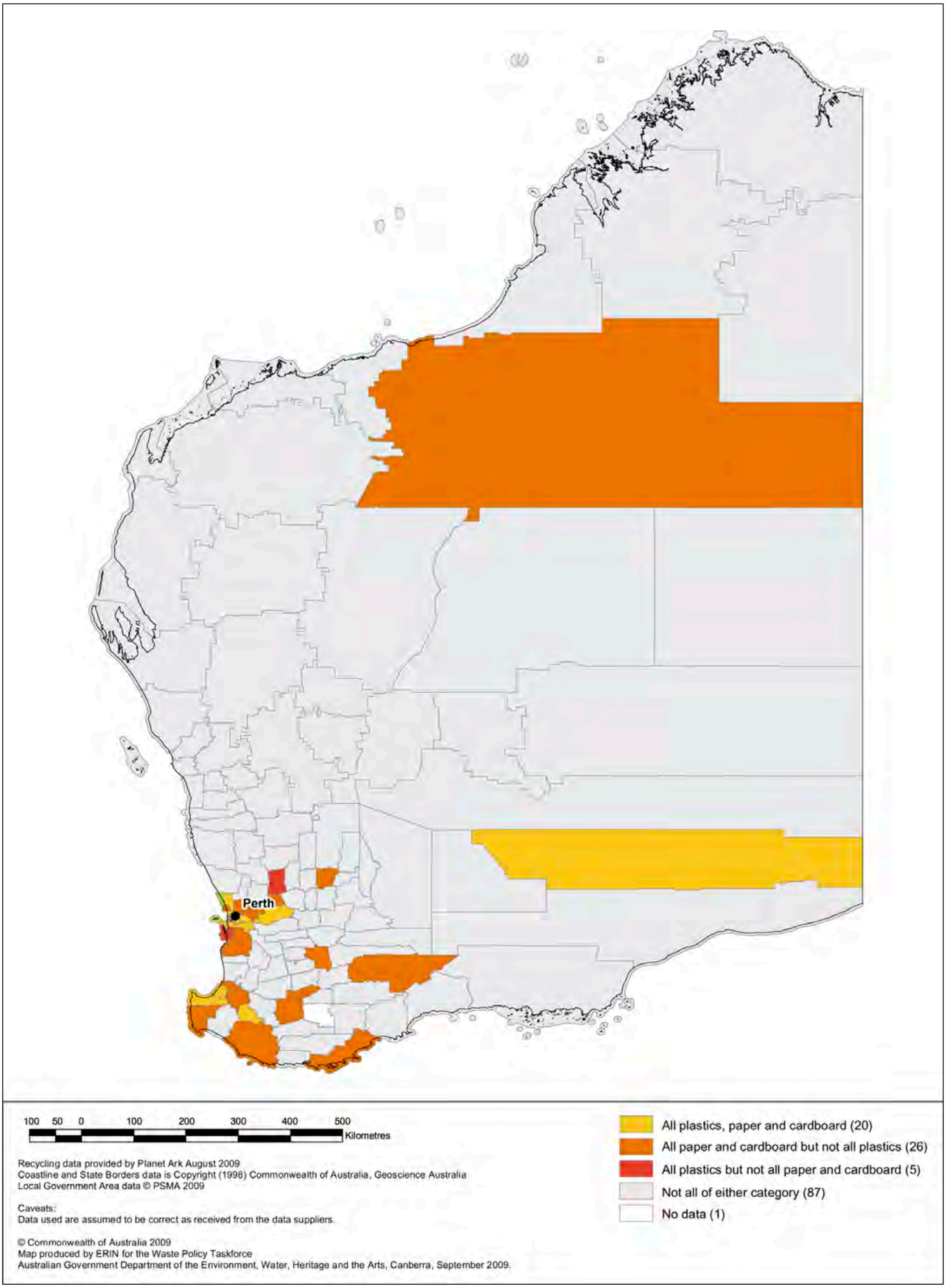
Municipal recycling services—what is collected and where

Around WA, households are offered different municipal recycling services, covering particular configurations of materials, depending on which local government area they are in. **Figures 2.51** and **2.52** show what municipal wastes can be recycled, and where.‡

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Perth metropolitan area, this information is also presented.

‡ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service.

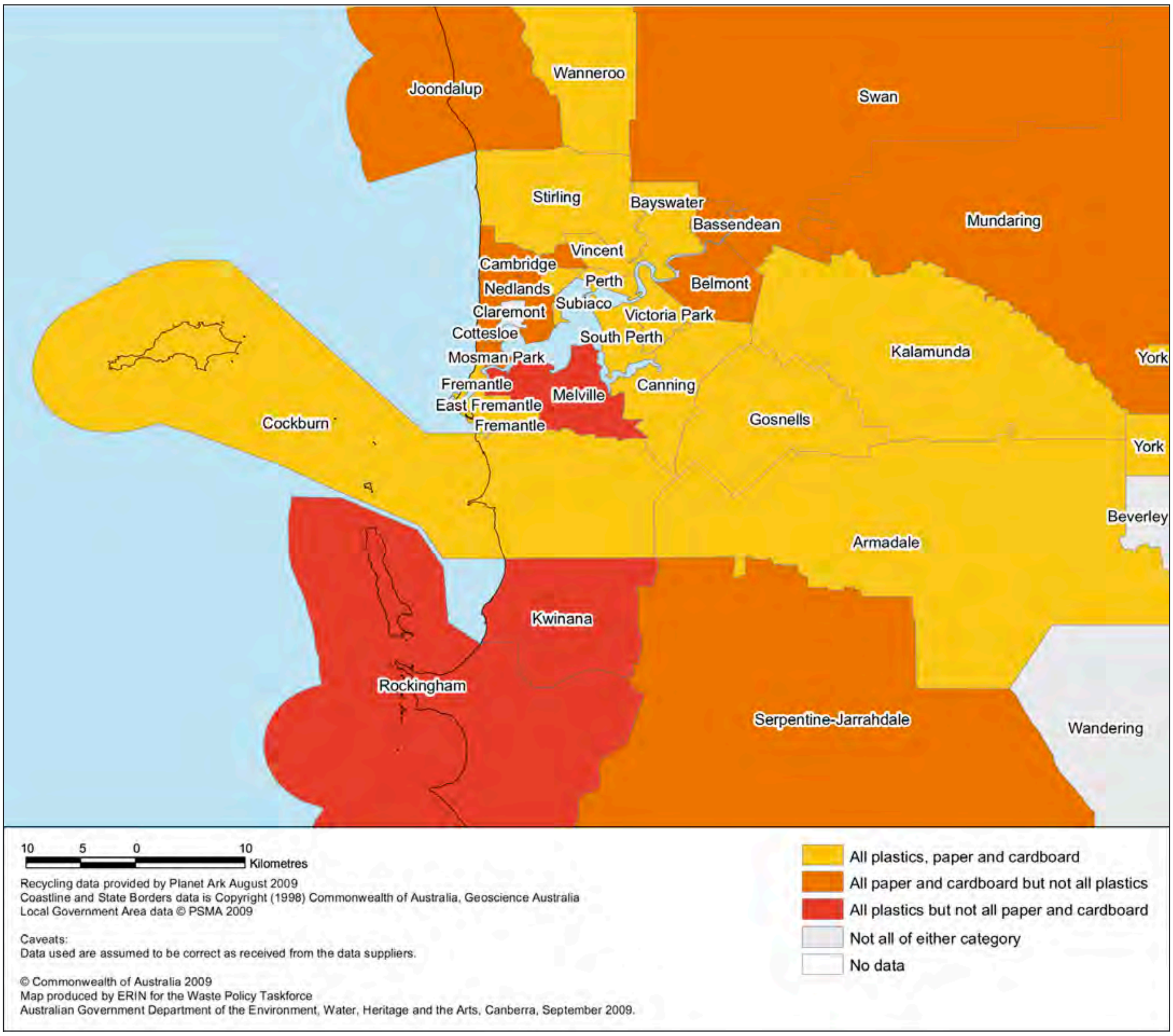
Figure 2.51: WA—municipal recycling of plastics, paper and cardboard, by LGA



This figure shows that of the 139 Local Government Areas (LGAs) in WA, 20 (14%) collect all types of paper, cardboard or plastic through kerbside recycling.

The figure below shows that LGAs in the Perth area are more likely to offer a comprehensive recycling service for the different types of paper and cardboard than for plastics types.

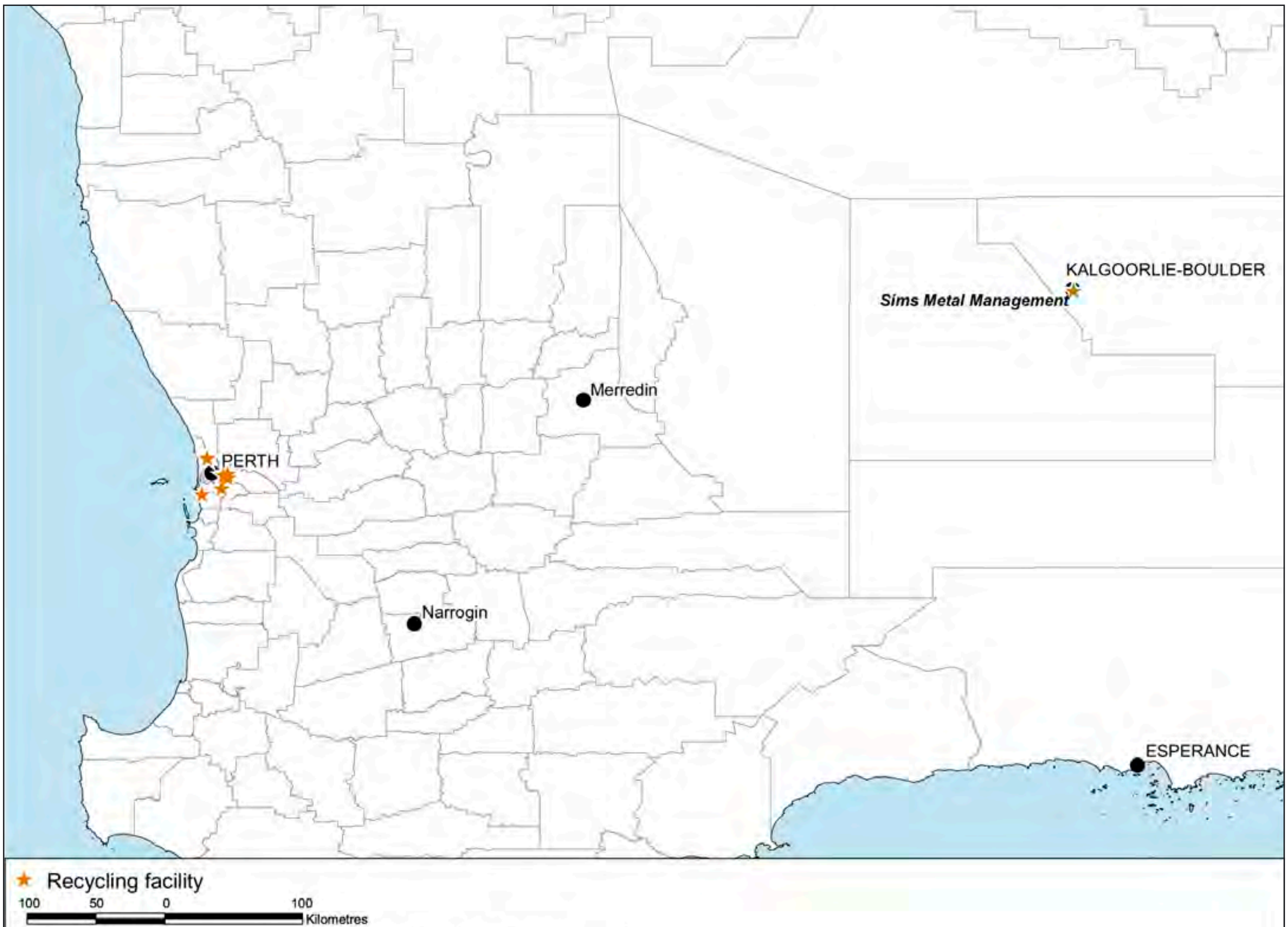
Figure 2.52: Perth area—municipal recycling of plastics, paper and cardboard, by LGA



Location of recycling facilities

Figures 2.53 and **2.54** show some of the largest recycling facilities in WA, highlighting their range and spread, including within the Perth area. It is a sample rather than a comprehensive view of all facilities and information is provided at the beginning of this chapter on the sourcing of data used in the figures below and **Table 2.19**.

Figure 2.53: WA—recycling facilities—location map

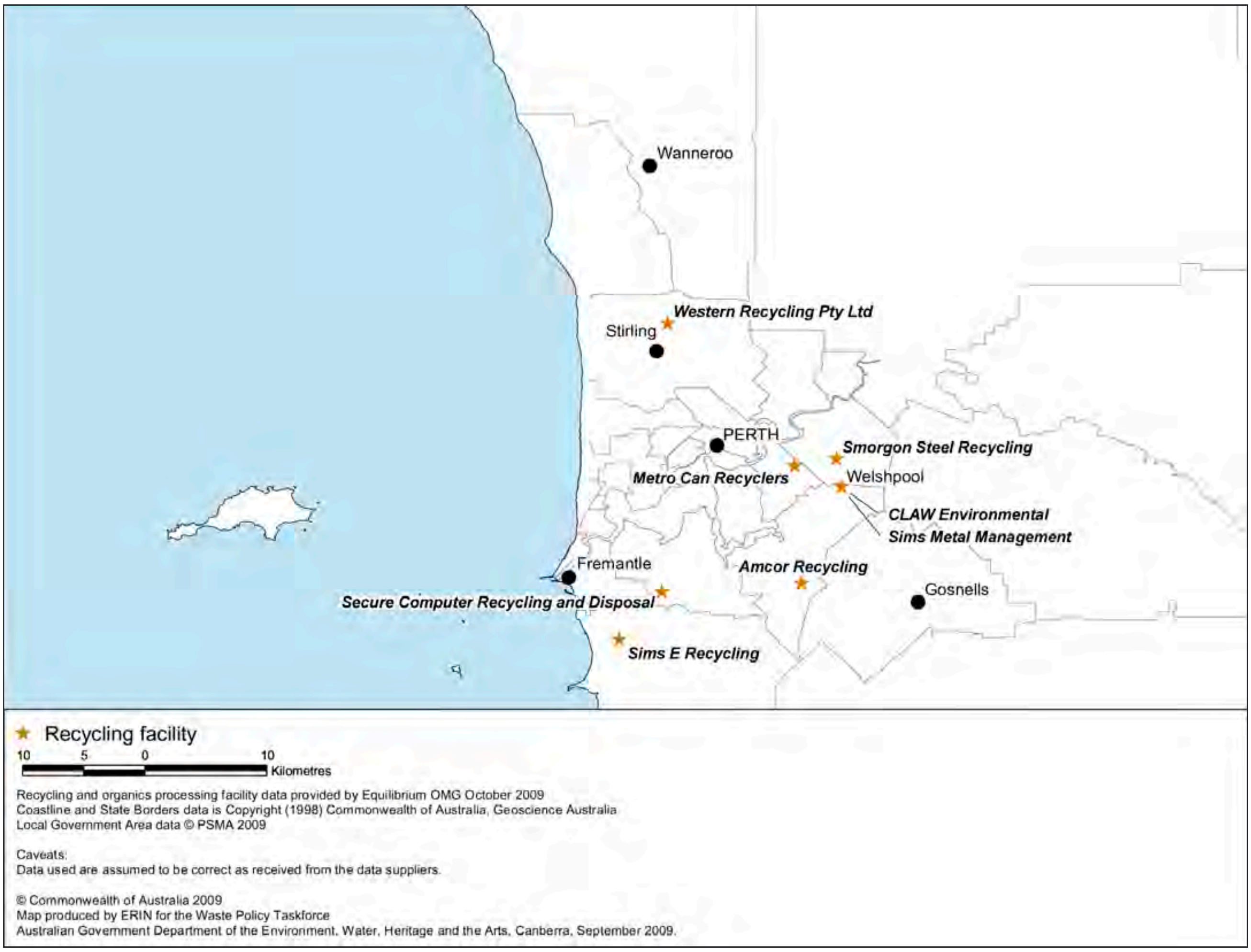


Recycling and organics processing facility data provided by Equilibrium OMG October 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data © PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

© Commonwealth of Australia 2009
Map produced by ERIN for the Waste Policy Taskforce
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

Figure 2.54: Perth—recycling facilities—location map



WA facilities accept and process the following materials:

Table 2.19: Perth—recycling facilities—details

Name	Materials	Source of materials
Amcor Recycling, Canning Vale	Paper	Business
Metro Can Recyclers, Lathlain	Aluminium and steel cans	Households
Sims E Recycling, Spearwood	e-waste	Businesses and collection centres
Sims Metal Management, Welshpool	Metals	C&I
Smorgon Steel Recycling, Cloverdale	Steel	C&I
Western Recycling, Balcatta	Paper	Businesses

WA organics processing facilities

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.55 shows the range and spread of major facilities for processing organic wastes in the Perth and the surrounding region of WA. It is presented as a snapshot rather than a comprehensive view of all facilities and information is provided at the beginning of this chapter on the sourcing of data used in the figure below and the associated table.[§]

§ There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.55: WA—organics processing facilities—location map

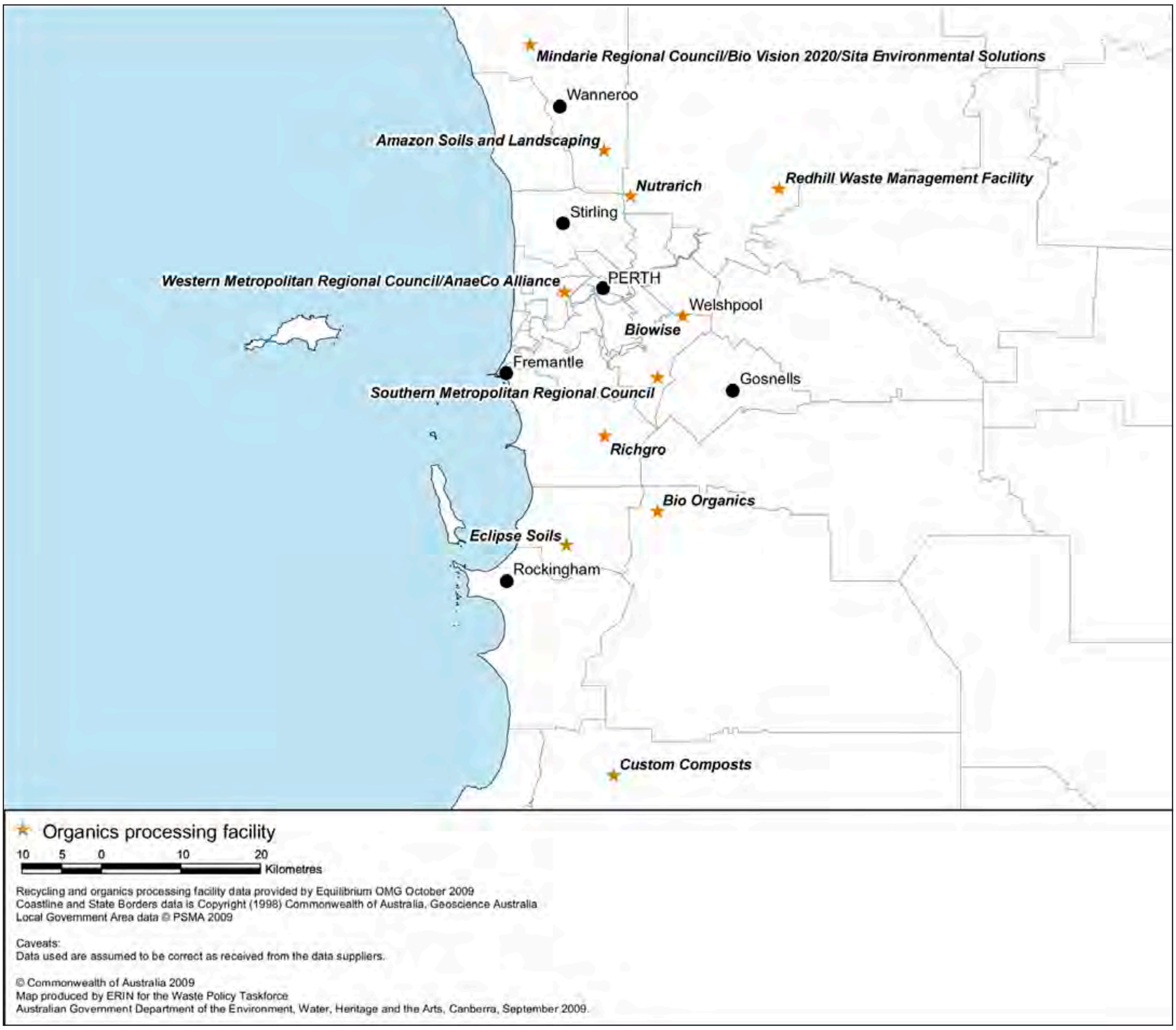


Table 2.20: WA—organics processing facilities—details

Name	Activity	Source of materials
Mindarie Regional Council/Bio Vision 2020/ SITA Environmental, Neerabup	Aerobic composting	Households, businesses
Southern Metropolitan Regional Council, Canning Vale	Bedminster site in-vessel composting facility	Households, businesses
Western Metropolitan Regional Council/ AnaeCo Alliance, Shenton Park	DICOM facility—recycling organic material into compost	Household/kerbside, businesses

WA alternative waste treatment (AWT) facilities

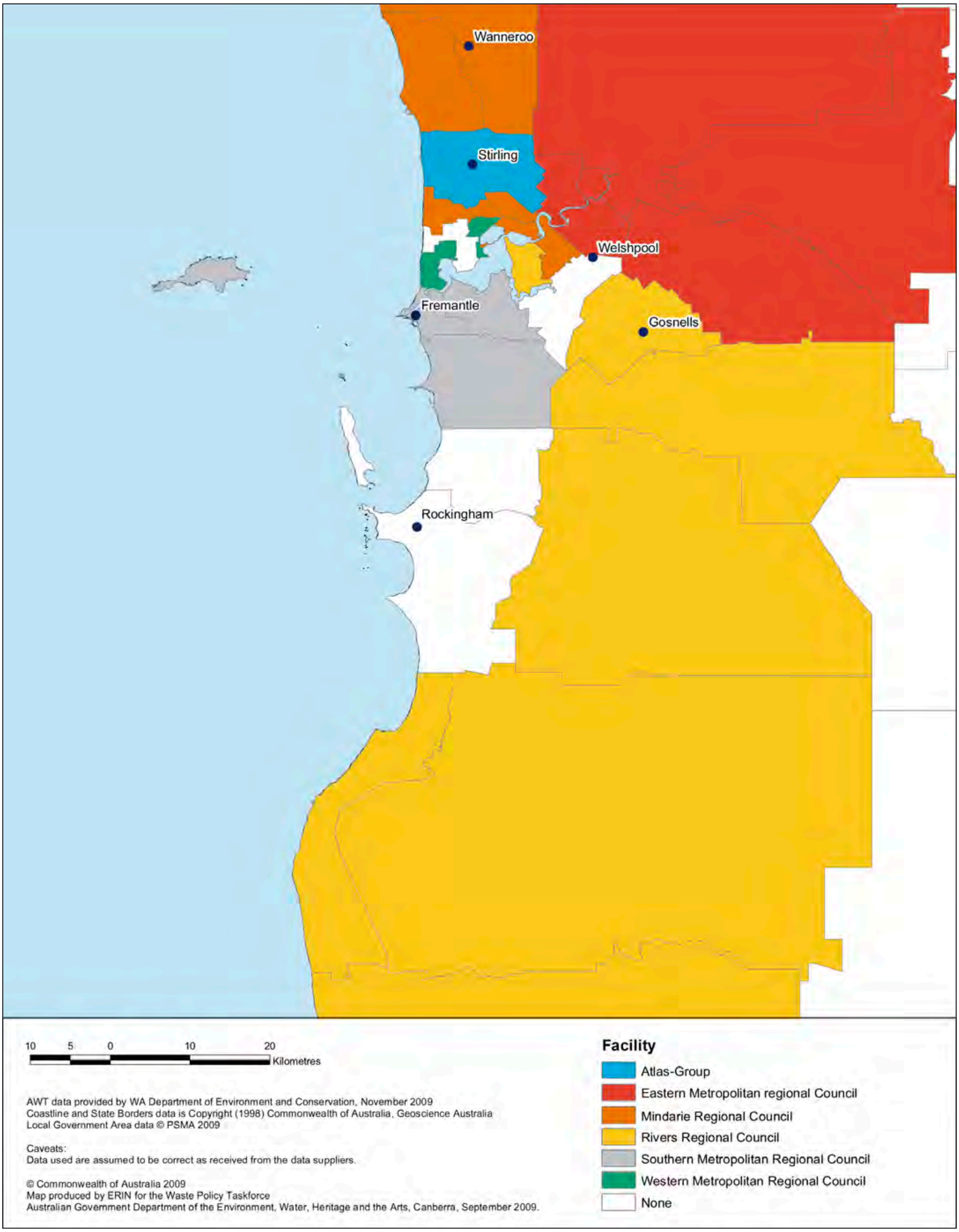
Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic wastes from the MSW stream. Their functions are described more fully in **Chapter 4.7**.

AWT facilities provide opportunities to make significant reductions in the volumes of organic waste currently being sent to landfill. WA has six AWT facilities currently operating or planned and **Figure 2.56** shows areas of WA covered by existing and planned AWT plants.

Table 2.21: WA—AWT facilities, current and planned—details of tonnes per annum (tpa)

Name	LGAs involved	Size	Technology type
Western Metropolitan Regional Council, Shenton Park	City of Subiaco; Towns of Claremont, Cottesloe and Mosman Park; Shire of Peppermint Grove	55 000 tpa (Stage I)	Biological processing of organics; green waste mulching
Mindarie Regional Council, Neerabup	Cities of Wanneroo, Joondalup, Perth and Stirling*; Towns of Cambridge, Vincent and Victoria Park (*not participating in Mindarie AWT; has separate facility)	70 000-100 000 tpa (Stage I)	Composting of waste
Southern Metropolitan Regional Council, Canning Vale	Cities of Cockburn, Canning*, Fremantle, Kwinana*, Melville and Rockingham*; Town of East Fremantle (*not participating in AWT)	80 000 tpa waste composting; 30 000 tpa green waste processing	Composting of waste; green waste processing
Atlas-Group, Mirrabooka	City of Stirling	70 000 tpa	Composting of waste
Rivers Regional Council, Location not yet determined	Cities of Armadale, Gosnells, Mandurah and South Perth; Shires of Murray, Waroona and Serpentine-Jarrahdale	Not yet determined	Not yet determined
Eastern Metropolitan Regional Council, Location not yet determined	Cities of Belmont, Bayswater and Swan; Town of Bassendean; Shires of Mundaring and Kalamunda	Not yet determined	Not yet determined

Figure 2.56: WA—AWT facilities, current and planned—location map



WA landfill

Construction and demolition waste was the largest component of waste sent to landfill in WA for 2006–07, at 1 939 000 tonnes or 54%.

Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3**), **Figure 2.58** shows the location of many of these landfills.

The major WA landfills are detailed in **Table 2.22**. This information was supplied by the WA Government.

Some additional landfills in WA are listed in **Table 2.23** and information is provided at the beginning of this chapter on the sourcing of data used in this table.

Annual tonnage information for all these landfills was not publicly available.

Figure 2.57: WA—waste to landfill apportioned by source, 2006–07

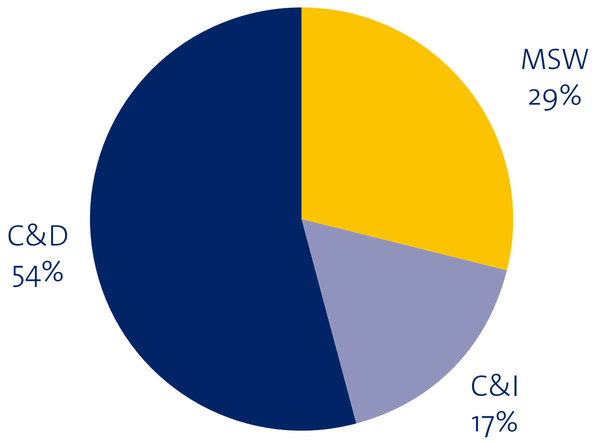


Figure 2.58: WA—landfill locations

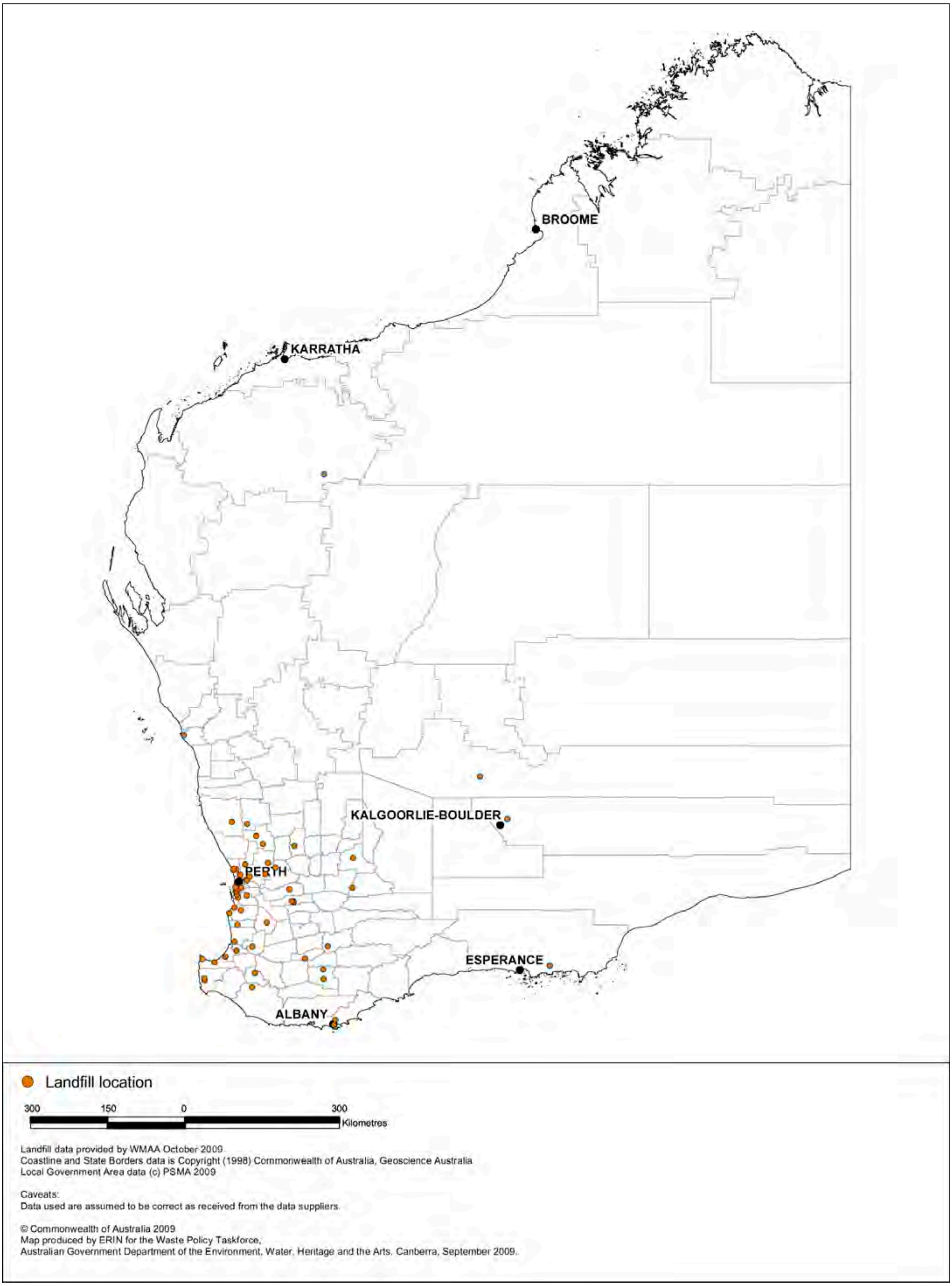


Table 2.22: WA—major landfills—details

Name	Service area (LGAs covered)	Size (tonnes per year disposed, 2006–07)	Landfill type	Owner
Waste Stream Management, Kwinana	All of Metro (located in southern suburbs)	*	Inert	Private
Non Organic Disposals, Driver Road	All of Metro (located in inner northern suburbs)	*	Inert	Private
Mindarie Regional Council, Tamala Park	Perth, Stirling, Joondalup, Wanneroo (northern suburbs)	353 685	Putrescible	Regional Council
Eastern Metropolitan Regional Council, Red Hill	Eastern Metro suburbs and all Metro for Class IV solid wastes	344 815	Putrescible	Regional Council
City of Rockingham, Millar Road	Southern suburbs (LGAs)	308 890	Putrescible	Local Govt
Eclipse Resources, Abercrombie Road	All of Metro (located southern suburbs)	*	Inert	Private
Eclipse Resources, Flynn Drive	All of Metro (located northern suburbs)	*	Inert	Private
RCG Technologies, Quinns Quarry	All of Metro (located northern suburbs)	*	Inert	Private
West Australian Landfill Services, South Cardup	South eastern metro	*	Putrescible	Private
City of Cockburn, Henderson	Southern suburbs (LGAs)	185 592	Putrescible	Local Govt

* Privately operated landfills—data is commercial and confidential.

Table 2.23: WA—additional landfills—details

Entity	Name
City of Albany, Albany	Barkers Junction Waste Management Facility
City of Canning, Canning Vale	Canning Waste Disposal Site
City of Cockburn, Cockburn	Henderson landfill
City of Geraldton-Greenough, Geraldton	Meru waste disposal facility
Moltoni waste management, Hazelmere	Midland Road landfill
Shire of Augusta-Margaret River, Forest Grove	Davis Road disposal site
Steg P/L, Brookton	Buckingham Road landfill
Transpacific Cleanaway, Dawesville	Tim's Thicket septage and inert disposal facility
Veolia Environmental Services, Narngalu	Veolia Environmental Services
Western Australian landfill services (WALS), a joint venture between SITA Environmental Solutions and Pioneer, South Cardup	South Cardup landfill
Opal Vale Pty Ltd, Toodyay	Salt Valley Road Inert Landfill

WA landfill gas

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from WA landfills were 1 094 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year was 945 000 tonnes of CO_2-e, or 46% of estimated total production of landfill gas.[¶]

Key points

- After the announcement by the state government that the landfill levy will increase 300% for both putrescible and inert landfills, the volume landfilled has dropped 50% in 12 months.
- In 2006–07, 5 247 000 tonnes of waste were generated in WA.
- Of that, 33% or 1 708 000 tonnes were recycled, with 3 539 000 tonnes (67%) being disposed of in landfill.
- The recycling throughput for many inert sites has increased since mid 2008.
- Waste generation in WA for 2006–07 was 2490 kilograms per person, which is 20% above the national average generation of 2080 kilograms per person.

¶ These estimates come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

CHAPTER 2.6 SOUTH AUSTRALIA

South Australia Government perspective

South Australia is committed to reducing the amount of waste generated and disposed of to landfill, with *South Australia's Strategic Plan 2007* setting a target of reducing waste to landfill by 25% by 2014.[1] This is underpinned by the targets set for particular waste streams within the *Zero Waste Strategy 2005–2010* as outlined later in this chapter.

Since the adoption of the State Waste Strategy, the total amount of waste disposed to landfill has decreased by over 15% to 2008, despite population growth. Recycling rates continue to grow, and are the highest in Australia, except for the ACT.

Zero Waste SA co-ordinates a range of incentive- and grant-based programs to assist businesses, industry, local government and communities in working towards a zero waste vision for South Australia. Zero Waste SA also partners with other government agencies to deliver the Business Sustainability Alliance, a suite of programs designed to offer stakeholders government services related to sustainability.

South Australia has the nation's only container deposit scheme, which has been in place for around 30 years and enjoys strong community support. More than 20% of packaging recovery in South Australia was via the container deposit scheme in 2007–08[2]—when the refund was still 5 cents per bottle. With the increase of the deposit to 10 cents, recent figures have shown that the total number of containers returned in the first full year of the 10 cent refund was 592.5 million containers—76.8 million more containers than returned in 2007–08. The return rate with the 10¢ refund has increased to 77.7 %.

South Australia has also acted to implement a ban on plastic bags. In November 2009 it was estimated that after six months of the ban operating, some 200 million checkout style bags had been stopped from entering landfill. Research has shown that the ban has strong community support.[3]

State government waste management efforts promote the source separation of waste. There are no alternative waste treatment facilities in South Australia. There is a well-developed locally-based composting industry and refuse-derived fuel is produced for use in a cement kiln.

South Australia has Australia's only television and computer monitor glass recycling facility, capable of processing around 300 000 screens per year.

As a result of the container deposit scheme, South Australia has a network of bottle and can depots across the State. These are considered well-placed to support the collection of further recyclable materials, such as electronic wastes, and a survey of depots by Zero Waste SA this year demonstrated that around 80% of depots would be willing to participate in such a scheme.

The South Australian EPA regulates waste management and resource recovery activities in the state. Most regional councils in South Australia have, with funding assistance from Zero Waste SA, developed or almost completed regional waste management plans which provide a blueprint for infrastructure and services across the state.

South Australian EPA Guidelines released in 2007 set design requirements to be met by landfills of different sizes and types over defined periods.[4] Councils and the EPA have worked together on compliance with these guidelines, resulting in a rationalisation of licensed landfills from over 150 in 2007 to 120 in November 2009, due to the closure of smaller, less-engineered landfills. Improvements to transfer station facilities have often occurred in association with this rationalisation process, as waste management services change.

The EPA also has guidelines, and is developing additional guidelines, to assist in the regulation of various recovered products to support waste recovery and avoid environmental harm.[5] These guidelines will be used as standards for the production and use of three waste-derived products that are put back into the environment—waste-derived fill, waste-derived soil enhancer and refuse-derived fuel. The aim is to conduct this in a safe and scientifically sound manner, consistent with aims set out in the National Waste Policy. It is to be similar in outcome to the Resource Recovery Exemptions in NSW and the 'End of Waste' criteria that form part of the EU Directive on Waste.

Outline of the chapter

The chapter provides a snapshot of the following:

- The amounts of waste generated, recycled and landfilled in total and by waste stream in South Australia.
- What can be recycled through municipal collection services in South Australia—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard.
- The location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in South Australia.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from:

- the Hyder Consulting report Waste and Recycling in Australia (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- internet sites, White Pages, Yellow Pages and Green Pages.

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

Amounts generated, recycled and disposed to landfill in SA

In 2006–07, 3 318 000 tonnes of waste were generated in South Australia (SA). Of that, 66% or 2 173 000 tonnes were recycled, with 1 144 000 tonnes (35%) being disposed of in landfill.† **Figure 2.59** shows the proportions from the municipal solid waste (MSW) stream, the commercial and industrial waste (C&I) stream and the construction and demolition (C&D) waste stream that went to each destination.

For **MSW**, total waste generation in SA for 2006–07 was 753 000 tonnes, or 23% of all waste generated in the state. SA recycled 408 000 tonnes of MSW waste. This is a recycling rate of 54%. MSW recycling made up 19% of total SA recycling (by tonnage). SA sent 344 000 tonnes of MSW to landfill in 2006–07, which was 30% of total SA landfill disposal.

For **C&I**, there were 1 106 000 tonnes generated, which was 33% of total generation in SA. There were 610 000 tonnes of C&I waste recycled, or 28% of total SA recycling. This was a recycling rate of 55%. SA disposed of 496 000 tonnes of C&I waste to landfill (43% of total landfilling in the state).

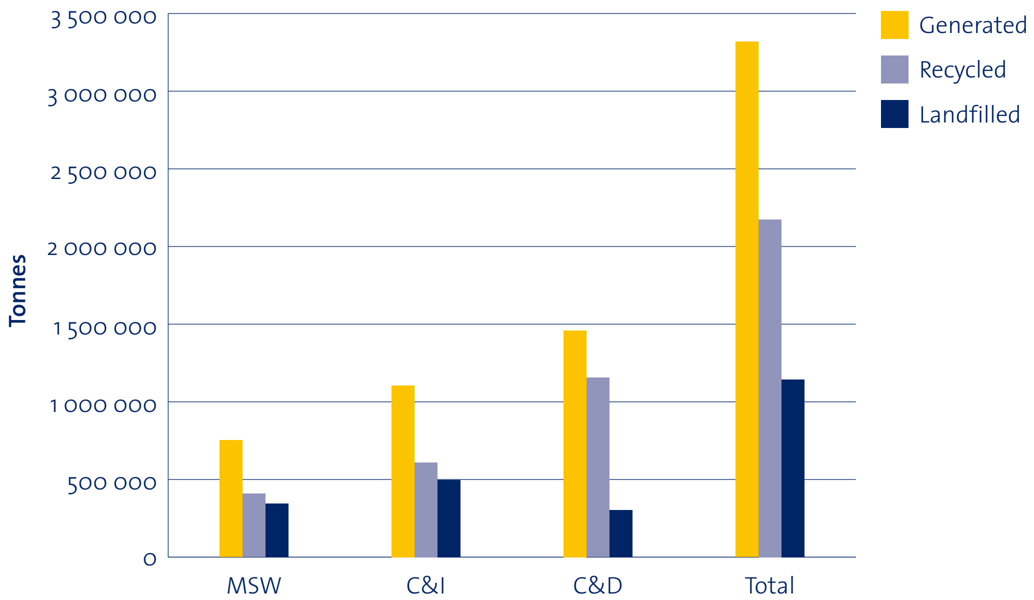
For **C&D**, total generation was 1 460 000 tonnes in SA for the 2006–07 year. This was 44% of total waste generated in the state. There were 1 155 000 tonnes of C&D waste recycled, which was 53% of total SA recycling, and represents a recycling rate of 79%.

Waste generation in SA for 2006–07 was 2090 kilograms per person, which is 0.5% above the national average generation of 2080 kilograms per person.‡

† After the compilation of data for this report, the SA Government provided some revised figures for 2006–07. These lift SA waste generation from 3 318 000 tonnes to 3 578 557 tonnes. Recycling increased from 2 173 000 tonnes to 2 434 128 tonnes (a 68% rather than 66% recycling rate), and waste to landfill increased by 429 tonnes (a landfilling rate of 32%, not 35%). Those figures are available in the *Review of Recycling Activity in South Australia 2006/07* report.

‡ National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.59: SA—amounts of waste generated, recycled and landfilled, 2006–07



SA recycling

Of the 2 173 000 tonnes of material recycled out of the MSW, C&I and C&D streams in SA for 2006–07, 53% of the material (by weight) came from the C&D waste stream. The MSW stream produced 19% of total recycling, and the C&I stream 28%.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available for reporting. Most of MSW recycling is at the kerbside.

Municipal recycling services—what is collected and where

Around SA, households are offered different kerbside recycling services, covering particular configurations of materials, depending on which local government area they are in. **Figures 2.60** and **2.61** show what municipal wastes can be recycled, and where.§

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Adelaide metropolitan area, this information is also presented.

Figure 2.61 shows that many LGAs in the greater Adelaide area provide best practice coverage for the collection of all types of plastics, paper or cardboard by their kerbside collection service.

§ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service. Since these data were entered, the South Australian State Government has advised that additional recycling capacity for plastics, paper and cardboard exists in the Councils of Gawler, Mitcham, Unley, Charles Sturt, Walkerville, NP&SP, Adelaide and Prospect.

Figure 2.60: SA—municipal recycling of plastics, paper and cardboard, by LGA

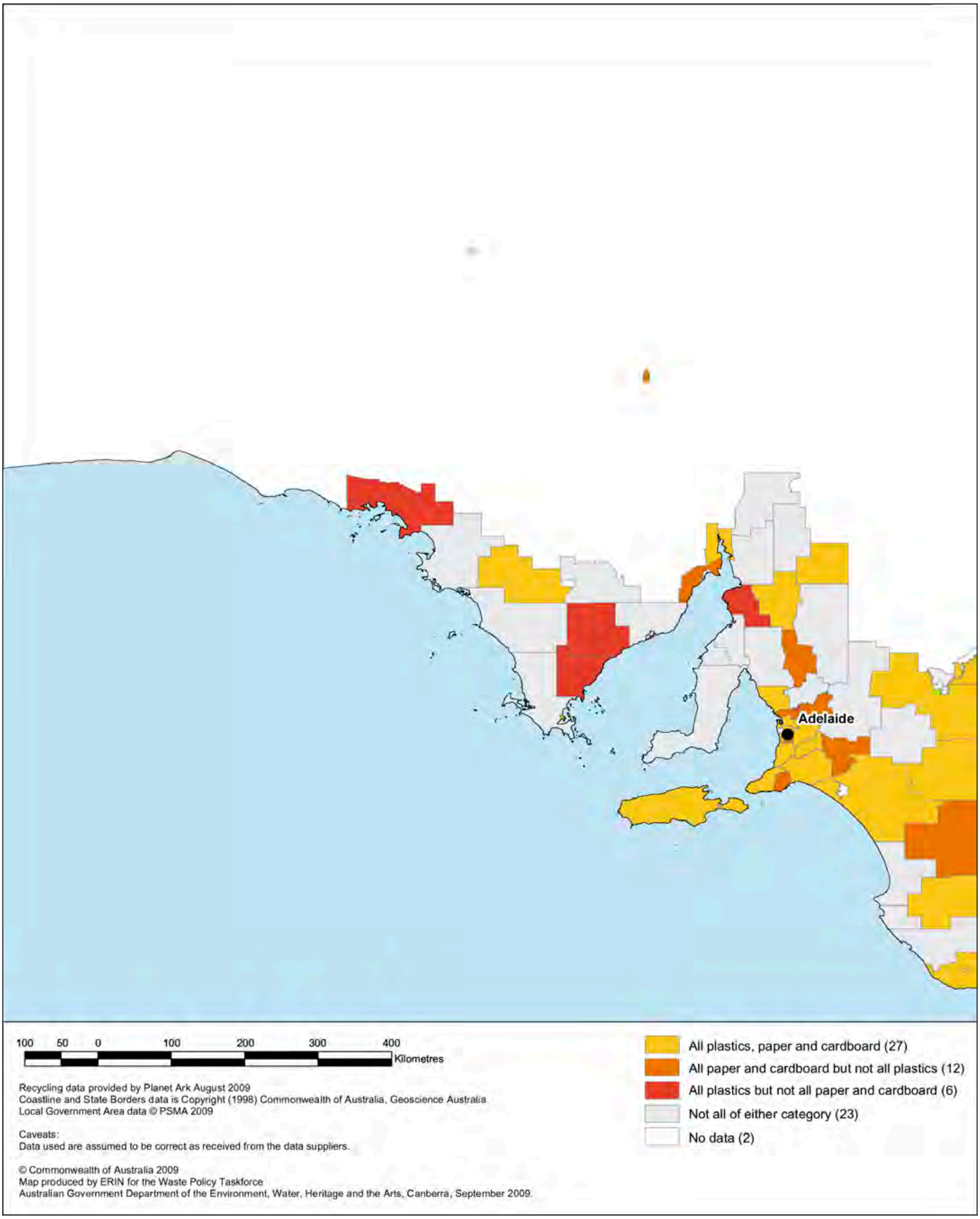
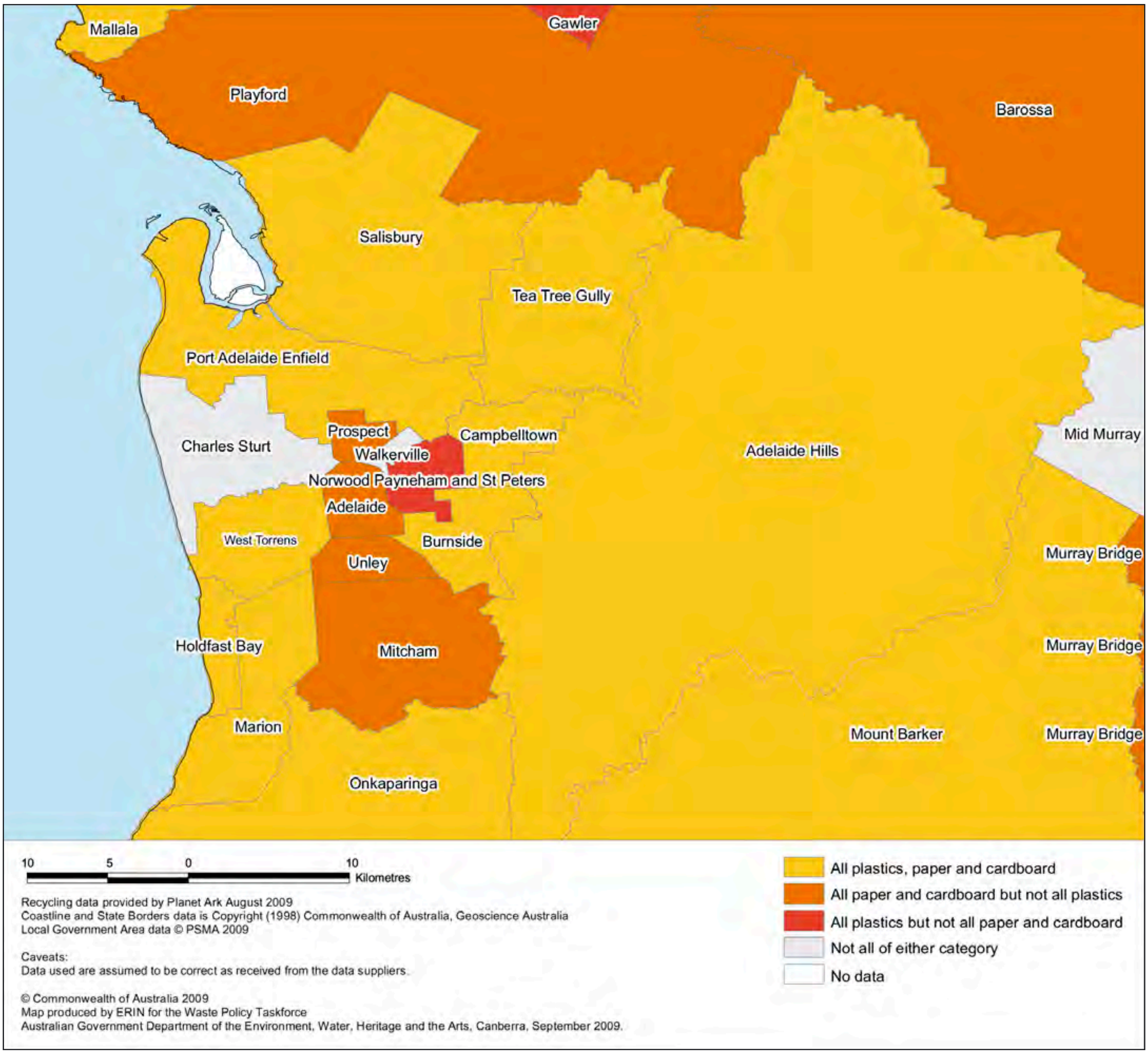


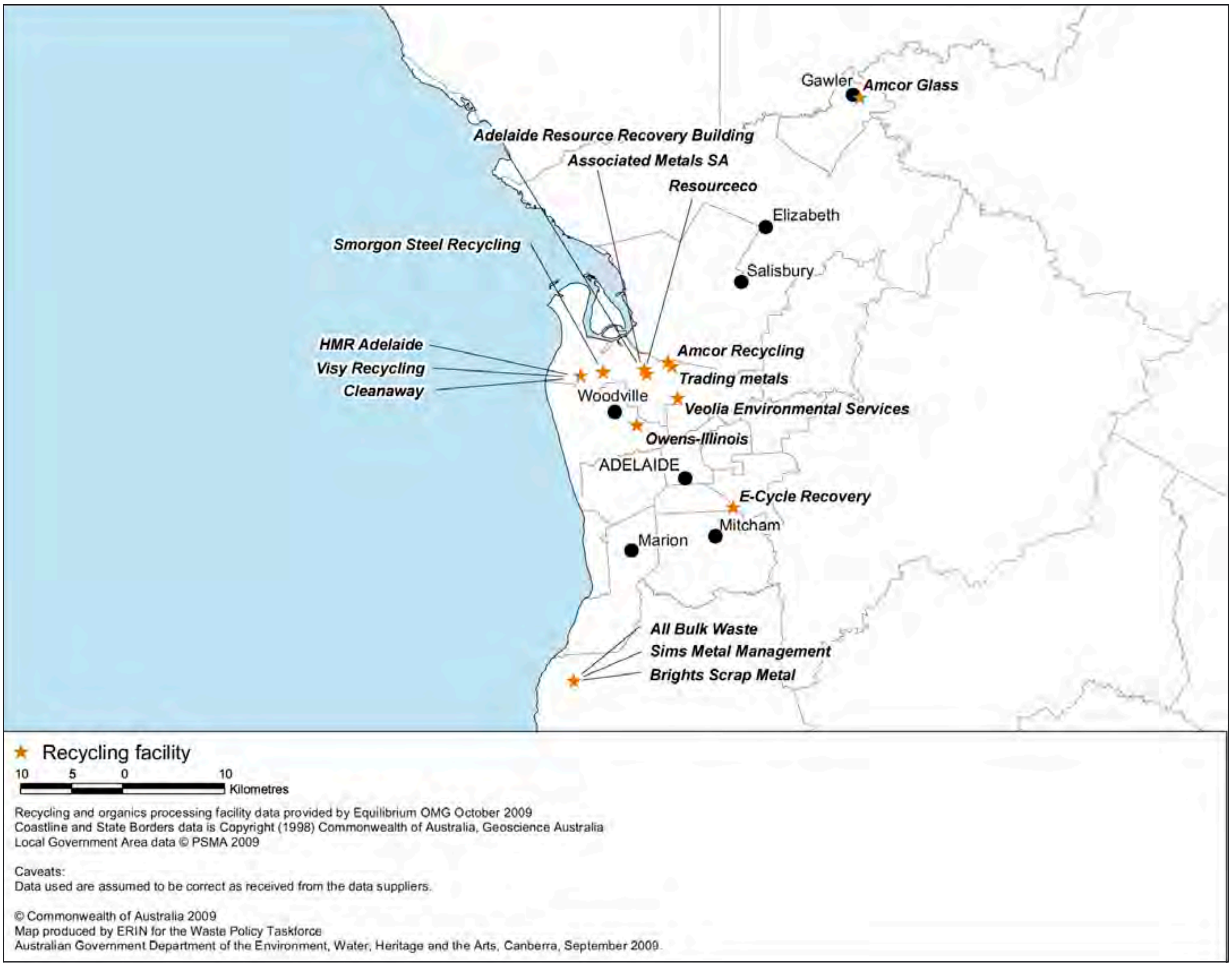
Figure 2.61: Greater Adelaide—municipal recycling of plastics, paper and cardboard, by LGA



Location of recycling facilities

Figure 2.62 shows some of the largest recycling facilities in the region surrounding Adelaide. It is a sample rather than a comprehensive view of all facilities and information is provided at the beginning of this chapter on the sourcing of data used in the figure and the associated table.

Figure 2.62: SA—recycling facilities—location map



SA facilities cover the following materials and processes:

Table 2.24: SA—recycling facilities—details

Name	Materials	Source of materials
Adelaide Resource Recovery, Wingfield	C&D waste	Building and demolition industry
All Bulk Waste, Lonsdale	Rubble, scrap metal, organics and cardboard	Business and households
Amcor Glass, Gawler	Glass recycling/re-manufacture into wine bottles	MRFs and beneficiators locally and interstate
Amcor Recycling, Dry Creek	MSW materials	MSW kerbside and MRFs
Brights Scrap Metal, Lonsdale	Metals	C&I
Owens-Illinois, West Croydon	Glass recycling	MRFs and beneficiators locally and interstate
Resourceco, Wingfield	C&D waste	C&I
Sims Metal Management, Lonsdale	Metals	C&I
Smorgon Steel Recycling, Gillman	Steel	C&I
Trading Metals, Dry Creek	Metals	C&I
Visy Recycling, Port Adelaide	Paper	Business/commercial and kerbside (MRFs)

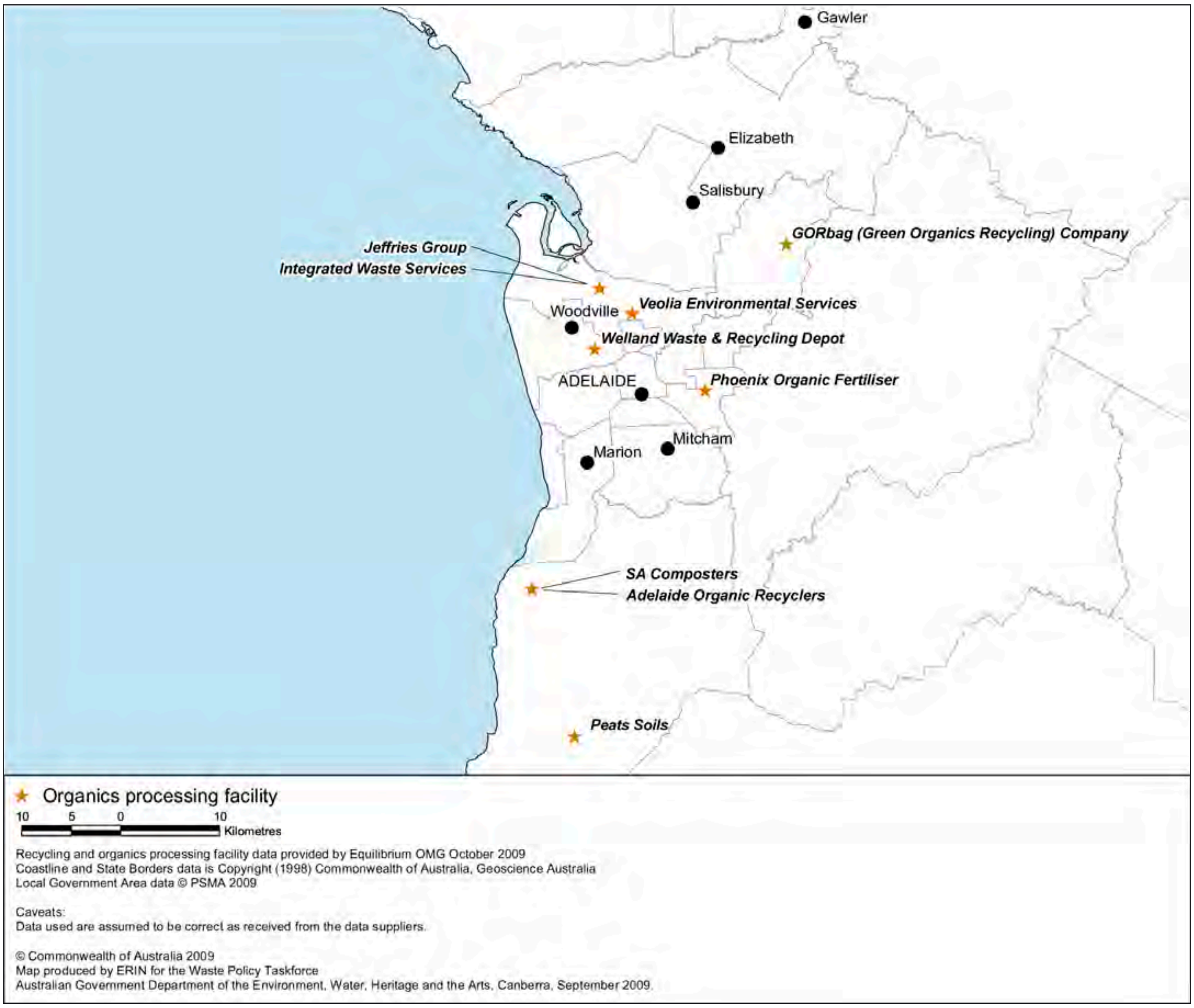
SA organics processing

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.63 shows the range and spread of major facilities in SA for processing organic wastes in the region surrounding Adelaide. It is presented as a snapshot rather than a comprehensive view of all facilities and information is provided at the beginning of this chapter on the sourcing of data used in the figure and **Table 2.25**.¶

¶ There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.63: SA—organics processing facilities—location map



SA facilities accept and process the following materials:

Table 2.25: SA—organics processing facilities—details

Name	Materials	Source of materials
Adelaide Organic Recyclers, Lonsdale	Organic/garden waste	Households/businesses
Peats Soils, Willunga	Organic/garden waste	Households/businesses
Phoenix Organic Fertiliser, Glynton Road	Organic/garden waste	Households/businesses
GORbag (Green Organics Recycling) Company, Fairview Park	Green organic waste	Recovery from businesses and households
Integrated Waste Services, Wingfield	Green organic waste	Resource Recovery and Transfer Facility
Jeffries Group, Wingfield	Green organic waste, wooden pallets, composting/worms	Local government, commercial and residential sources
Welland Waste and Recycling Depot, Welland	Green organic waste	Local government, households, business
Veolia Environmental Services, Kilburn	Green organic waste	Local government, MRFs, transfer stations
SA Composters, Lonsdale	Green organic waste—vegetation and untreated clean timber, mixed soil with organic material	Local government, households

SA alternative waste treatment (AWT) facilities

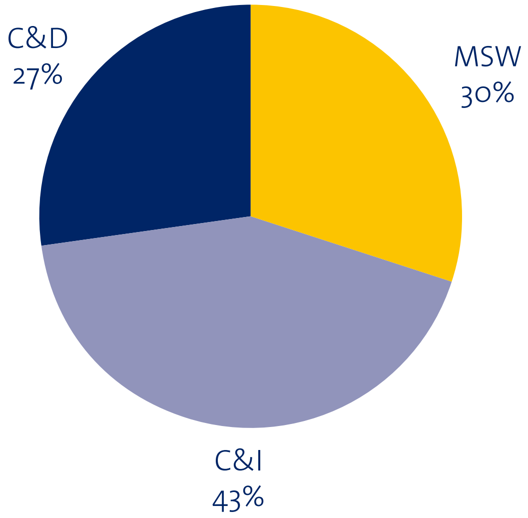
Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic wastes from the municipal mixed waste to landfill stream. Their functions are described more fully in **Chapter 4.7**.

There are no AWT facilities currently in place in SA.

SA landfill

C&I waste was the largest component of the 1 144 000 tonnes of waste sent to landfill in SA for 2006–07, at 496 000 tonnes or 43%.

Figure 2.64: SA—waste to landfill apportioned by source, 2006–07



Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1**). **Figure 2.65** shows the location of many of these landfills.

The data in the map are derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1**).

Figure 2.65: SA—landfill locations

Information available from the SA Government regarding their ten largest landfills is limited to numbers of landfills appearing in tonnage ranges. This is detailed in **Table 2.26**.

Nine of these ten landfills receive mostly MSW (domestic sources, hard waste and kerbside bin collection). One landfill receives mostly foundry sand (approximately 30 000 tonnes per year).

Complete information on currently operating landfills is not available from the SA.

Some additional landfills in SA are listed in **Table 2.27**. The identification of additional landfill sites below was undertaken as a public domain search.

Greenhouse emissions and gas capture

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from SA landfills are 594 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year is 226 000 tonnes of CO_2-e, or 28% of estimated total production of landfill gas.**

** These estimates come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

Table 2.26: SA—top ten major landfills—details

Tonnes per year	No. of major landfills
250 000-300 000	1
200 000-250 000	2
100 000-200 000	0
50 000-100 000	2
25 000-50 000	2
10 000-25 000	3

Table 2.27: SA—additional landfills—details

Entity	Location	Name
City of Mount Gambier	Caroline	Caroline landfill
District Council of Ceduna	Otc Road Ceduna	Ceduna Council landfill
District Council of Yorke Peninsula (x3)	Warooka, Arthurton and Port Vincent	Warooka landfill, Arthurton landfill and Port Vincent landfill
Flinders Ranges Council	Hawker	Hawker landfill
Veolia Environmental Services (Australia) Pty Ltd	Iron Knob Road, Whyalla	Whyalla landfill site
Remove All	Nuriootpa	Landfill and resource recovery

The table was sourced from:

- a review of state and territory public registers of licensed landfills
- searches of government and industry websites, and
- internet and directory searches including White Pages, Yellow Pages and Green Pages.

Annual tonnage information for these landfills was not publicly available.

Key points

- Since the formation of Zero Waste SA in 2003, (a statutory authority created to reform waste management in the state), the total amount of waste disposed to landfill has decreased by over 15% to 2008, despite population growth.
- Recycling rates are continuing to grow, and are the highest in Australia, with the exception of the ACT.
- In 2006–07, 3 318 000 tonnes of waste were generated in SA.
- Of that, 66% or 2 173 000 tonnes were recycled, with 1 144 000 tonnes (35%) being disposed of in landfill.
- Waste generation in SA for 2006–07 was 2090 kilograms per person, which is 0.5% above the national average generation of 2080 kilograms per person.

Endnotes

1 Target 3.8. Government of South Australia, *South Australia's Strategic Plan*, 2007.

2 ZWSA, *Recycling Activity in South Australia 2007–08*, 2009.

3 Ehrenberg-Bass Institute, University of South Australia, *Plastic Bag Ban Research*, 2009.

4 South Australian Environment Protection Authority, *Guidelines for Environmental Management of Landfill Facilities (Municipal and Commercial and Industrial General Waste)*, 2007.

5 <http://www.epa.sa.gov.au/environmental_info/waste/waste_reform_project>, accessed 14 October 2009.

CHAPTER 2.7
TASMANIA

Tasmania Government Perspective–Waste Data Management in Tasmania

In late 2005, Tasmanian state and local Governments agreed to jointly pursue the collection and reporting of waste data on a consistent basis across the state with the following objectives in mind:

- to facilitate waste management strategic planning, budgeting and cost control for all levels of government;
- to facilitate the identification of priority areas and opportunities for resource recovery;
- to measure progress that is made in resource recovery.

In April 2006 the then Department of Tourism, Arts and the Environment (DTAE) proceeded to prepare and issue Environment Protection Notices (EPNs) imposing waste data reporting obligations upon operators of municipal landfills.

Under these EPNs landfill operators are required to report waste data for each financial year in accordance with the Tasmanian Solid Waste Classification System which has been jointly adopted by State and Local Government. The classification system is supported by an agreed set of definitions.

The Tasmanian Waste Classification System is based largely on the Australian Waste Database that was developed in the 1990s. The current requirements of the EPN limit the level of reporting to the three main waste streams:

- municipal solid waste (MSW)
- commercial and industrial waste (C&I), and
- construction and demolition waste (C&D).

The approach adopted in Tasmania means that all landfills are reporting against agreed definitions and classifications. The fact that the system was developed in partnership with local government means that there is agreed ownership on the reasons why the data is necessary.

An important point to note in relation to the Tasmanian Waste Classification System is that soil is not classified as a waste within the Tasmanian system as it is used as cover fill. This could explain some of the difference in the waste per capita generation rates between Tasmania and some other jurisdictions.

The first full year of reporting was the 2006–07 financial year with all landfills required to forward their waste data to the Director, Environmental Protection Authority by 30 October of each year. Since the commencement of data collection, the accuracy of data being presented has continued to improve.

Waste data from 2006–07 have been used for the National Waste Report and the Tasmanian figures should therefore be read taking into consideration that 2006–07 was the first year of Tasmania's new classification system.

Whilst the reporting system for waste disposal in Tasmania is quite accurate, the next significant challenges in data measurement for Tasmania will be to gain a more accurate understanding of waste generation rates, current recycling and re-use initiatives that at present are not being measured, as well as seeking a better understanding of the types of materials currently within the waste disposal stream that have a capacity to be economically recoverable.

In June 2009 the Tasmanian Minister for the Environment released the *Tasmanian Waste and Resource Management Strategy* after extensive consultation across all sectors of the waste management community. One of six key objectives of the strategy is to improve waste data collection and management. The first action undertaken was the formation of the Waste Advisory Committee which met for the first time in November 2009.

The Waste Advisory Committee will oversee the implementation of the Strategy. It will also be charged with ensuring a seamless integration of any relevant National Waste Policy initiatives.

In early 2010, Tasmania expects to introduce a Controlled Waste Tracking System which will replace the current regulatory reporting system. It will also include for the first time a requirement for controlled waste producers to accurately report their waste generation by type.

Outline of the chapter

This chapter provides a snapshot of the following:

- The amounts of waste generated, recycled and landfilled in total and by waste stream in Tasmania.
- What can be recycled through municipal collection services in Tasmania—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard.
- The location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in Tasmania.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to show the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to show additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from:

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- internet sites, White Pages, Yellow Pages and Green Pages.

Amounts generated, recycled and disposed to landfill in Tasmania

In 2006–07, 521 000 tonnes of waste were generated in Tasmania. Of that, 14% or 75 000 tonnes were recycled, with 446 000 tonnes (86%) being disposed of in landfill. **Figure 2.66** shows the proportions from the MSW stream, the C&I waste stream and the C&D waste stream that went to each destination.

For **MSW**, total waste generation in Tasmania for 2006–07 was 340 000 tonnes, or 65% of all waste generated in the state. Tasmania recycled 75 000 tonnes of MSW waste. This is a recycling rate of 14%. MSW recycling made up 71% of total Tasmanian recycling (by tonnage). Tasmania sent 287 000 tonnes of MSW to landfill in 2006–07, which was 64% of total Tasmanian landfill disposal.

For **C&I**, there were 167 000 tonnes generated, which was 32% of total generation in Tasmania. There were 22 000 tonnes of C&I waste recycled, or 29% of total Tasmanian recycling. This was a recycling rate of 13%. Tasmania disposed of 145 000 tonnes of C&I waste to landfill (33% of total landfilling in the state).

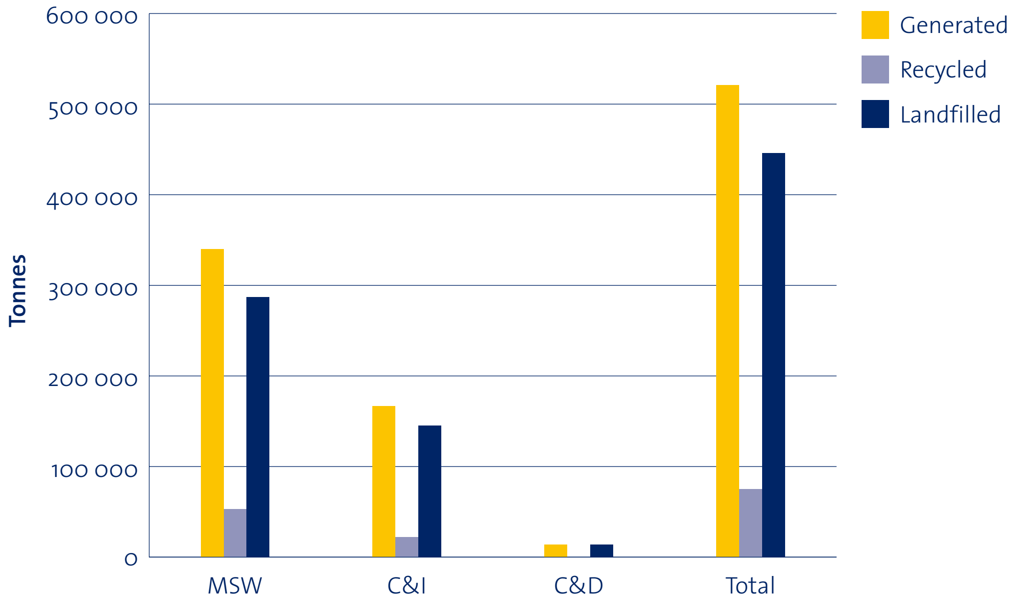
For **C&D**, total reported generation was 14 000 tonnes in Tasmania for the 2006–07 year. This was an estimated 3% of total waste generated in the state, which is likely to be an underestimate. No C&D waste was reported as recycled. Under-reporting of C&D data in Tasmania may be due to a default reporting code that favours the C&I stream.

Waste generation in Tasmania for 2006–07 was 1057 kilograms per person, which is 49% below the national average generation of 2080 kilograms per person.† It is likely that this is artificially low due

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete

† National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.66: Tasmania—waste generated, recycled and landfilled, 2006–07



to under-reported generation of construction and demolition waste.‡

Tasmanian recycling

Of the 75 000 tonnes of material recycled out of the MSW, C&I and C&D streams in Tasmania for 2006–07, 71% was reported as coming from the MSW stream, with 29% from C&I. No data are available for Tasmanian C&D waste recycling.

The following section focuses primarily on recycling within the MSW stream. Comparable data for the other two streams were not available for reporting. Most of MSW recycling is at the kerbside.

‡ It is likely that the 14 000 tonnes of estimated Tasmanian C&D waste generation is a significant underestimate, as this is only 6% of ACT C&D generation, and Tasmania has a population which is 45% larger than the Australian Capital Territory (having 153 000 more people). The national average for C&D generation, excluding Tas and NT, is 810 kilograms per person. The Tasmanian population of 493 000 people, were they generating at that national average, would have generated 399 330 tonnes of C&D waste. This would add an additional 2.3%, or 385 330 tonnes, on top of the previous national C&D generation estimate (which included 14 000 tonnes from Tasmania).

Municipal recycling services—what is collected and where

Around Tasmania, households are offered different municipal recycling services, covering particular configurations of materials, depending on which local government (LGA) area they are in. **Figures 2.67**, **2.68** and **2.69** show what municipal wastes can be recycled, and where.§

Where available, data are presented for the whole state. Because the largest flows of municipal waste and recycling are generated and handled in the Hobart metropolitan area, this information is also presented.

Figures 2.67 and **2.68** indicate what can be recycled where in Tasmania, using data entered by local councils into the 'Recycling Near You' service provided by Planet Ark. **Figure 2.67** shows that one of 29 LGAs in Tasmania offers a kerbside recycling service covering all types of plastic, paper and cardboard.

§ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service. Since those data were entered, the Tasmanian State Government has advised that, in the opinion of Veolia Environmental Services, all Tasmanian LGAs are able to recycle plastic containers coded 1–7 (excluding polystyrene foam), paper and cardboard.

Figure 2.67: Tasmania—municipal recycling of plastics, paper and cardboard, by LGA

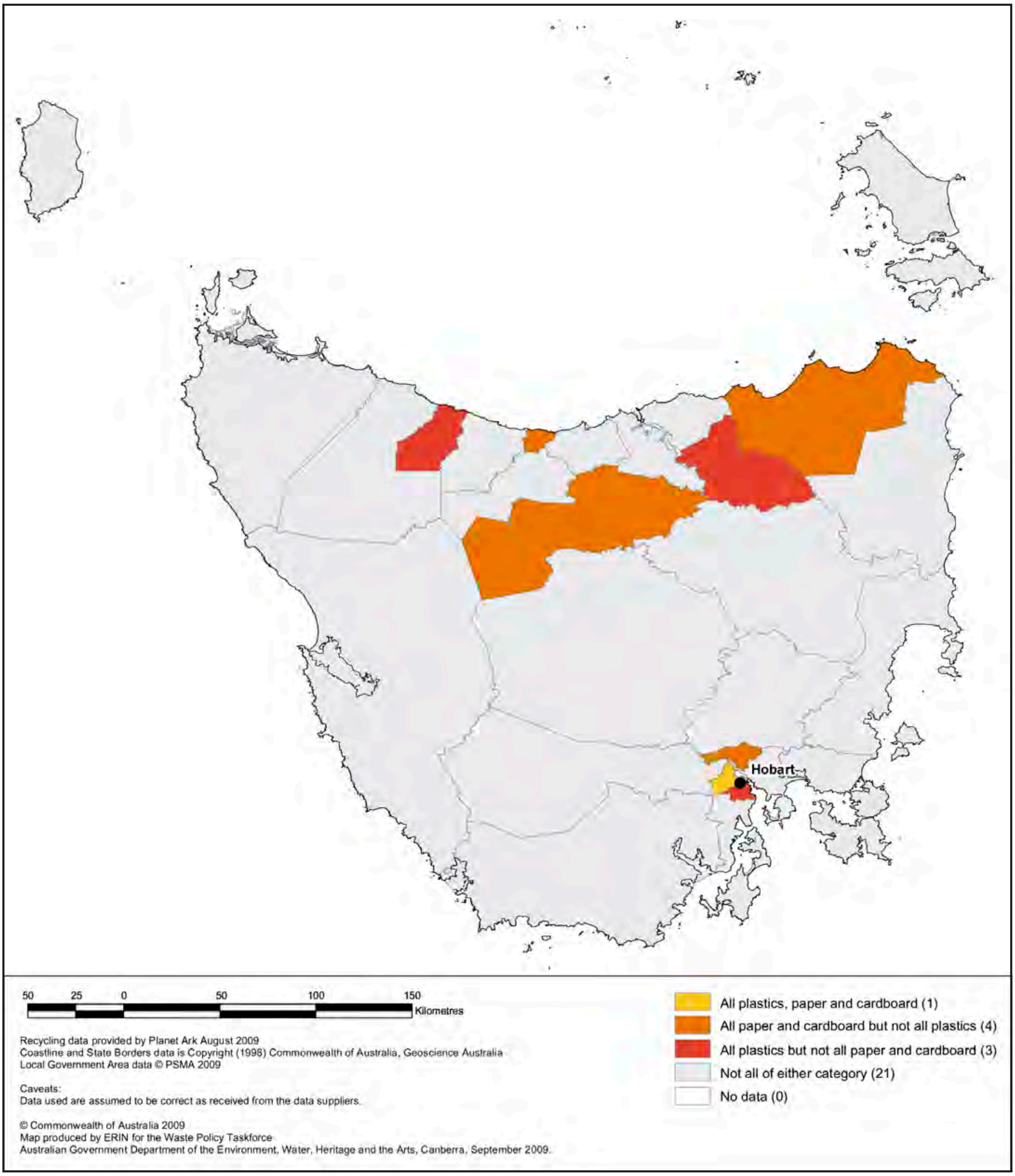


Figure 2.68: Hobart area—municipal recycling of plastics, paper and cardboard, by LGA

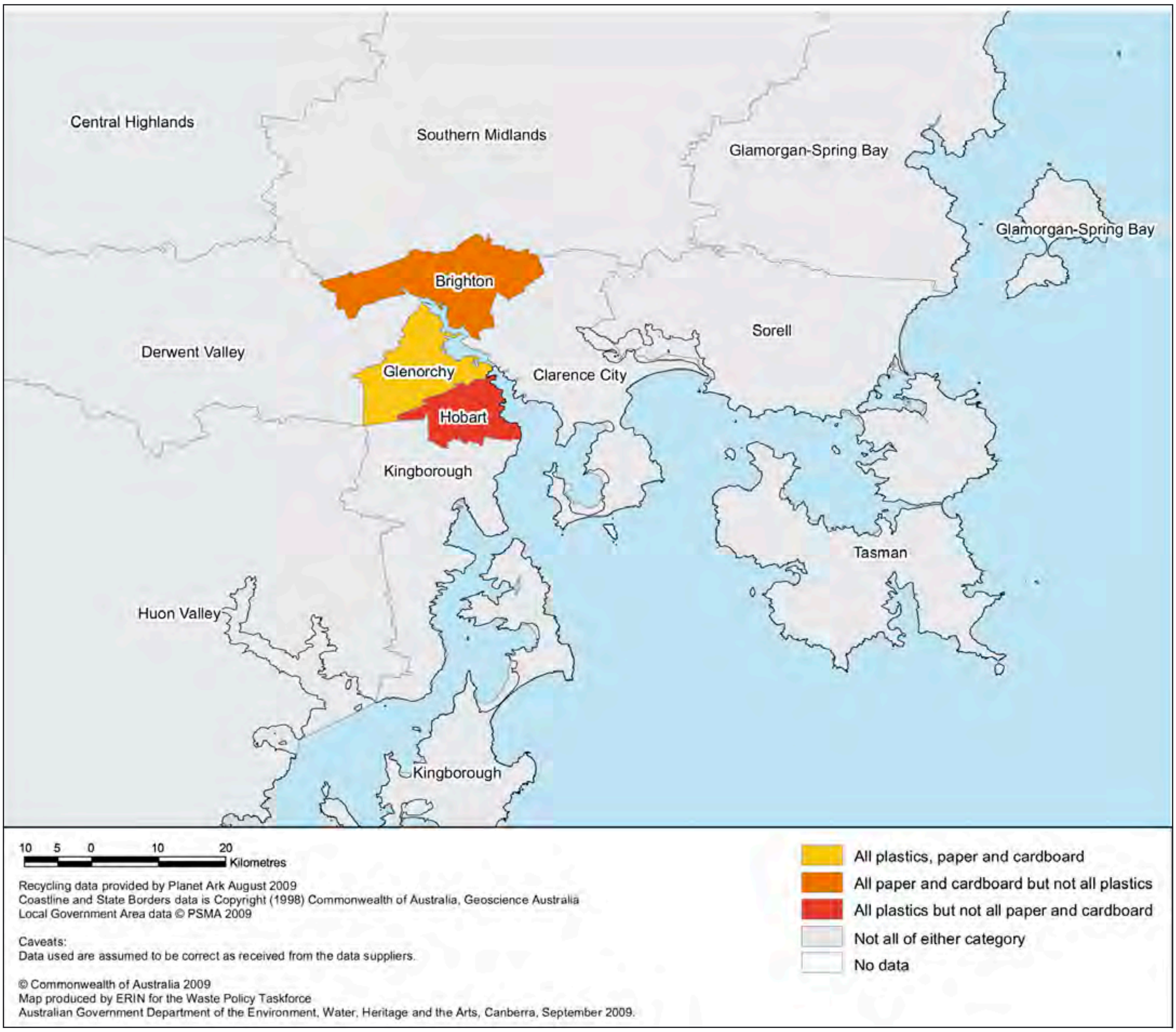


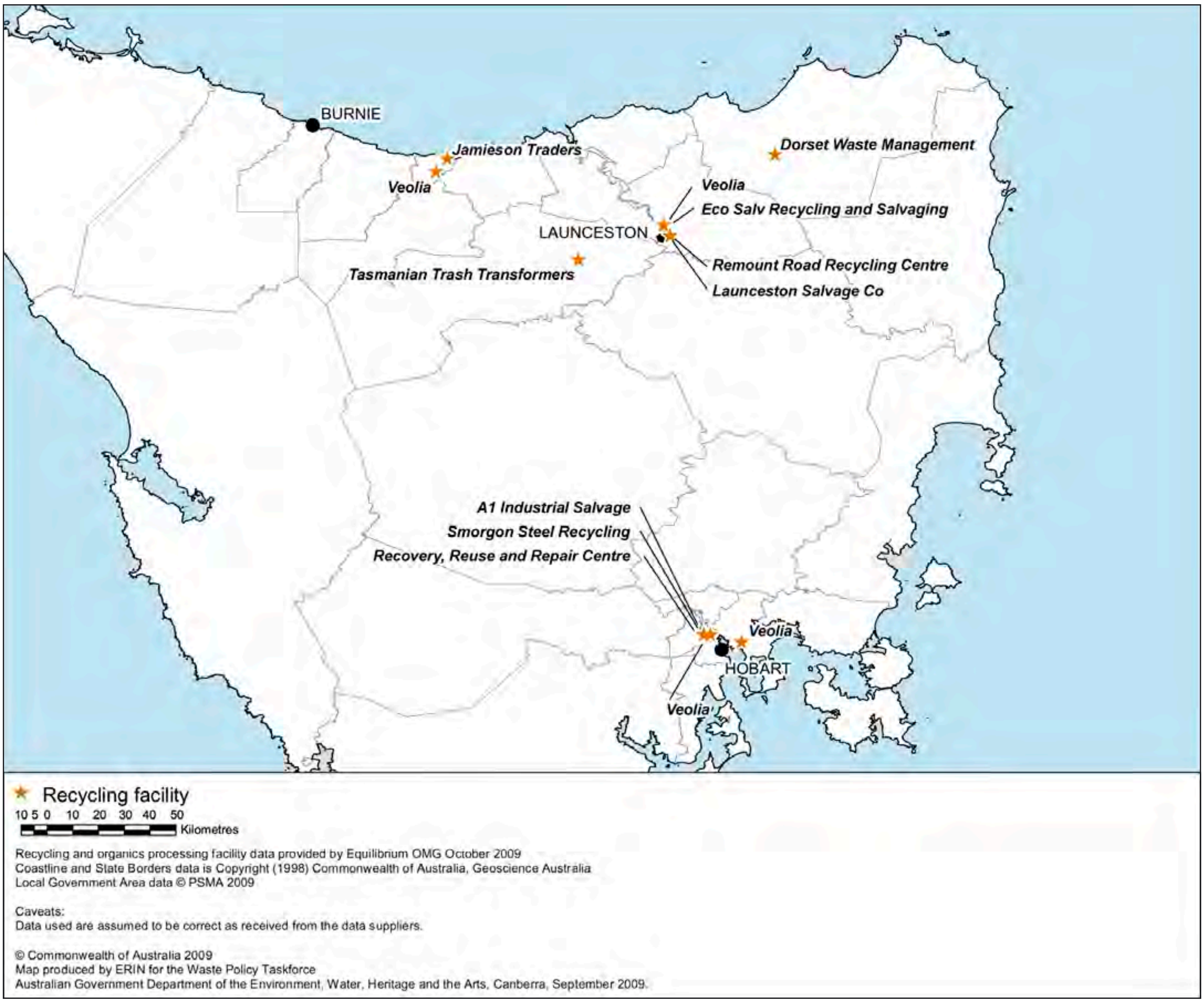
Figure 2.68 shows that there are differences in the coverage of plastics, paper and cardboard between Hobart City and the adjacent LGAs. Kingborough and Clarence are considered part of Greater Hobart.¶

Location of recycling facilities

Figure 2.69 shows some of the largest recycling facilities in Tasmania. It is a sample rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in the figure and **Table 2.28**.

¶ The Tasmanian State Government has advised that, in the opinion of Veolia Environmental Services, all Tasmanian LGAs are able to recycle plastic containers coded 1–7 (excluding polystyrene foam), paper and cardboard.

Figure 2.69: Tasmania—recycling facilities—location map



These facilities accept and process the following materials:

Table 2.28: Tasmania—recycling facilities—details

Name	Materials	Source of materials
A1 Industrial Salvage, Glenorchy	e-waste	Households, businesses
Dorset Waste Management, Scottsdale	C&D waste	Building and demolition industry
Eco Salv Recycling and Salvaging, Invermay	C&D waste	Building and demolition industry
Jamieson Traders, East Devonport	Glass	Households, building and demolition industry
Launceston Salvage Co, Launceston	C&D Waste	Building and demolition industry
Recovery, Re-use and Repair Centre, Glenorchy	e-waste	Households, businesses
Remount Road Recycling Centre, Launceston	C&D waste	Building and demolition industry
Smorgon Steel Recycling, Glenorchy	Steel	Commercial and industrial
Tasmanian Trash Transformers, Westbury	C&D Waste	Building and demolition industry
Veolia Environmental Services, Invermay	Newspaper, including: cardboard, office paper and printers wastepaper, plastic grades—PET, HDPE, PVC, LDPE, LLDPE, aluminium & steel cans, glass, organic composting	MSW kerbside and businesses

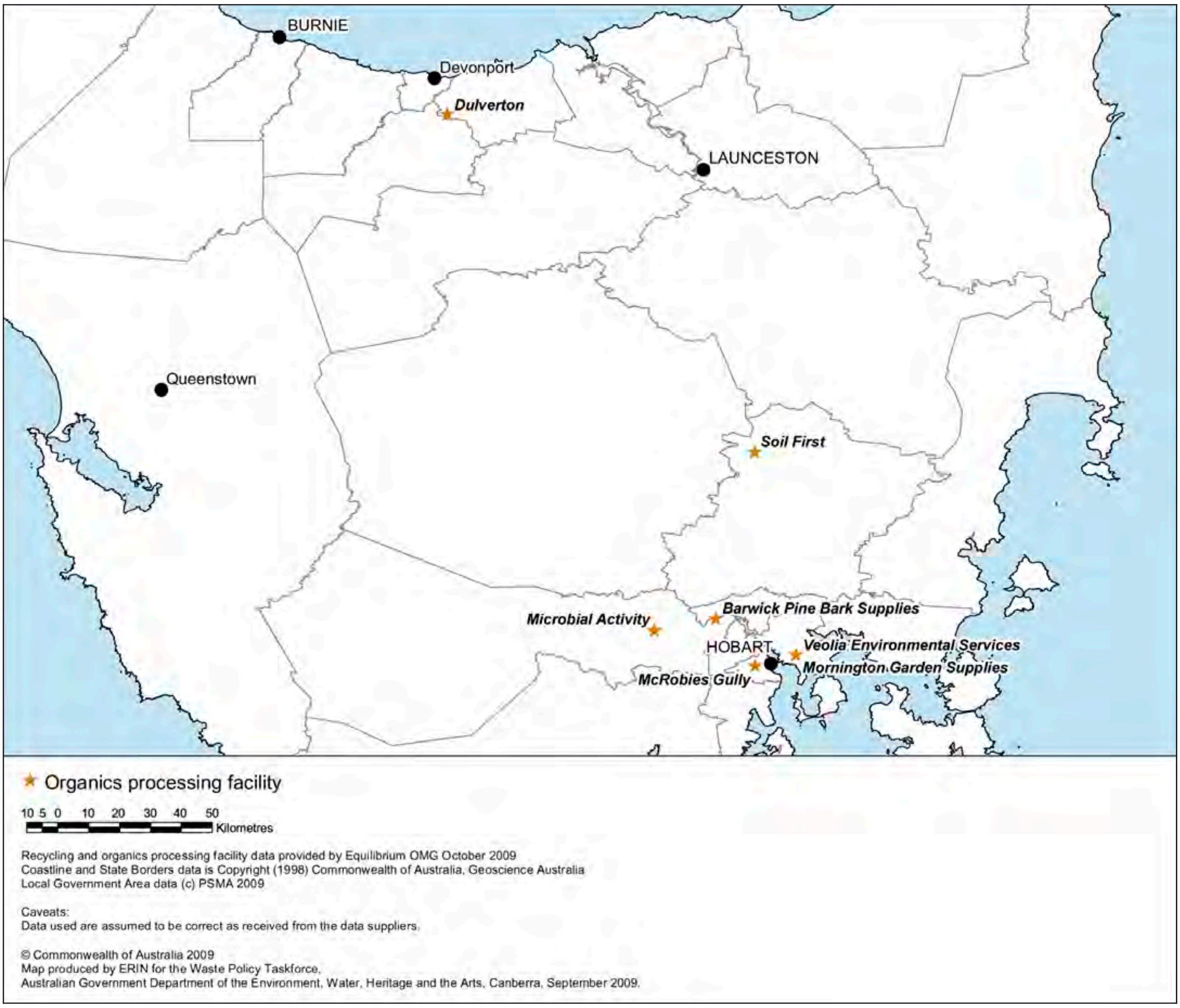
Tasmania organics processing facilities

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.70 shows the range and locations of major facilities in Greater Hobart for processing organic wastes. It is presented as a snapshot rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in **Figure 2.70** and **Table 2.29**.**

** There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.70: Tasmania—organics processing facilities—location map



Tasmanian facilities accept and process the following materials:

Table 2.29: Tasmania—organics processing facilities—details

Name	Location	Owner	Materials	Source of materials
Compost Tasmania	Bridgewater	Compost Tasmania	Organic/garden waste	Households, businesses
Groundswell Organics	Margate	Groundswell Organics	Organic/garden waste	Households, businesses
Mornington Garden Supplies	122 Mornington Road, Mornington	Mornington Garden Supplies	Organic/garden waste	Households, businesses
Soil First	Interlaken Road, Interlaken	David Duggan	Organics	Businesses
Dulverton	Dawson's Siding Road, Dulverton	Dulverton Regional Waste Management Authority	Organics	Businesses
Microbial Activity	Plenty	Microbial Activity	Organics	Businesses
Hobart City Council	McRobies Road, South Hobart	Hobart City Council	Organics	Households, businesses

Tasmanian Alternative waste treatment (AWT) facilities

Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic wastes from the municipal-mixed-waste to landfill stream. Their functions are described more fully in **Chapter 4.7**.

There are no alternative waste treatment facilities in Tasmania, current or planned.

Tasmanian landfill

Of the 446 000 tonnes of waste sent to landfill in Tasmania for 2006–07, MSW was the largest component at 64%, or 287 000 tonnes.

Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1**), **Figure 2.72** below shows the location of many of these landfills.

Annual tonnage information for these landfills was not publicly available.

Figure 2.71: Tasmania—waste to landfill apportioned by source, 2006–07

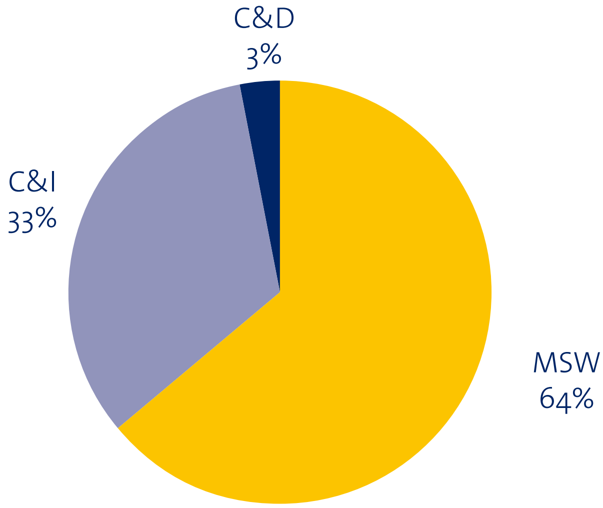


Figure 2.72: Tasmania—landfill locations

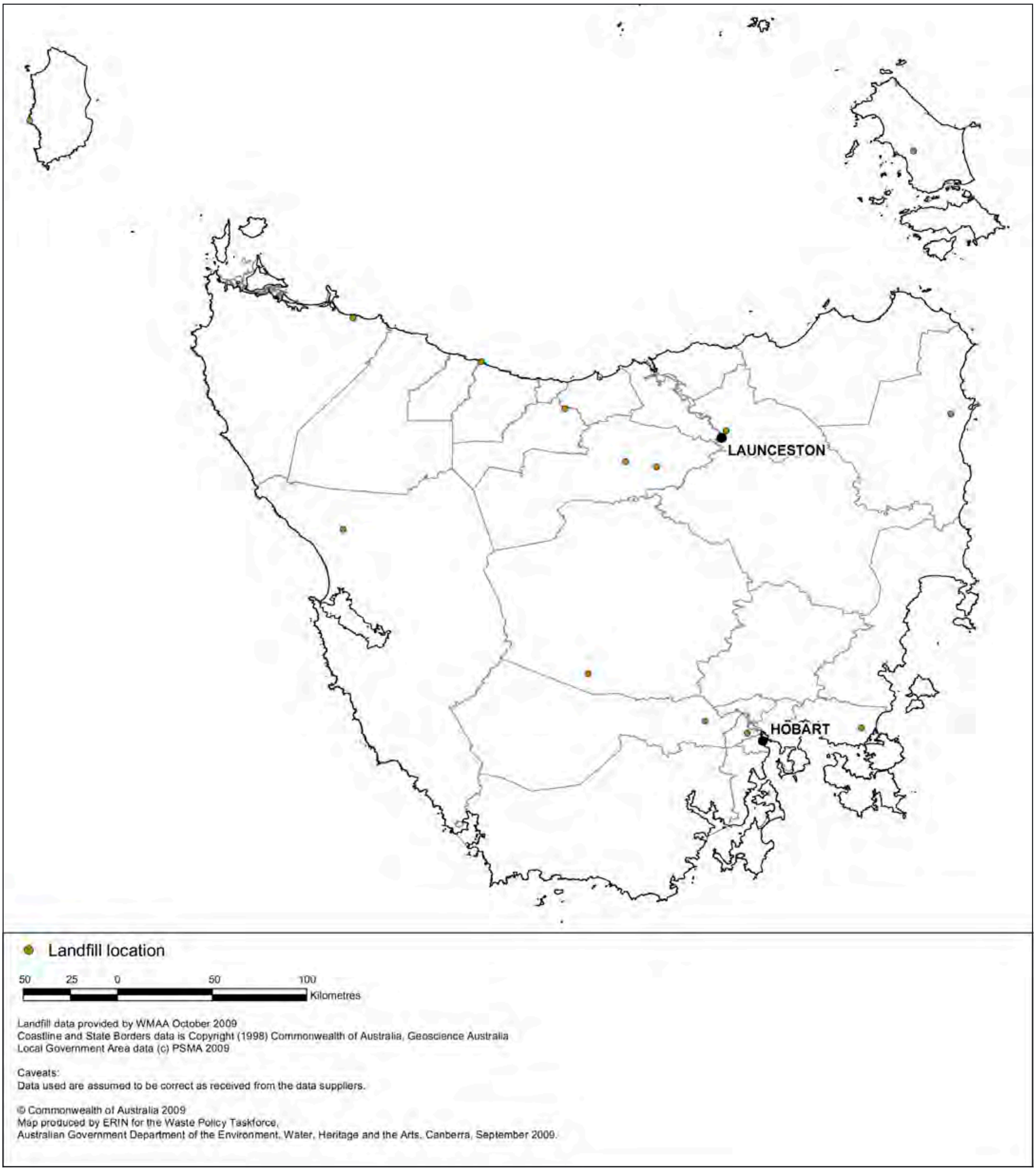


Table 2.30: Tasmania—major landfills—details

Name	Service area (LGAs covered)	Size (tonnes per year disposed, 2006–07)	Landfill type	Owner
Remount Road landfill, Mowbray	Launceston, Northern Midlands, West Tamar	107 816	Putrescible	Launceston City Council
Copping landfill, Copping	Clarence, Sorrel, Tasman, Huon, Break O'Day, Glamorgan/Spring Bay	55 098	Putrescible	Copping Regional Waste Authority
Jackson Street landfill, Glenorchy	Glenorchy, Brighton	48 177	Putrescible	Glenorchy City Council
McRobies Gully landfill, South Hobart	Hobart	45 036	Putrescible	Hobart City Council
Dulverton landfill, Dulverton	Devonport, Latrobe, Kentish, Central Coast	35 540	Putrescible	Dulverton Regional Waste Authority
Baretta landfill, Baretta	Kingborough	34 100	Putrescible	Kingborough Municipal Council
Port Latta landfill, Port Latta	Waratah/Wynyard, Circular Head	33 300	Putrescible	Circular Head Council
Zeehan landfill, Zeehan	West Coast	19 698	Putrescible	West Coast Council
Burnie landfill, Burnie	Burnie	18 578	Putrescible	Burnie City Council
Peppermint Hill landfill, New Norfolk	Derwent Valley	15 138	Putrescible	Derwent Valley Council

Table 2.31: Tasmania—additional landfills—details

Entity	Location	Name
Heybridge Landfill	Heybridge	Heybridge landfill
Tasmanian Trash Transformers	Deloraine	Deloraine landfill
Tasmanian Trash Transformers	Westbury	Westbury landfill

The table was sourced from

- a review of state and territory public registers of licensed landfills
- searches of government and industry websites, and
- internet and directory searches including White Pages, Yellow Pages and Green Pages.

Greenhouse emissions and gas capture

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from Tasmanian landfills are 233 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year is 65 000 tonnes of CO_2-e, or 22% of estimated total production of landfill gas.[††]

Key points

- In June 2009 the Tasmanian Minister for the Environment released the *Tasmanian Waste and Resource Management Strategy* after extensive consultation across all sectors of the waste management community.
- In 2006–07, 521 000 tonnes of waste were generated in Tasmania.
- Of that, 14% or 75 000 tonnes were recycled, with 446 000 tonnes (86%) being disposed of in landfill.
- Waste generation in Tasmania for 2006–07 was 1057 kilograms per person, which is 49% below the national average generation of 2080 kilograms per person.[‡‡]

†† These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

‡‡ It is likely that this figure is artificially low due to under-reporting of construction and demolition waste generated in Tasmania.

CHAPTER 2.8
AUSTRALIAN CAPITAL TERRITORY

Australian Capital Territory Government perspective

The ACT *No Waste by 2010* strategy, released in 1996, has been very successful in improving recycling rates in the ACT from 42% in 1995–96 to 75% in 2009. This is the highest recovery level in the country and has helped the ACT achieve the lowest volumes of waste to landfill in Australia. The ACT is presently developing a new waste strategy.

In 1994, a collection service was introduced for household dry recyclables and the quantity and range of materials collected and recovered through this service progressively increased.

Over the last decade three material recovery facilities (MRFs) for Construction and Demolition (C&D) waste have been built in the ACT. This has increased the recovery of material from the C&D sector from less than 50% in 1995–96 to over 90% in 2009. However, the markets for these products are variable and there is an excess supply of recovered timber, which is accumulating in stockpiles. The ACT is looking at a range of options, including energy from waste, to ensure that this resource is utilised efficiently and sustainably.

The ACT's extensive gardens and public open spaces lead to a large amount of green waste generation. High participation in self-haulage results in over 90% of green waste being diverted from landfill, with a significant portion turned into high-value potting mixes and composts.

This high level of green waste recovery and data capture contributes to the ACT's high waste generation rates compared to those in all other jurisdictions.

Following gains in domestic recycling, green-waste composting and resource recovery from the C&D sector, improvements in Commercial and Industrial (C&I) waste management is now a key focus for the ACT Government.

In August 2009, the ACT Government launched the BusinessSmart and OfficeSmart programs to educate and encourage the business sector to sort and recover waste on site. By December 2009 over 100 ACT businesses had signed on to these programs.

Private sector interest in building and operating additional waste facilities at the Hume Resource Recovery Estate (HRRE) will be canvassed in 2010. In particular, this process aims to achieve improved resource recovery from dry unsorted C&I waste and separate collection and processing of putrescible waste.

The proposed HRRE development and the uptake of the OfficeSmart/BusinessSmart programs are expected to significantly increase resource recovery in the ACT. Additional measures will be part of the new waste management strategy due for release in 2010.

Outline of the chapter

The chapter provides a snapshot of the following:

- The amounts of waste generated, recycled and landfilled in total and by waste stream in the Australian Capital Territory (ACT).
- What can be recycled through municipal collection services in the ACT—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard.
- The location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in the ACT.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from:

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- Internet sites, White Pages, Yellow Pages and Green Pages.

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

Amounts generated, recycled and disposed to landfill in the ACT

In 2006–07, 784 000 tonnes of waste were generated in the ACT. Of that, 75% or 587 000 tonnes were recycled, with 197 000 tonnes (25%) being disposed of in landfill.

For **municipal solid waste (MSW)**, total waste generation in the ACT for 2006–07 was 363 000 tonnes, or 46% of all waste generated in the territory. The ACT recycled 278 000 tonnes of MSW waste. This is a recycling rate of 77%. MSW recycling made up 48% of total ACT recycling (by tonnage). The ACT sent 85 000 tonnes of MSW to landfill in 2006–07, which was 43% of total ACT landfill disposal.[†]

For **commercial and industrial waste (C&I)**, there were 194 000 tonnes generated, which was 25% of total generation in the ACT. There were 102 000 tonnes of C&I waste recycled, or 17% of total ACT recycling. This was a recycling rate of 53%. The ACT disposed of 91 000 tonnes of C&I waste to landfill (46% of total landfilling in the territory).

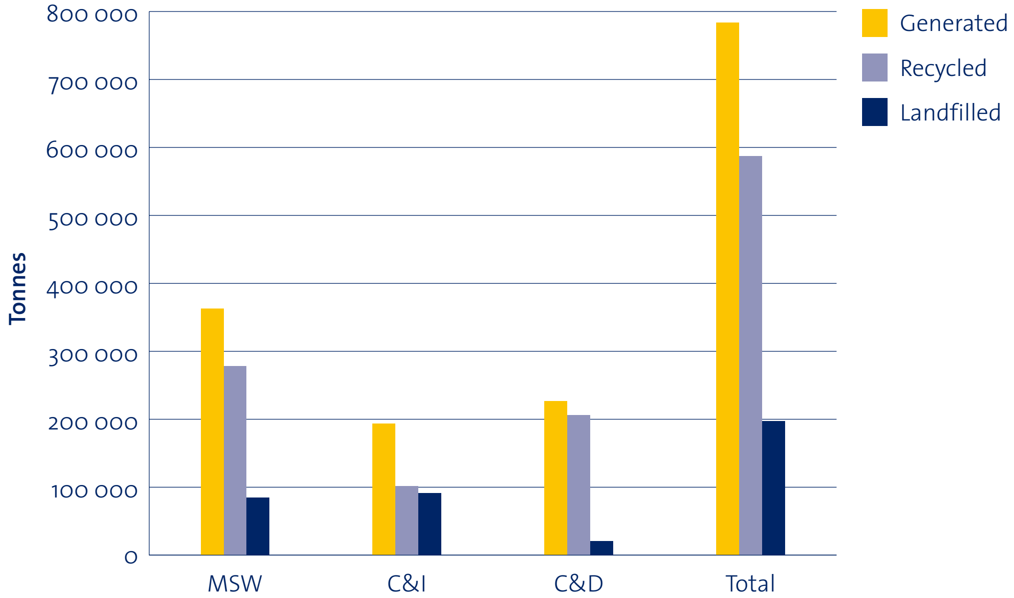
For **construction and demolition waste (C&D)**, total generation was 227 000 tonnes in the ACT for the 2006–07 year. This was 29% of total waste generated in the territory. There were 206 000 tonnes of C&D waste recycled, which was 35% of total ACT recycling, and represents a recycling rate of 91%.

Waste generation in the ACT for 2006–07 was 2310 kilograms per person, which is 11% above the national average generation of 2080 kilograms per person.[‡] This includes MSW from Queanbeyan (NSW). When the Queanbeyan population is taken into account, ACT per capita waste generation is less than 2310 kilograms per person.

† It is estimated that between 10% and 20% of the waste to landfill in the ACT comes from NSW waste brought over the border from places such as Queanbeyan and the Palerang Shire.

‡ National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

Figure 2.73: ACT—waste generated, recycled and landfilled, 2006–07



ACT recycling

Of the 587 000 tonnes of material recycled out of the MSW, C&I and C&D streams in the ACT for 2006–07, a little less than half of the material (by weight) came from the municipal waste stream. The C&D stream produced 35% of total recycling, and the C&I stream 17%.

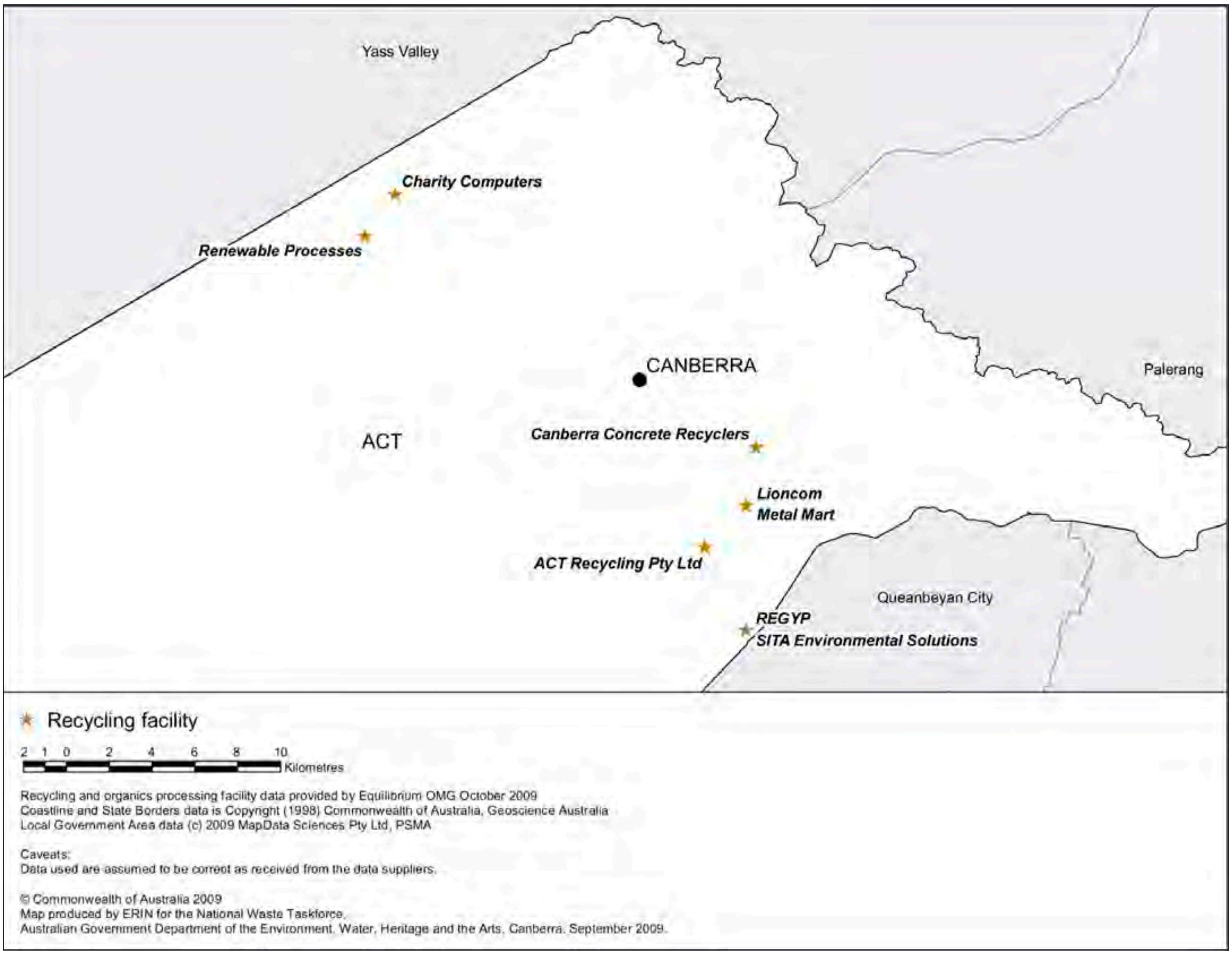
Municipal recycling services—what is collected and where

The ACT is a single zone for local government area comparison purposes. Municipal kerbside recycling services in the ACT include coverage of all rigid, food-grade plastics. It should also be noted that some flows of waste and recycling into the ACT come from nearby areas in New South Wales, such as Queanbeyan and the Palerang Shire.

Location of recycling facilities

Figure 2.74 shows some of the largest recycling facilities in the ACT. It is a sample rather than a comprehensive view of all facilities and information is provided at the beginning of this chapter on the sourcing of data used in the figure and **Table 2.32**.

Figure 2.74: ACT—recycling facilities—location map



These facilities accept and process the following materials:

Table 2.32: ACT—recycling facilities—details

Name	Materials	Source of materials
ACT Recycling, Symonston	C&I materials	C&I
Canberra Concrete Recyclers, Pialligo	Demolition rubble	Building and demolition industry
Charity Computers, Charnwood	e-waste	Households and businesses
Lioncom, Fyshwick	e-waste	Households and businesses
Metal Mart, Fyshwick	Metals—incl. aluminium cans, batteries and stainless steel	C&I, domestic
REGYP, Hume	Gyprock, plasterboard	Households, construction, commercial and industrial
Renewable Processes, Macgregor	e-waste	Households, government, business
SITA Environmental Solutions, Hume	Glass, steel, aluminium cans, paper and cardboard recycling	Household/kerbside and business

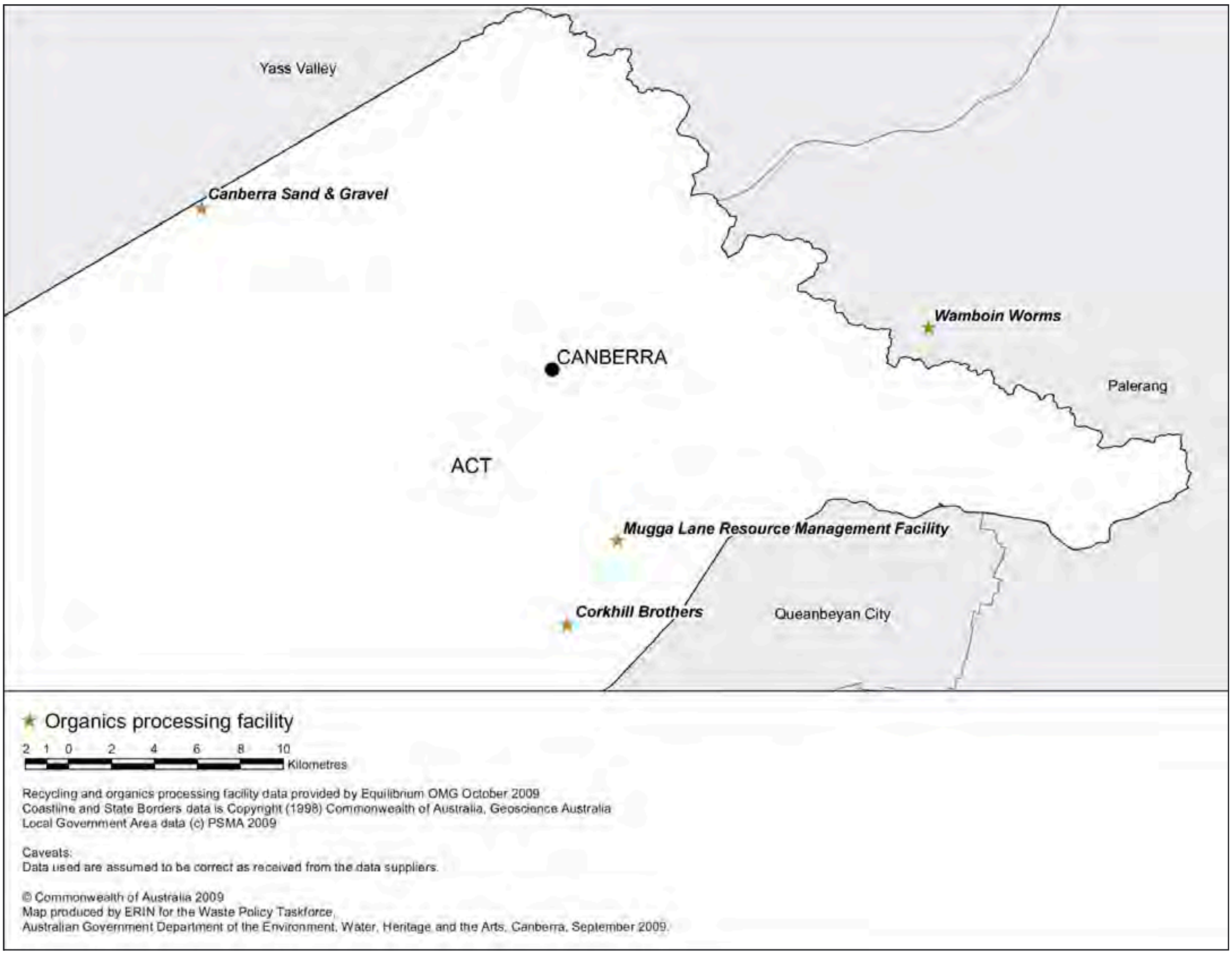
ACT organics processing facilities

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.75 shows the range and spread of major facilities in the ACT for processing organic wastes. It is presented as a snapshot rather than a comprehensive view of all facilities. Information is provided at the beginning of this chapter on the sourcing of data used in **Figure 2.75** and **Table 2.33**.§

§ There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.75: ACT—organics processing facilities—location map



These facilities accept and process the following materials:

Table 2.33: ACT and region—organics processing facilities—details

Name	Materials	Source of materials
Corkhill Brothers, Symonston	Green waste	Primarily self-hauled domestic and commercial green waste
Canberra Sand & Gravel, Macgregor	Green waste	Primarily self-hauled domestic and commercial green waste
Mugga Lane Resource Management Facility	Green organic waste	Households
Wamboin Worms, Wamboin	Food/organic waste	C&I food waste, some green waste

ACT alternative waste treatment (AWT) facilities

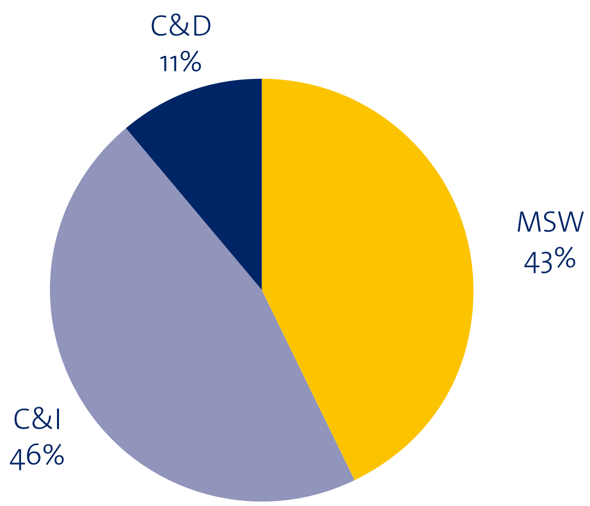
The ACT does not currently have any alternative waste treatment (AWT) facilities. Planning work is underway to provide augmented organic waste processing capacity for the territory.

ACT landfill

C&I waste was the largest component of the 197 000 tonnes of waste sent to landfill in the ACT for 2006–07, at 91 000 tonnes or 39%.

The major landfill for the ACT is the Mugga Lane Landfill, which is part of the Mugga Lane Resource Management Centre in Symonston. The local government areas (LGAs) covered by this facility include the ACT and Queanbeyan City Council, as well as private delivery and deliveries from commercial waste service providers who may come from within and outside the ACT. In 2006–07, 197 425 tonnes were disposed of to landfill at this facility. The current open landfill area is above ground, lined, and capped daily with biogas extraction from four cells, with no leachate recirculation. It is owned by the ACT government and managed by Theiss Pty Ltd.

Figure 2.76: ACT—waste to landfill apportioned by source, 2006–07



As well as the Mugga Lane Landfill, which is the operating landfill site for the ACT, there are closed landfills in the ACT that are still emitting methane. Biogas extraction continues at the West Belconnen Resource Management Centre, although this is a closed landfill. Prior landfill sites in the ACT were owned and managed by the Commonwealth, before the commencement of ACT self government in 1989.

Greenhouse emissions and gas capture

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

ACT data on landfill gas generation, capture and emissions are included within the NSW totals. New landfill cell development at the Mugga Lane site includes liners and gas capture.[¶]

Key points

- The ACT *No Waste by 2010* strategy, released in 1996, has been very successful in improving recycling rates in the ACT from 42% to 75% in 2009.
- This is the highest recovery level in the country and has helped the ACT achieve the lowest volumes of waste to landfill in Australia.
- In 2006–07, 784 000 tonnes of waste were generated in the ACT. Of that, 75% or 587 000 tonnes were recycled, with 197 000 tonnes (25%) being disposed of in landfill.
- Waste generation in the ACT for 2006–07 was 2310 kilograms per person, which is 11% above the national average generation of 2080 kilograms per person.[**]

¶ These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

** It is estimated that between 10% and 20% of the waste to landfill in the ACT comes from NSW waste brought over the border from places such as Queanbeyan and the Palerang Shire. When that additional population is taken into account, ACT per capita generation is less than 2310 kilograms per person.

CHAPTER 2.9
NORTHERN TERRITORY

Northern Territory Government Perspective

The management of waste and resource recovery in the Northern Territory faces significant obstacles, most of which stem from the effects of distance, and lack of resources. There are no facilities in the NT to recycle aluminium, glass, plastic or any other recyclables, all of which are transported interstate for treatment at considerable cost. Overall, there are not enough facilities and resources to enable a streamlined approach to resource recovery.

Landfill: The Northern Territory, with a population of around 192 898,[1] has 17 licensed landfills and an undetermined number of unlicensed landfills. Only the two largest centres of population (Darwin and Alice Springs) keep data on the amount of waste disposed of to landfill. It is estimated that over 360 000 tonnes of waste were disposed to landfill across the NT in the 2006–07 financial year.

Recycling: Only 47% of the Northern Territory population have access to kerbside recycling facilities, in Darwin and Palmerston. No data are collected on recycling volumes outside these localities. The total volume recycled in Darwin and Palmerston in 2006–07 was 0.97% of total waste, and 53% of recyclable waste collected had to be disposed of in landfill because it was contaminated.

Outline of the chapter

The chapter provides a snapshot of the following:

- The amounts of waste generated, recycled and landfilled in total and by waste stream in the Northern Territory (NT).
- What can be recycled through municipal collection services in the NT—this covers three of the main materials collected through kerbside recycling services: plastics of various types, paper and cardboard.
- The location of facilities for recycling, organic waste processing, alternative waste treatment, and landfilling in the NT.

The report presents information on the key waste management and resource recovery facilities and some of the key materials covered in municipal collections. The scope of this snapshot is restricted by the availability of data. As knowledge improves over time it may be possible to map the recovery of additional materials and products present in the three main waste streams, including those collected and processed by non-government organisations, and to map additional facilities for managing the wastes generated.

Sourcing of data

Unless otherwise specified, data for the tables and maps in this chapter were sourced from

- the Hyder Consulting report *Waste and Recycling in Australia* (amended 2009)
- data included by local governments in the Planet Ark 'Recycling Near You' database
- a review of all state and territory registers of licensed facilities*
- industry intelligence reports (*The Blue Book*, IBIS World)
- stakeholders—industry associations (WMAA, ACOR) and governments, and
- internet sites, White Pages, Yellow Pages and Green Pages.

New data for the NT for the period 2006–07 were identified in November 2009 but time did not allow these data to be incorporated into this document. The new data show that total waste generated in the NT was 374 000 tonnes, waste disposed was 361 000 tonnes and waste recycled was 13 000

* Licensing requirements are not uniform (for example, some jurisdictions license the company address, rather than the actual facility) and records may be incomplete.

tonnes (all of which was derived from MSW and excludes listed wastes). A stand-alone report on updated data for the period 2006–07 is expected to be released separately by the NT Government in 2010.

Waste generated, recycled and disposed to landfill

In 2006–07, 181 000 tonnes of waste were generated in the NT, of which 30 000 tonnes (17%) were recycled and 151 000 tonnes (83%) disposed to landfill.

Average waste generation in the NT for 2006–07 was 842 kilograms per person, 60% below the national average of 2080 kilograms per person.[†]

The Darwin region contributed 74 000 tonnes, or 41% of all waste generated in the Territory.

† National average calculated from Hyder Consulting, *Waste and Recycling in Australia*, Amended Report November 2009, excluding Tasmania and the Northern Territory, which do not have available figures.

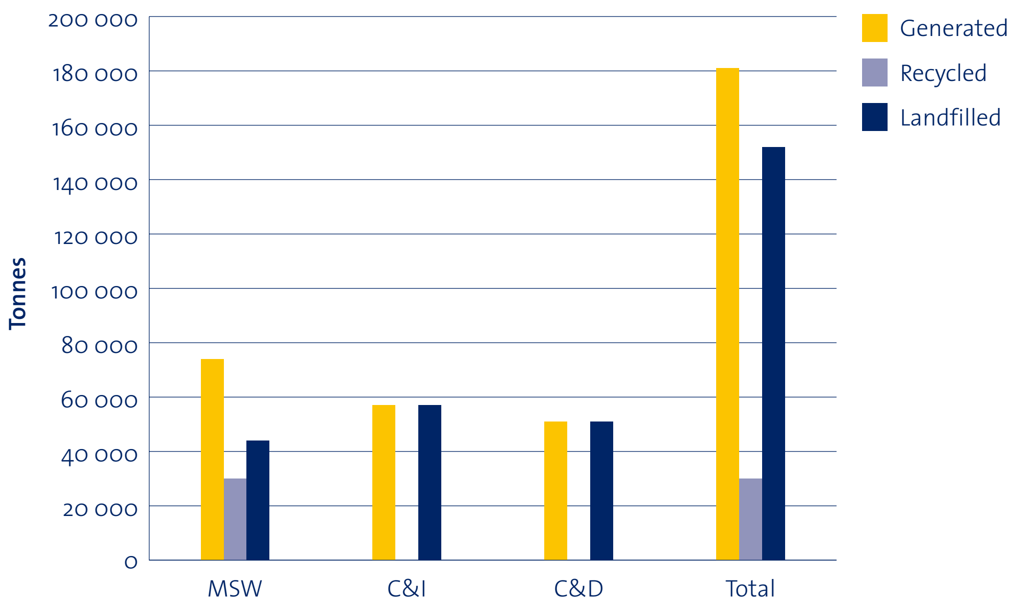
The Waste Streams (2006–07 figures)

For **municipal solid waste (MSW)**, total waste generated was 74 000 tonnes, of which 30 000 tonnes (41%) were recycled. Figures for MSW recycling show it as 100% of total NT recycling, but as data are not available for recycling in the other two streams, this may be misleading. 44 000 tonnes (59%) of MSW went to landfill (which is 29% of the total landfill disposal).

For **commercial and industrial waste (C&I)**, 57 000 tonnes were generated, which was 32% of total generation in the NT. There are no data available on tonnages of C&I waste recycled. The NT disposed of 57 000 tonnes of C&I waste to landfill (which was 38% of total landfill disposal).

For **construction and demolition waste (C&D)**, total waste generated was 51 000 tonnes, 28% of total waste generated in the territory. There are no data available for C&D recycling. The NT disposed of 51 000 tonnes of C&D waste to landfill (which was 34% of total landfill disposal).

Figure 2.77: NT—waste generated, recycled and landfilled, 2006–07



NT recycling

Of the 30 000 tonnes of material recycled in the NT for 2006–07, all came from the MSW stream. Recycling data for other streams are not available.

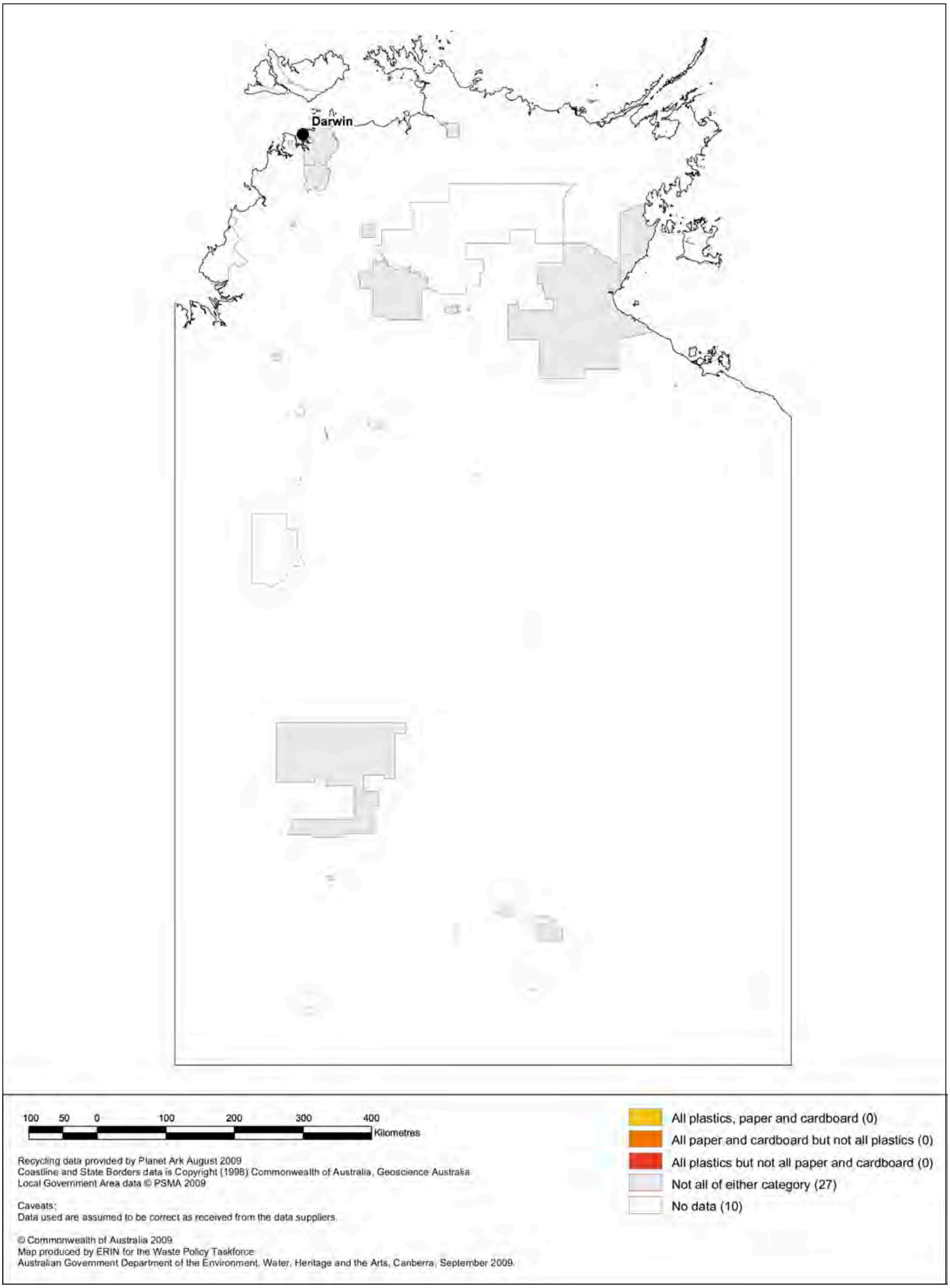
Municipal recycling services—what is collected and where

Around the NT, households are offered different municipal recycling services, covering particular configurations of materials, depending on which local government area they are in. **Figure 2.78** shows what municipal wastes can be recycled, and where.[‡]

Where available, data are presented for the whole territory. Information is also provided for the Darwin metropolitan area, where the largest flows of municipal waste and recycling are generated and handled.

‡ These are based on data entered by local councils into Planet Ark's 'Recycling Near You' service. The NT Government also advises that not all plastics are collected for recycling in the NT. Only plastics coded 1 and 2 are collected by kerbside pickup. Palmerston also has kerbside collection.

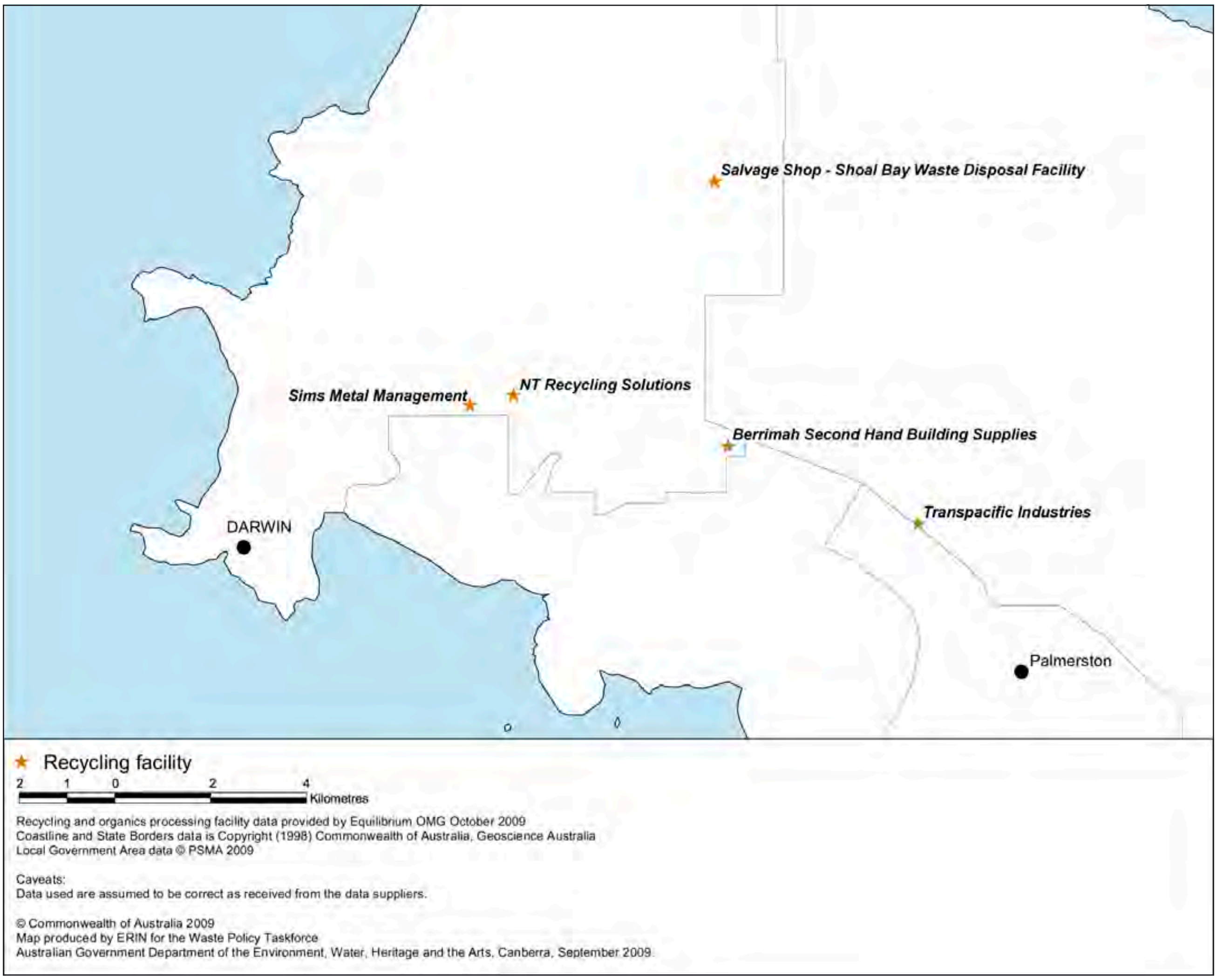
Figure 2.78: NT—municipal recycling of plastics, paper and cardboard, by LGA



Location of recycling facilities

Figure 2.79 shows some of the largest recycling facilities in the NT. It is a sample rather than a comprehensive view of all facilities. (Information is provided at the beginning of this chapter on the sourcing of data used in the figure and **Table 2.34**).

Figure 2.79: Darwin area—recycling facilities—location map



These facilities cover the following materials and processes:

Table 2.34: NT—recycling facilities—details

Name	Materials	Source of materials
Berrimah Second Hand Building Supplies, Berrimah	C&D waste	Building and demolition industry
NT Recycling Solutions, Winnellie	C&I materials	C&I
Salvage Shop	Metals and general materials	MSW, C&I, and C&D
Sims Metal Management, Winnellie	Metals—including aluminium and stainless steel	C&I
Transpacific Industries	MRF, MSW kerbside, commercial paper and commingled	MSW and C&I

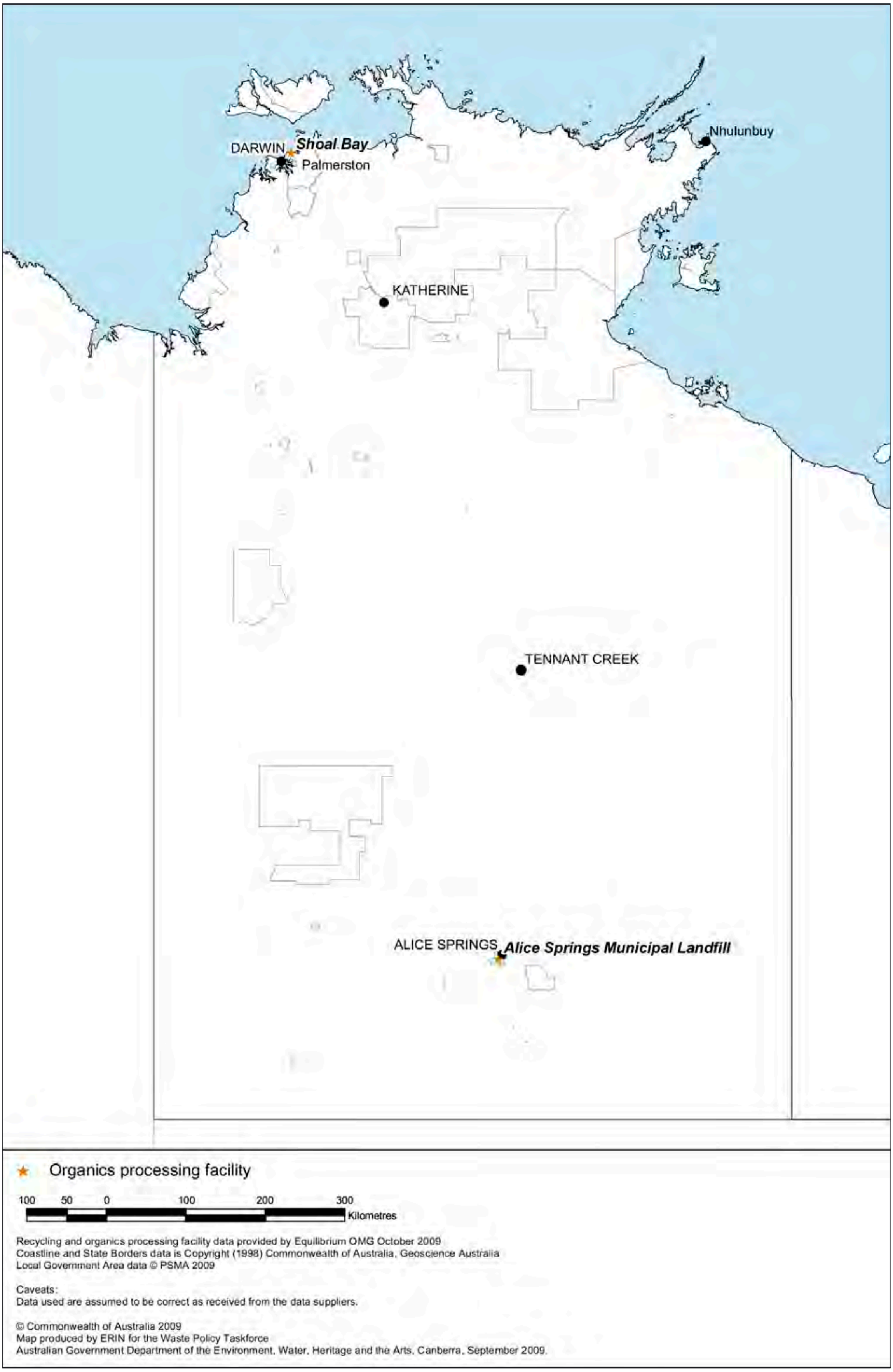
NT organics processing facilities

Organic wastes include all materials that once were living, such as food waste, garden waste, paper and cardboard. There is a variety of technologies and processes for handling and processing organic wastes. These include windrow composting of green waste, indoor composting, and biodigestion for gas, liquid and solid digestate.

Figure 2.80 shows the range and spread of major facilities in the NT for processing organic wastes. It is presented as a snapshot rather than a comprehensive view of all facilities. (Information is provided at the beginning of this chapter on the sourcing of data used in **Figure 2.80** and **Table 2.35**).[§]

§ There is no comprehensive record of all waste and recycling stakeholders and facilities.

Figure 2.80: NT—organics processing facilities—location map



These facilities cover the following:

Table 2.35: NT—organics processing facilities—details

Name	Materials	Source of materials
Alice Springs Town Council Landfill	Organics (food and green waste)	MSW, C&I and C&D
Darwin City Council Shoal Bay Waste Disposal Site	Garden/organic waste	Household, commercial and industrial

NT alternative waste treatment (AWT) facilities

Alternative waste treatment (AWT) facilities provide mechanical and biological treatment options and processes for achieving resource recovery from wastes that would otherwise have gone to landfill—including organic wastes from the municipal mixed-waste-to-landfill stream. Their functions are described more fully in **Chapter 4.7**.

There are currently no AWT facilities in the NT.

NT landfill

Commercial and industrial waste was the largest component of the 151 000 tonnes of waste sent to landfill in the NT for 2006–07, at 57 000 tonnes or 37%.

Using data derived from the 2009 Waste Management Association of Australia survey of Australian landfills (see **Chapter 3.1**), **Figure 2.82** maps the location of some of these landfills.

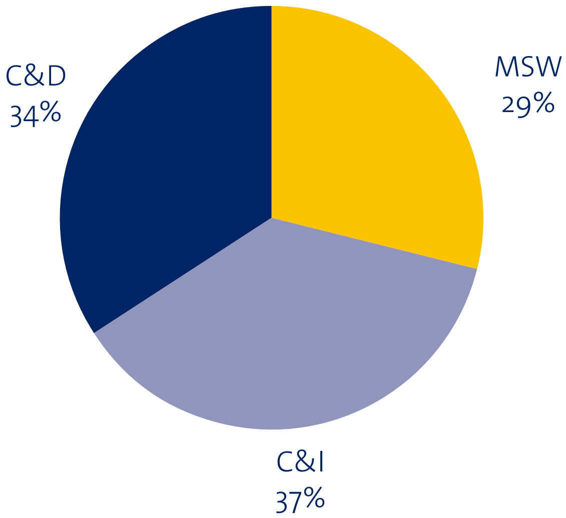
Only five NT landfill sites were available for mapping purposes. Data were not available for smaller landfills, including those in remote communities.

The major landfill sites for the Northern Territory are listed in **Table 2.36**. This information was provided by the NT government.

Table 2.37 includes one additional landfill site.

Annual tonnage information for this landfill was not publicly available.

Figure 2.81: NT—waste to landfill apportioned by source, 2006–07



Greenhouse emissions and gas capture

Organic materials can decompose in landfills and produce methane, which is a potent greenhouse gas. Methane can also be captured and used to generate renewable energy.

It is estimated that annual emissions to atmosphere for 2006–07 of greenhouse gases from NT landfills were 74 000 tonnes of CO_2-e. Estimated gas capture (flaring and energy generation) in that year was 57 000 tonnes of CO_2-e, or 43% of estimated total production of landfill gas.¶

¶ These estimations come from landfill gas emission modelling conducted by MMA. The sources and methods involved in this work are detailed in Appendix A of this report.

Figure 2.82: NT—landfill locations

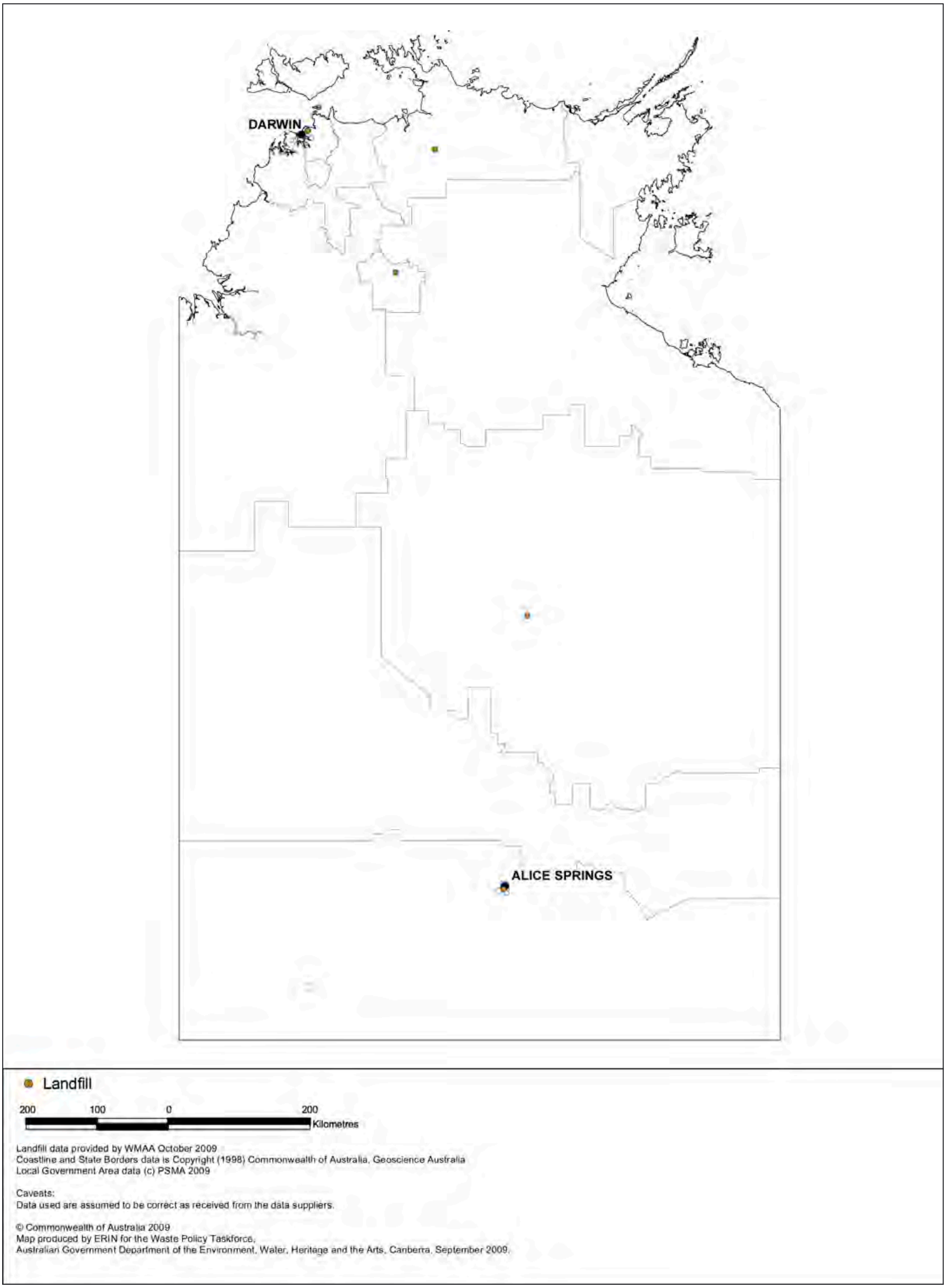


Table 2.36: NT—major landfills—details

Landfill name	Service area	Size (tonnes per year disposed, 2006–07)	Landfill type	Owner
Shoal Bay, Sanderson	Darwin, Litchfield, Palmerston	165 429	Inert/Putrescible/ Controlled	Darwin City Council
Alice Springs	Alice Springs	51 834	Inert/Putrescible	Alice Springs Town Council
Tennant Creek	Tennant Creek	20 000	Inert/Putrescible	Tennant Creek Town Council
Katherine	Katherine	10 000	Inert/Putrescible	Katherine Town Council

Table 2.37: NT—additional landfills—details

Entity	Location	Name
Jabiru Town Council	Jabiru	Jabiru waste depot

The table was sourced from

- a review of state and territory public registers of licensed landfills
- searches of government and industry websites, and
- internet and directory searches including White Pages, Yellow Pages and Green Pages.

Key points

- The management of waste and resource recovery in the NT faces significant obstacles, largely due to the effects of distance, and lack of resources.
- There are no facilities in the NT to recycle aluminium, glass, plastic or any other recyclables, all of which are transported interstate for treatment at considerable cost.
- In 2006–07, 181 000 tonnes of waste were generated in the NT, of which 30 000 tonnes (17%) were recycled and 151 000 tonnes (83%) disposed to landfill
- Average waste generation in the NT for 2006–07 was 842 kilograms per person, 60% below the national average of 2080 kilograms per person.
- The Darwin region contributed 74 000 tonnes, or 41% of all waste generated in the Territory.

Endnotes

1 Australian Bureau of Statistics, *2006 Census Data by Location*, <http://www.censusdata.abs.gov.au/>, accessed 11 November 2009.

CHAPTER 2.10
WHAT DOES AUSTRALIA WASTE AND RECYCLE?

This chapter describes the materials found within the municipal solid waste (MSW), commercial and industrial (C&I), and construction and demolition (C&D) waste streams in Australia. Where data are available, the materials composition of waste generated, recycled and landfilled for each of these waste streams is presented.

Sources

There is no one definitive national source of information on the composition of the three main waste streams—MSW, C&I, and C&D. The composition of these three waste streams can vary considerably among jurisdictions, within jurisdictions and regions within Australia as well as over time.

This report draws on several key information sources to present what is known about the type of materials present in the different waste streams, in particular:

- data in the Hyder Consulting report—*Waste and Recycling in Australia*[1]—a key data source for the period 2006–07 (Hyder Consulting 2009)
- information generated as part of the Australian Government's National Greenhouse and Energy Reporting Initiative (the Greenhouse and Energy Reporting Initiative), and
- information presented in an industry intelligence report prepared by Wright Corporate Strategies—*The Blue Book: Australian Waste Industry* (the Blue Book)—this presents data for the period 2004–05.

Municipal solid waste materials

In 2006–07, 12.7 million tonnes of MSW waste were generated in Australia, of which 40% was recycled and 60% was disposed to landfill (see **Chapter 2.1**). MSW is defined as, and consists mainly of, household and council waste and some construction waste from owner/occupier renovations which is delivered directly to landfill.

The Greenhouse and Energy Reporting Initiative indicates that MSW sent to landfill is made up of the materials in **Table 2.38**. Food, paper and cardboard and garden waste contribute 64.5% of the total materials sent to landfill.

Table 2.38: Average proportions of different materials in MSW waste sent to landfill[2]

Waste type—MSW	Percentage to landfill
Organic:	
Food	35
Paper and cardboard	13
Garden and park	16.5
Wood and wood waste	1
Textiles	1.5
Sludge	0
Nappies	4
Rubber and leather	1
TOTAL	**72**
Inert:*	
Inert waste (including concrete, metal, plastic and glass)	28
TOTAL	**28**

* 'Inert' means not able to produce methane through decomposition in landfill.

**

At a state and territory level, data on the materials found in MSW are limited. Those jurisdictions which do have data use a range of typologies and accounting frameworks. Acknowledging these limitations, individual jurisdictional data can provide some insight into what materials are found in MSW and the extent of recycling or disposal to landfill.

Data for NSW and Victoria (**Tables 2.39** and **2.40**), highlight the significance of paper and cardboard, green waste, food waste to the MSW profile and the high recycling rates achieved for paper and cardboard, glass, organic waste and for Victoria, metals and concrete, bricks and asphalt.

Estimates of the composition of materials generated, disposed and recycled in 2006–07 are also available for Western Australia (**Table 2.41**) which indicate lower volumes of waste materials generated and high recovery rates for metals, concrete, bricks, sand and rubble.

Table 2.39: NSW—materials in municipal waste, 2006–07 (tonnes)[3]

	Generated	Disposed	Recycled	Recycling rate
Paper and cardboard	613 000	206 000	407 000	66%
Plastic	227 000	195 000	32 000	14%
Glass	290 000	118 000	172 000	59%
Ferrous	130 000	79 000	51 000	39%
Garden organics	491 000	360 000	131 000	27%
Food	Unknown	819 000	Unknown	
Other organics	178 000	69 000	109 000	61%
Timber	Unknown	25 000	Unknown	
Soil and rubble	Unknown		Unknown	
Concrete, asphalt, brick, sand	Unknown	92 000	Unknown	
Other recyclables	3000	<1000	2000	
Other waste	Unknown	445 000	Unknown	
Total		2 408 000	1 483 000	38%

Table 2.40: Victoria—materials in municipal waste, 2006–07 (tonnes)[4]

	Generated	Disposed	Recycled	Recycling rate
Paper and cardboard	401 000	171 000	230 000	57%
Plastic (codes 1–3)	165 000	50 000	39 000	31%
Other plastic		76 000		
Glass	285 000	117 000	168 000	59%
Metals	313 000	123 000	190 000	61%
Food waste	660 000	658 000	2000	0%
Garden waste	585 000	307 000	278 000	47%
Wood/timber	116 000	111 000	5000	4%
Other organic	56 000	55 000	1000	3%
Clean excavated materials		20 000	Unknown	
Concrete, bricks, asphalt	158 000	20 000	138 000	88%
Textiles		<1000	7000	
Other		20 000	<1000	
Total	2 783 000	1 727 000	1 056 000	38%

Table 2.41: Western Australia—materials in municipal waste, 2006–07 (tonnes)[5]

	Generated	Disposed	Recycled	Recycling rate
Paper and cardboard	251 000	144 000	107 000	43%
Plastic	21 000	14 000	7000	33%
Glass	75 000	59 000	16000	21%
Metals	100 000	22 000	78 000	78%
Organics, incl. timber	645 000	483 000	162000	25%
Concrete, bricks, sand, rubble	<38 000	<1000	37 000	97%
Other		292 000	<1000	
Total	1 130 000	1 015 000	408 000	49.5%

Factors that have facilitated the recovery of particular materials from this waste stream include:

- the presence of kerbside recycling service for paper, paperboard and plastics, steel cans and glass to over 90% of Australian households.
- the extension of green waste processing in some jurisdictions (e.g. South Australia diverts 75% of garden organics away from landfill)
- bans of some material from landfill
- increased prices for some commodities such as metals on the world markets
- availability of alternative markets for recovered material supported by government procurement policies (e.g. the use of crushed concrete in roads in Victoria where 88% of concrete, brick and asphalt is diverted from landfill).

Commercial and industrial waste materials

In 2006–07, 14.5 million tonnes of C&I waste were generated in Australia, of which 56% were recycled and 44% were disposed to landfill (see **Chapter 2.1**). C&I waste is defined as waste from businesses, educational institutions and governments (other than councils). It comes from commercial office buildings, education facilities, shopping centres, public buildings and government facilities (other than from councils), sports facilities, and a range of industrial sites stretching from light industry (such as warehousing) through to heavy industry (such as manufacturing). It covers only solid waste from these operations and may include hazardous or potentially hazardous wastes.

Data on the quantity of different types of C&I waste generated, recycled or landfilled are limited and not readily comparable across jurisdictions. The Greenhouse and Energy Reporting Initiative indicates that C&I waste sent to landfill is made up of the materials in **Table 2.42**.

This table shows that 62.5% of C&I waste sent to landfill in Australia is organic. The main components are food, paper and cardboard and wood and wood waste. The table also shows a higher proportion of inert waste (38%) than found in MSW.

Data for Victoria (**Table 2.43**) illustrate that metals, paper and cardboard, concrete, brick, asphalt and wood and timber are the materials recycled most. The low proportion of food waste and garden waste recycled from this waste stream compared with the recycling rates for these materials in the MSW stream suggests that there is considerable scope for improvement and that there may be other market impediments.

Economic factors can influence recycling rates. For some materials, such as clean office paper, in some markets (particularly those with waste levies), it can be cheaper to recycle C&I materials than send them to landfill. In general, C&I recycling is driven by institutional, market, and commercial factors.

The recovery of particular waste types is more likely if

- generators of C&I waste, or managers of C&I facilities have corporate commitments to reduce waste to landfill and increase recycling
- there is a sufficient quantity of material to achieve economies of scale in transport and processing

Table 2.42: Average proportions of different materials in C&I waste sent to landfill[6]

Waste type—C&I	Percentage to landfill
Organic:	
Food	21.5
Paper and paper board	15.5
Garden and park	4.0
Wood and wood waste	12.5
Textiles	4.0
Sludge	1.5
Nappies	0
Rubber and leather	3.5
TOTAL	**62.5**
Inert:	
Inert waste (including concrete, metal, plastic and glass)	37.5
TOTAL	**37.5**

Table 2.43: Victoria—materials recovered from C&I waste, 2006–07[7]

	Materials tonnages of C&I recovery	% of C&I recovery
Metals	948 000	40%
Paper and cardboard	592 000	25%
Other organic	249 000	11%
Concrete, bricks, asphalt	245 000	11%
Wood/timber	164 000	7%
Plastic	65 000	3%
Food waste	35 000	2%
Glass	34 000	1%
Garden waste	25 000	1%

- the price of the recycled material compares favourably to the price of alternative (virgin) materials
- there is a financial incentive for waste generators to source-separate materials for recycling, i.e. when recycling costs less than disposal in landfill, and
- there is sufficient recycling capacity.

Some factors may hinder the recycling of C&I generated waste compared with C&D waste. For example, businesses that generate C&I waste may be more spread out than those that generate C&D waste and this could require more trips to a greater number of places for smaller volumes of materials. Collection fees for C&I recycling are also low compared to MSW ($9-$13/tonne for C&I waste compared to $125–$175/tonne for MSW).

Construction and demolition waste materials

In 2006–07, 16.5 million tonnes of C&D waste were generated in Australia of which 42% was disposed to landfill and 58% was recycled (see **Chapter 2.1**). C&D waste is defined as waste from residential, civil and commercial construction and demolition activities[8] and consists of:

- waste from demolition sites, e.g. concrete, bricks, timber, tiles, ceramic fittings, plastic pipes and cable
- unwanted materials, e.g. soil, rocks and trees, removed when sites are prepared for construction

- waste generated during construction, e.g. scrap plasterboard, timber and pipe off-cuts, broken bricks and tiles and packaging (plastic film, strapping, paint pails, cardboard boxes, cement bags)
- waste from office refurbishments, e.g. used carpet, packaging, wall panels, timber partitions and cupboards—approximately 10–20% of commercial floor area is estimated to be refurbished each year (referred to as 'churn')[9]
- waste from home renovations (although much of this is likely to be included in data for municipal waste), and
- waste generated during the rehabilitation and reconstruction of roads, e.g. concrete pavement and asphalt.

The largest components of the C&D waste stream, and the most commonly recycled materials, are concrete, bricks, asphalt, soil, timber and ferrous metals.[*]

* It is important to note that construction and demolition wastes (materials) are also present in the MSW and C&I waste streams.

Materials in C&D waste generated

Table 2.44 shows that of the main building products consumed or used in 2005, the largest quantities were concrete paving and construction bricks, asphalt and structural timber.[†] Most buildings, roads, bridges and other components of the built environment have a relatively long life—for example, the average life of a brick home is 88 years.[10] Therefore, most of the building materials consumed in 2005 are unlikely to enter the waste stream for decades.

Australian spending on buildings has grown 3% per year over the past 25 years. If the trend continues, our building stock may increase fourfold by 2050,[11] and the resulting annual increase of almost 40% in the consumption of building materials[12] would create long-term challenges for the management of C&D waste.

† In table 2.44 'consumption' refers to flows of material into buildings and sites, with 'disposal' referring to flows of materials away from buildings, whether into recycling or landfill. Data from 2005 are used, as 2006–07 national construction materials values were not available, and these 2005 figures will include materials flows outside the C&D waste stream (i.e. construction and demolition wastes from MSW and C&I).

Table 2.44: Building and construction products: consumption and disposal, Australia, 2005[13]

Building & construction products	Consumption ('000 tonnes)	Disposal ('000 tonnes)	Disposal rate (%)
Asphalt road materials	8200	3814	47
Bricks	14 141	7920	56
Cables	121	2	2
Concrete paving & construction	58 561	14 597	25
Wire fencing	143	84	59
Insulation	153	80	52
Office fittings	80	15	19
Piping (plastic)	246	34	14
Roofing iron	347	136	39
Roofing tiles	822	406	49
Structural timber	4312	1112	26
Window glass	303	92	30
Hot water systems	36	25	69
Carpet	109	111	102

Materials in C&D waste sent to landfill

The total amount of C&D waste disposed to landfill in Australia was almost 7 million tonnes in 2006–07, making up 33% of all waste disposed to landfill (see **Chapter 2.1**). The materials and products described in **Table 2.44** are indicative of those found in the C&D waste stream.

There is no consolidated data available on the specific composition of the C&D waste which is landfilled in Australia because of the different waste categories used in each jurisdiction. **Figure 2.83** shows that the largest components by weight of C&D waste landfilled in NSW are concrete, asphalt, bricks and sand (31%), soil and rubble (25%) and timber (13%). Other components include paper and cardboard, glass, steel, garden organics and textiles.

C&D waste can also include significant components of potentially hazardous materials such as asbestos and contaminated soils, although these are typically reported separately rather than as a component of the C&D waste stream.

A separate, detailed analysis of C&D waste disposed to landfills in NSW found that the largest components were asbestos and asbestos-contaminated wastes and contaminated soil.[15] Chemical testing of timber samples also found that 6% was contaminated to levels unacceptable for recovery purposes (4% copper chrome arsenate (CCA) treated timber and 2% lead).[16] While most C&D materials in landfill are inert, timber and wood products generate greenhouse gas emissions as they degrade.

Materials in C&D waste recycled

The recovery and recycling of C&D materials has expanded significantly in recent years in most jurisdictions and is now at relatively high levels (**Table 2.45**).

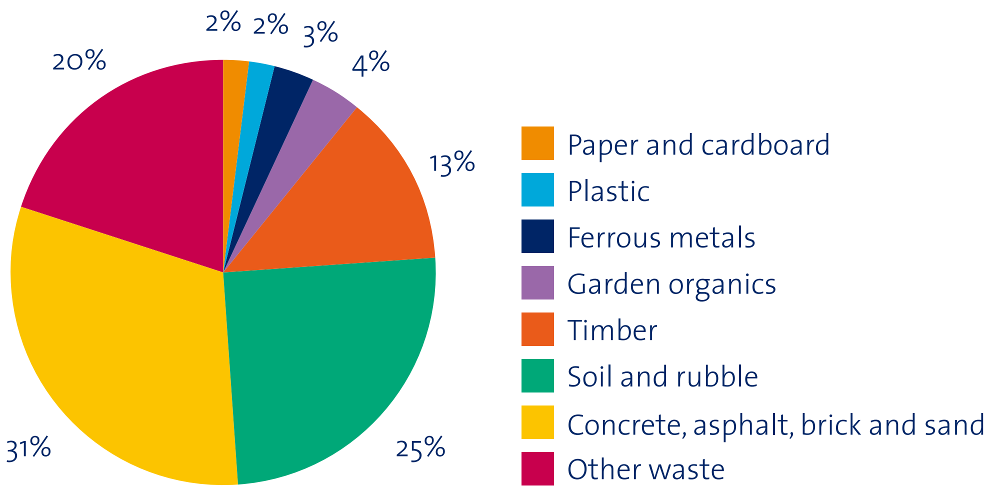
Table 2.45: Recycling rates for C&D materials by jurisdiction, 2006–07[17]

Jurisdiction	Diversion rate
NSW	67%
Vic	72%
Qld	30%
WA	17%
SA	79%
ACT	91%
Tas	Unknown
NT	Unknown

Recycling of C&D waste is largely driven by commercial factors, and tends to be most viable when:

- there is a sufficient quantity of material to achieve economies of scale in transport and processing
- the price of the recycled material compares favourably with the price of alternative (virgin) materials, and

Figure 2.83: NSW—C&D materials landfilled, 2006–07[14]



- there is a financial incentive for waste generators to separate the materials for recycling, i.e. when recycling costs less than disposal in landfill.

The materials in the C&D waste stream most commonly recycled are concrete, bricks, asphalt, soil and rubble, and ferrous metals. These are either available in large quantities from demolition sites and have a ready market in the construction industry (e.g. concrete, bricks and asphalt), or they have a relatively high commercial value (e.g. metals). In South Australia the diversion rate for concrete is 97%, and it makes up almost 70% of all C&D material recycled. In Victoria the diversion rate for concrete, bricks and asphalt is 86%, and these materials make up 95% of all C&D materials recycled. These are generally 'down-cycled' into lower-value products such as aggregate for use as road base. Asphalt can also be recycled back into asphalt for road construction or patching.

Timber from demolition sites is either re-used, re-processed into mulch, particleboard or animal bedding, or used as a biofuel. Efforts to increase recycling may be prevented by a lack of market drivers to re-use or recycle post-consumer timber, low costs of disposal, a lack of time available for the demolition process, saturated markets for timber in some regions, and mixing of post-consumer timber with other materials.[18] In South Australia some organic materials and small amounts of plastics are used as a refuse-derived fuel by Adelaide Brighton Cement, produced from processing mixed C&I and C&D waste. Metals also have high diversion rates from the C&D stream, for example 92% in Victoria and 75% in WA.

Some building material manufacturers offer builders a collection service (e.g. for bricks, tiles and plasterboard) if the builder separates the material on-site.[19] Some industry associations have developed voluntary product stewardship programs to increase the recovery and recycling of specific building products. These include

- Recycling Expanded Polystyrene Australia (REPSA)—off-cuts from EPS pods and insulation[20]
- Australian Resilient Flooring Association—off-cuts from vinyl flooring
- Plastic Industry Pipe Association of Australia—off-cuts from plastic pipe[21], and
- National Timber Product Stewardship Group—post-consumer timber and wood products.

Further information on product stewardship is provided in **Chapter 4.5**.

The collection and disposal of waste from construction sites is generally contracted to specialist waste removal companies. While some materials are recycled, most are disposed to landfill. Recycling is particularly problematic for smaller building sites, which tend to be widely dispersed and have relatively small quantities of each waste material at different stages of the construction process. One solution is for the developer of a previously undeveloped or 'greenfield' construction site to co-ordinate the recovery of waste materials, lowering the cost to individual builders. An example is the program managed by the Alex Fraser Group at VicUrban's Aurora Estate in Melbourne, which diverted 94% of waste from landfill.[22]

There is potential to increase diversion rates for some C&D materials, particularly concrete, bricks, soil, clay products and ferrous metals, especially if the prices of competing virgin materials increase.[23]

Conclusion

Materials that comprise Australia's waste streams vary considerably, as do the factors that influence how easy it is to divert those materials for re-use or recycling.

Overall figures show that far more of MSW goes to landfill than C&D and C&I waste, but more detailed analysis reveals a clearer picture of the complex nature of waste across and within the three streams. Broadly, much C&I and C&D waste can be re-used in ways which will bring commercial rewards, and some lends itself more easily to separation at source than the household component of MSW. Other chapters in this report address the implications of these facts more fully, and provide particular case studies as illustrations.

Endnotes

1 Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009.

2 *National Greenhouse and Energy Reporting (Measurement) Amendment Determination (No. 1)*, p. 163, <http://www.frli.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/current/bytitle/D053129F65CE1633CA2575F50032F8A3?OpenDocument&mostrecent=1>, accessed 27 October 2009.

3 Based on Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009, p. 129.

4 Ibid, p. 131.

5 Ibid, p. 133.

6 *National Greenhouse and Energy Reporting (Measurement) Amendment Determination (No. 1)*, p. 163, <http://www.frli.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/current/bytitle/D053129F65CE1633CA2575F50032F8A3?OpenDocument&mostrecent=1>, accessed 27 October 2009.

7 Based on Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009, p. 129.

8 Ibid, p. 14.

9 Centre for Design at RMIT University, BIS Shrapnel, CSIRO, Deni Greene Consulting and Syneca Consulting, *Scoping study to investigate measures for improving the environmental sustainability of building materials*, Report to Department of the Environment and Heritage and the Australian Greenhouse Office, 2006, p. xvi.

10 Ibid, p. 23.

11 Ibid, pp. xiv–xv.

12 Ibid, p. 81.

13 Based on Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009, pp. 77–78.

14 NSW Department of Environment, Conservation and Climate Change, *Report into the construction and demolition waste stream audit 2000–2005*, 2007, p. 8.

15 Ibid, p. 12.

16 Based on Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2009, pp. 129–37.

17 Ibid, p. 129.

18 National Timber Product Stewardship Group, *Timber—more life: a product stewardship strategy for post-consumer timber and wood products*, 2007. <http://www.timberstewardship.org.au/images/pdf_documents/tml_strategy_final.pdf>.

19 Housing Industry Association, *Submission in response to A National Waste Policy: Consultation Paper*, May 2009.

20 <www.repsa.org.au>, accessed 27 October 2009.

21 <www.pipa.com.au/recycling.html>, accessed 27 October 2009.

22 EcoRecycle Victoria, *2002–2003 Annual Report*, p. 17.

23 NSW Department of Environment, Conservation and Climate Change, *Report into the construction and demolition waste stream audit 2000–2005*, 2007, p. 12.

Chapter 3
Impacts and opportunities

This chapter examines issues associated with the impacts and benefits of waste, and covers:

- landfill
- resource recovery and recycling, including the environmental benefits of recycling
- hazardous waste and substances, and how they can be managed and recovered
- organic waste and the climate change implications of waste generation and waste management
- litter, and
- marine debris.

This chapter provides a general account of facts and findings as they relate to the two main waste management practices and four important categories of waste. It does not purport to be a comprehensive survey of the available information but seeks to provide basic information that assists in developing a national picture of the waste management and resource recovery and recycling in Australia.

CHAPTER 3.1 LANDFILLS

This chapter presents information about the environmental impacts of landfill, how landfills will be affected by climate change, how landfills affect communities, the cost of landfills and the characteristics of landfills in Australia.

Landfill remains a significant waste destination, with around 48% of all waste by weight being disposed of to landfill in 2006–07.[1]

There were at least 665 landfills operating in Australia in 2008, although it is likely that more landfills both operational and closed may exist.[2]

Landfill facilities accept putrescible (degradable organic), inert, or hazardous wastes. Organic waste, (mainly from the municipal solid waste (MSW) and commercial and industrial (C&I) waste streams), is sent to putrescibles sites, while non-degradable waste from C&I stream, as well as the construction and demolition (C&D) stream, is sent to inert sites. Around half of all waste to landfill is sent to putrescibles landfill sites.[3] Hazardous waste is generally sent to specialist facilities. However, there is an increasing trend for those consumer products and materials which may contain potentially hazardous substances to be sent to putrescibles landfills.* If such substances are treated as part of the general waste stream, this may increase risks to the environment and the surrounding community, as well as requiring more costly waste sorting and/or treatment.

Landfill impacts

Landfills can impact on air, water, soil and biota in several ways. Landfill gas is created by the decomposition of organic waste and consists mainly of methane which when released to the air contributes to local smog and global warming. Leachate is formed when water moves from or through the waste, and has the potential to contaminate nearby surface and ground water. Potentially hazardous substances can also migrate through the surrounding soil either directly, via leachate, or in landfill gas.

Landfill gas

Landfill gas is produced when organic waste decomposes under anaerobic conditions. Usually it consists of approximately 40% carbon dioxide, 55% methane, 5% nitrogen (and other gases) and trace amounts of non-methane organic compounds.[4]

Methane is highly explosive in air and therefore requires careful management. It can accumulate in structures within and surrounding the landfill and present a risk to local vegetation, wildlife and surrounding communities. Most modern landfills are required to manage landfill gas as part of their licence conditions. Flaring or gas capture for electricity generation are common ways of controlling methane in medium-to-large landfills. Capping with a layer of soil or vegetation is also widely used, particularly for smaller landfills. Methane is also directly linked to the production of ozone in the troposphere and ozone is the primary constituent of smog. Both methane and ozone are significant greenhouse gases. Methane has a global warming potential 25 times that of carbon dioxide over a 100 year period.[5] The control of methane from landfills therefore contributes to greenhouse abatement strategies (see below for discussion).

Landfill gas is generated for at least 15–30 years after the organic waste is deposited in landfill and begins to decompose. The rate of decomposition is influenced by a number of factors, including:

- the composition of the organic waste (wood can take over 30 years to break down, paper and cardboard 10 to 17 years)[6]
- the geographic location of the landfill which determines temperature range and rainfall (dry conditions slow decomposition), and
- landfill design and operational procedures (the recirculation of leachate or moisture will assist decomposition).

* Further discussion about the potentially hazardous substances in consumer products and materials is contained in *The hazardous components of waste*, Chapter 3.3.

Leachate

Leachate collects at the base of the landfill cell or landfill, and its composition depends on the type of waste material put into the landfill, the amount of water entering the landfill, and landfill conditions such as pH, temperature, moisture, age and climate. Depending on the characteristics of the landfill and the waste it contains, the leachate may be relatively harmless or it may be toxic and will need to be managed in particular ways.

For landfills that receive a mixture of municipal, commercial, and mixed industrial waste, but not significant amounts of industrial chemical waste, landfill leachate may comprise the following four main groups of contaminants:

- dissolved organic matter
- inorganic compounds including sulfate, chloride, iron, aluminium, zinc and ammonia,[7] heavy metals including lead, nickel, copper and mercury, and
- man made organic compounds such as halogenated organics including polychlorinated biphenyls and dioxins, solvents and phenols (from paints).[8]

Leachate can contaminate surface water and ground water if not properly managed. A high water table below the landfill is likely to allow the contaminants in leachate to enter the groundwater directly without filtration by the soil. Sandy soils are also more likely to increase the rate of leachate discharge than clay soils which prevent groundwater movement and are more effective at filtering out contaminants.

Most modern engineered landfills control leachate through a combination of landfill liners and collection systems and are generally required to be sited in suitable locations to avoid risks to groundwater. Collection systems include piping leachate to a storage pond or a treatment plant, or recirculating the leachate through the landfill to aid in waste decomposition. In specially designed bioreactor landfills, leachate is recirculated in a controlled way through landfill cells as a means of maintaining moisture content and maximising the production of landfill gas which in turn is captured to produce energy.

Hazardous materials in landfills

Landfill continues to be a repository for various types of potentially hazardous waste, including consumer goods, electronic waste, some household chemical waste, household clinical waste and hazardous waste, disposed of in the C&I and C&D waste streams. Many consumer goods and electronic waste contain potentially hazardous components such as plastics that incorporate brominated flame retardants, cathode ray tubes which contain lead, and circuit boards and power supply units containing copper, mercury, cadmium and phthalates. The effects of their presence in leachate and migration into the surrounding environment are not well understood.

A study of the leaching of heavy metals from e-waste in simulated landfill columns over a two-year period found that lead was the hazardous substance that most readily leached from the e-waste and was absorbed by the solids around it.[9] In another study, mercury was found to occur in gaseous form at a distance of 100–160 metres from where it was disposed in a landfill in Nevada.[10]

Greenhouse emissions and landfill

Landfill emissions contribute to greenhouse gases, and therefore measures to reduce or abate them will contribute to the nation's emissions targets. The landfill sector contributed 11 Mt CO_2-e in 2008 to Australia's overall greenhouse gas emissions profile and is predicted to be around 11 Mt CO_2-e in 2020.[11]

The projections are based on the assumptions that organic waste will continue to be diverted from landfill at an increasing rate, and that landfill gas capture will grow by around 2.3% per annum.[12] The projections are also based on the assumption that one tonne of municipal waste produces 1.0 tonne of CO_2-e, one tonne of C&I waste produces 1.1 tonnes CO_2-e, and one tonne C&D waste produces 0.3 tonnes CO_2-e.[13] These values differ due to the varying mixes or concentrations of degradable organic material in the three waste streams.

Table 3.1 provides information by jurisdiction on the greenhouse gas emissions generated and abated from landfills at 2006–07, and projected to be generated and abated in 2020–21. Abatement is expected to increase in all states, with the greatest increases predicted in Western Australia, Victoria and Queensland.

Table 3.1: Net greenhouse gas emissions from solid waste avoided by state

	2006–07			2020–21		
	Emissions, Mt CO_2-e	Abated Mt CO_2-e	% Abated	Emissions, Mt CO_2-e	Abated Mt CO_2-e	% Abated
NSW/ACT	4.497	2.537	36%	3.568	2.232	38%
Qld	2.503	0.178	7%	2.374	1.450	38%
Vic	2.109	0.493	19%	2.706	1.913	41%
WA	1.094	0.945	46%	1.184	2.709	70%
SA	0.594	0.226	28%	0.781	0.399	34%
Tas	0.233	0.065	22%	0.234	0.157	40%
NT	0.074	0.057	43%	0.115	0.060	34%
Australia	11.104	4.500	29%	10.962	8.919	45%

Source: National Greenhouse Gas Inventory and McLennan Magasanik Associates Pty Ltd *Climate Change and the Resource Recovery and Waste Sectors, 2009 (unpublished)*

Note 1: The amount abated is equal to the methane recovered from landfill gas capture/generation, flaring and methane avoided as a result of waste diverted to waste-to-energy facilities.

Note 2: % abated is methane abated as a proportion of the total methane emissions that would have occurred if there was no abatement (i.e. emissions plus abatement).

Note 3: In some jurisdictions programs exist to divert organic waste to licensed composting facilities resulting in abatement of emissions.

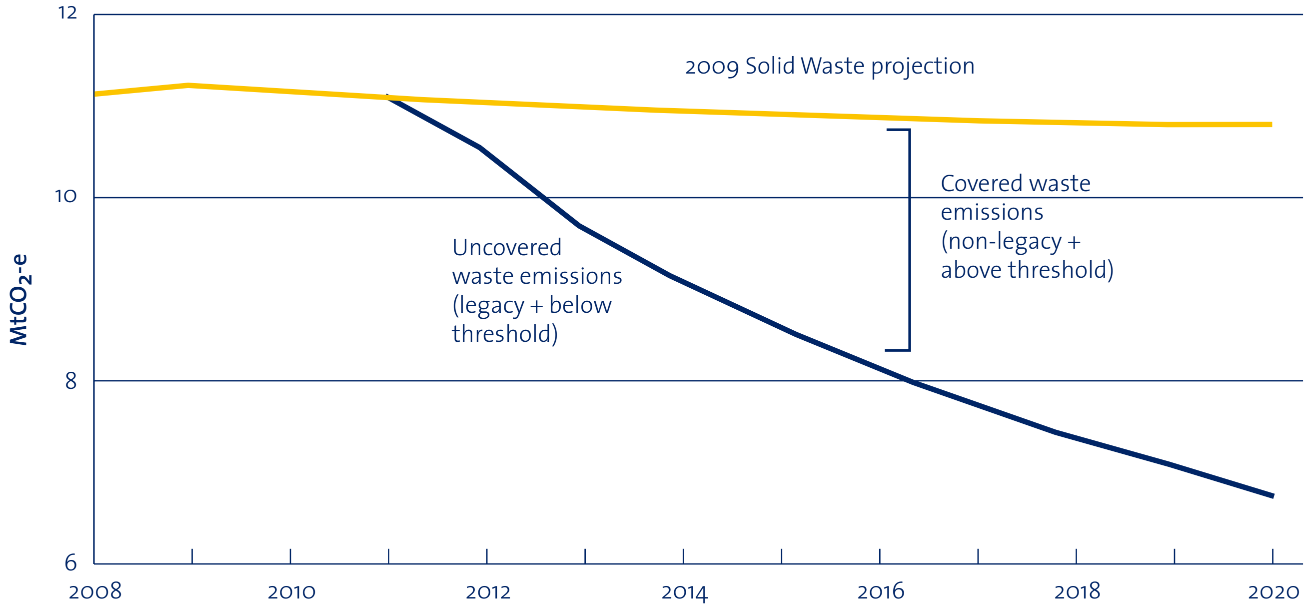
The actual abatement of greenhouse gas emissions from landfill will depend on the continued investment in organic waste treatment facilities and landfill gas capture. Development of policy and regulation, plus the future of cost of carbon, will affect the uptake of this form of abatement. Information on future infrastructure is in **Chapter 4.7**.

The Australian Government's 2009 policy is that greenhouse gas emissions from landfills will be covered by the proposed Carbon Pollution Reduction Scheme (CPRS). Under the proposed scheme, landfill operators will be liable for the emissions that they emit, and will need to purchase Australian Emission Units to offset their liability. However, operators of small landfills would be excluded from the proposed scheme and emissions from waste that is deposited prior to scheme commencement will also be excluded. (These are known as legacy emissions). **Figure 3.1** illustrates the coverage under the proposed CPRS of greenhouse gas emissions from landfill, 2008 to 2020. The report *Climate Change and the Resource Recovery and Waste Sectors* estimated that some 70% or 106.4 Mt CO_2-e of landfill sector emissions to 2020 would not be subject to the CPRS.[†14] The operation of the CPRS will influence the viability of alternative waste treatments and the uptake of landfill gas capture.

Landfill gas is regarded as a renewable energy source under the Australian Government's Renewable Energy Target.[15] The accompanying legislation requires that electricity generators

† This analysis and the DCC projections given above use a global warming potential for methane of 21.

Figure 3.1: Coverage under the proposed CPRS of greenhouse gas emissions from landfill, 2008 to 2020



Source: DCC analysis 2009.

generate a specified amount of renewable energy, purchase renewable energy certificates from eligible renewable energy generators or pay a liability charge. Landfill gas electricity generators can generate renewable energy certificates for each megawatt hour of electricity they produce which they can then sell to other electricity generators to enable them to meet their requirements under the Renewable Energy Target. Because landfill gas electricity generators have this additional income stream, there is a financial incentive to install landfill gas capture.

The commercial viability of landfill gas capture and generation is determined by the amount of organic waste deposited to landfill, the cost of the gas capture system and the electricity generation plant, the cost of connection to the electricity grid, and the price of the electricity generated (including the renewable energy certificate price). Industry sources indicate that it is generally not economic for landfills receiving under 10 000 tonnes per annum to install landfill gas capture and generation.[16]

Landfill gas capture

Methane produced at landfills from the decomposition of organic material can be captured and either burnt or used to generate electricity for onsite or offsite use. In 2005–06, Australian landfills captured 26% of total landfill gas emitted.[17]

Most major metropolitan and large regional landfills in Australia capture landfill gas from at least part of the landfill. In 2007, there were 58 landfill gas generation plants in Australia with a capacity totalling 165.3 MW.[18]

The 2009 survey of landfills by the Waste Management Association of Australia indicated that 11% of respondents had installed capture and generation equipment.[‡] These landfills accounted for approximately 49% of the landfilled waste reported by respondents.[19] Of the 318 responses to the survey question on landfill gas capture, 89% had no landfill gas capture in place. These landfills account for approximately 51% of respondents' landfilled waste. Landfills with no landfill gas capture and generation are usually located in rural and regional areas and receive under 100 000 tonnes of waste per annum.

‡ Respondents were not surveyed about the extent of landfill gas capture at their site.

There is considerable debate over the efficiency of landfill gas capture, and estimates vary from 60% to over 90% efficiency.[20] The Environment Protection and Heritage Council (EPHC), however, found that the average capture rate nationally was 45%.[21] These figures refer to operational efficiency but there is likely to be some system deterioration over the life of the capture and generation plant. This is illustrated in **Figure 3.2**.

The impacts of climate change on landfills

The report *Climate Change Risks to Australia's Coasts*[22] indicates that climate change is likely to bring rising sea levels, changes in ground water and more intense storm events including chaotic, heavy precipitation, high wind velocity, increased wave action and higher storm surges to Australia's coasts. These potential impacts will affect essential infrastructure such as landfills or waste disposal facilities. The report identifies 41 waste disposal facilities located within 200 metres of the coastline and 92 located within 500 metres of the coastline.[23] There may, however, be many smaller, historic landfills in this area.

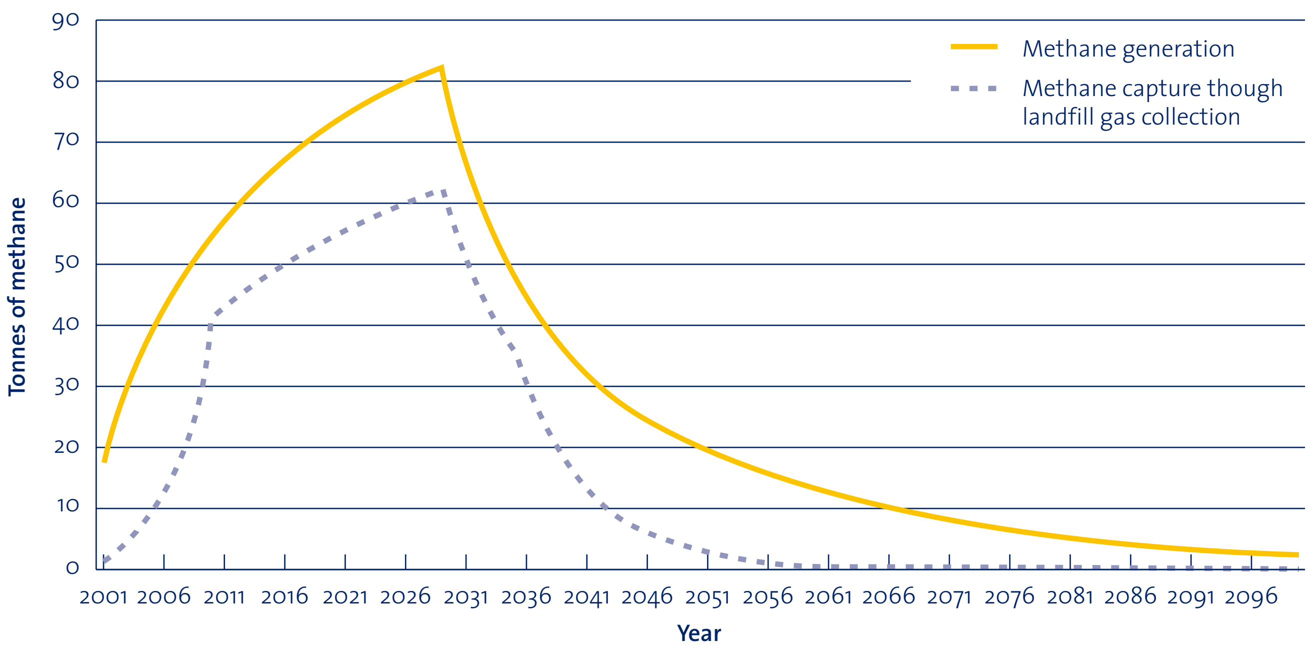
The report also notes that many old landfills are sited in or adjoining flood-prone and low lying lands such as mangrove swamps and salt marshes. These landfills contain quantities of oil, demolition waste, asbestos, pesticides, plastics and heavy metals, possibly including mercury. This waste has the potential to be released to the environment by progressive climate change-related erosion or sea level rise. Existing clay capping and vegetative cover are unlikely to withstand the direct action of waves, particularly those that are whipped up by storm events. Permanent inundation at the base of the landfill could generate additional leachate and disperse potentially hazardous substances into the surrounding environment.

While this report focuses on Australia's coastline, extreme rain events are also likely to cause inundation and erosion of inland landfill sites that are also located in low lying areas or near water courses. This issue is discussed in more detail in **Chapter 4.6**.

Social impacts of landfill

Landfills may affect the host community including through noise, odour, dust, increased traffic and exposure to the environmental impacts. To date studies to investigate the possible adverse

Figure 3.2: Diminishing capacity of landfill capture systems over time[24]



human health impacts from landfill sites have not established direct links.[§] There is limited scientific understanding of the chemical reactions and processes that occur within landfills and the possible pathways of hazardous substances into the surrounding environment.

There are few studies on the loss of amenity for people who live and work near landfills. The report *Australian Landfill Capacities into the Future* found that community objections to landfills are a significant and increasing constraint on the supply of landfills.[25] Even with widespread community concerns about landfills (some of which relate to amenity impacts), most estimates of landfill costs calculate social amenity costs at a low level. The Productivity Commission concluded in its 2006 report *Waste Management* that properly-located, engineered and managed landfill would have minimal amenity impacts and therefore adopted a typical amenity cost of $1.00 per tonne of waste. It also referenced an early study by the former NSW EPA which estimated that loss of amenity for a landfill located in a built up area and poorly managed was about $3.70 per tonne.[26]

National picture of landfill management

National information on landfill sites, including their environmental performance, compliance with licensing conditions and future capacity, is incomplete. This is due to a number of factors, including lack of regulation to require the provision of data and different collection methodologies and definitions. As well, some landfill data may be subject to commercial-in-confidence requirements or other forms of prohibitions on public release.

Some information is available in the National Landfill Survey conducted by the Waste Management Association of Australia.[27] The 2007–08 Survey identified 665 landfills and received responses from 324 landfill operators—a response rate of around 65%. The Survey divided landfill into six size categories which in the following analysis have been reduced to two to aid interpretation:

- small-to-medium sized landfills each receive less than 100 000 tonnes of waste per year
- large landfills each receive over 100 000 tonnes of waste per year.

Table 3.2 and **Figure 3.3** compare the selected environmental indicators for landfills of different sizes.

For large landfills, more than 90% have liners and groundwater monitoring while all large landfills surveyed have leachate monitoring. More than 80% of the surveyed large landfills receive waste classified as hazardous. It can be concluded that, on the whole, large landfills have in place environmental controls that could assist in monitoring or reducing impacts on the surrounding environment.

For small-to-medium landfills, less than 40% have liners and leachate monitoring while less than 50% of these sites have groundwater monitoring. These sites receive 27% of the waste generated by respondents to the survey and more than 50% of them accept waste classified as hazardous. Many small-to-medium sized landfills do not appear to have similar environmental controls that are evident in the large landfills.

The actual impacts on surface and groundwater or the surrounding soil of small-to-medium landfills are generally not known in any detail. Information is available on whether or not controls are in place but not on whether landfills constitute a significant pathway to harmful levels of exposure. Given potential water shortages in the future, it may be useful for research to be undertaken on the risks associated with exposure to landfill leachate particularly within stressed water catchments.

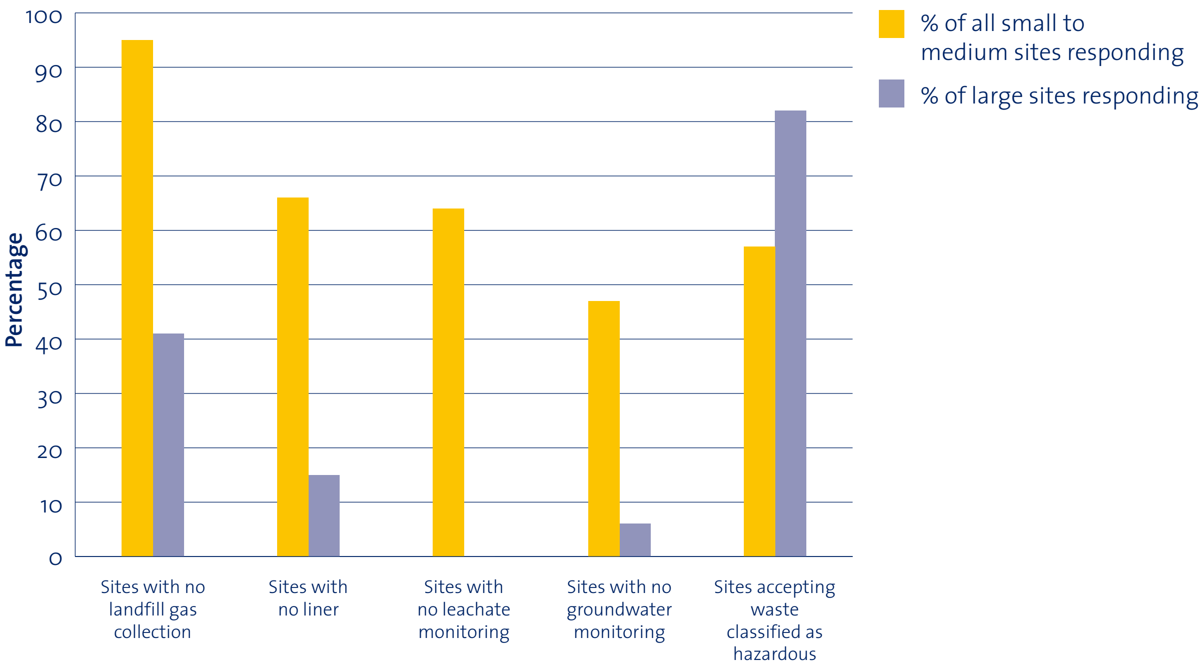
Some jurisdictions (Victoria and South Australia) have also undertaken assessments of landfills which may pose a risk to human health from methane gas emissions. These assessments were in response to an incident where dangerous methane gas levels were detected at a former landfill site in Cranbourne, Victoria affecting urban residents in the vicinity of the site. Victoria has completed

§ Studies have focused on congenital abnormalities, stillbirth, low birth weight and increased cancer risk and include the EUROHAZCON studies of 1998 and 2002 and the Small Area Health Statistics Unit (SAHSU) study, referred to in http://portfolio.mvn.ed.ac.uk/studentwebs/session 4/7/healtheffects.htm

Table 3.2: Selected environmental survey results for all sized landfills

Indicator	Landfill Size Category: Small–Medium 1–10 000 tonnes	10 001–20 000 tonnes	20 001–30 000 tonnes	30 001–50 000 tonnes	50 001–100 000 tonnes	Large >100 000 tonnes	Totals
Sites surveyed and responding in each category	205	25	23	14	23	34	324
Total weight of waste received (%)	439 948 (3%)	371 488 (3%)	596 617 (4%)	588 636 (4%)	1 649 771 (12%)	9 815 903 (73%)	13 462 363 tonnes (100%)
Sites accepting waste classified as hazardous	94	16	19	13	21	27	190
Sites with no landfill gas collection	197	25	21	12	14	14	283
Sites with no liner	163	10	6	5	5	5	194
Sites with no leachate monitoring	150	11	7	3	4	0	175
Sites with no groundwater monitoring	125	2	0	1	1	2	131

Figure 3.3: Comparison of environmental indicators for small-to-medium (<100 000 tonnes) and larger landfills (>100 000 tonnes)



a methane gas assessment on Victoria's licensed landfill sites and identified eight sites requiring further investigation. Voluntary environmental audits are being undertaken at all these sites and some sites are undertaking works designed to contain methane within the landfill site.[28] South Australia has identified 20 former and operating landfill sites that may pose a risk. The sites currently comply with regulation but will continue to be investigated and monitored.[29]

Landfill cost

Appropriately priced landfill services are important components of waste management. Landfill costs include the costs associated with the operation of the landfill (usually referred to as private costs) and the costs associated with the environmental, health and social impacts (usually referred to as public costs or external costs). While it is straightforward to calculate the land, infrastructure, operational, maintenance and post closure costs of landfill, it is more difficult to calculate the costs associated with environmental impacts such as those caused by leachate and hazard migration, landfill gas, and social costs such as loss of amenity and foregone opportunities to use the land for different purposes. To date no study has been able to fully estimate these impacts, mainly because of uncertainties involved in measuring external costs. It is therefore worth considering the findings from a range of studies. The discussion below is presented from a national perspective—more detailed estimates of costs would need to take into account local circumstances within individual jurisdictions and

Table 3.3: Costs and benefits of landfill[30]

	Costs	Benefits
Private costs and benefits	Land purchase The approval process Equipment and buildings Construction costs such as excavation and lining of landfill bases to minimise leaching On-site gas recovery and flaring Fencing and other measures to prevent waste from being blown into neighbouring properties Operational costs like fuels and materials Monitoring and reporting Capping landfills and landscaping Rehabilitation and after-care Employees and contractors	The availability of a convenient and relatively low cost method of waste disposal for most users
External costs and benefits	Emissions of greenhouse gases, particularly methane from the anaerobic degradation of organic material Emissions of other air pollutants such as hydrogen sulphide and volatile organic substances Leachate emissions (some toxic), which have potential to be discharged to ground or surface water Amenity impacts, including impacts on local communities from the operation of landfills (e.g. noise, dust, litter, odour and pests) Transport impacts, including emissions from the collection and disposal of waste Opportunity cost of materials being disposed to landfill rather than being recycled	Pollution avoided if landfill gas is used to generate energy and displaces energy from a more polluting source (e.g. a coal-fired power station) Protection of public health (compared with poorly managed waste disposal) Employment (direct and indirect)

specific to local landfills. **Table 3.3** outlines the private and public costs of landfill.

In its 2006 report *Waste Management*, the Productivity Commission examined the cost of landfill. Finding 4.1 of the report states that "the total external costs of properly located, engineered and managed landfill that incorporate efficient gas capture (with electricity generation) are likely to be less than $5 per tonne of waste".[31] This is based on three assumptions:

- firstly, that if landfills incorporate liners and leachate management, the risk that leachate will damage human health or the environment is small, and the external cost of leachate is likely to be less than $1 per tonne of waste;
- secondly, that if a landfill incorporates a gas capture system and uses the gas for electricity generation, the external costs of greenhouse gas emissions are unlikely to exceed $2 per tonne of waste;
- thirdly, that the typical amenity cost of a properly located, engineered and managed landfill is less than $1 per tonne of waste.

Since that report was published, a number of other studies have estimated the costs of landfill, and work by the Australian Government has been published on the social cost of carbon dioxide emissions as part of the development of its climate change policy and the Carbon Pollution Reduction Scheme.[32]

A 2009 study by the BDA Group found that total costs for putrescibles landfills range between $42 and $102 per tonne of waste in urban areas, and between $41 and $101 per tonne in rural areas, depending on the level of management controls and prevailing climate.[33]

Figures 3.4 and **3.5** show the breakdown of these costs for putrescibles landfills of different sizes, comparing costs for landfills having the strongest controls and most favourable climates (e.g. low rainfall) with those having the poorest controls and least favourable climates (e.g. high rainfall). **Figure 3.4** shows national average costs for urban areas and **Figure 3.5** shows national average costs for rural areas.

The landfill costs identified in the BDA study are averaged across Australia. Costs of land purchase, environmental controls, and operational and maintenance requirements for health and safety, will differ from region to region. The study provides a conservative estimate of landfill costs, and excludes environmental impacts such as those associated with hazardous substances leaving the confines of the landfill and consequent legal and clean up costs (which are likely to be greater for sites with poorer controls).

It is inherently difficult to predict the type and quantity of hazardous substances present in landfills and their likely behaviours, as this is related to the type of waste disposed, the chemical and biological reactions that occur within the landfill, the environmental controls in place, and characteristics of the receiving environment. This range of variables adds complexity to the process of costing the impacts of hazardous substances on human health and the environment.

The exclusion from this analysis of costs associated with hazardous substances migrating from landfill, as well as of clean-up costs, suggests that in reality the external costs for landfills with poor controls are likely to be greater. These exclusions may account for BDA's finding that small landfills with poor controls cost less than small landfills with best controls. However, as the case of large landfills illustrates, external costs can be greatly reduced by the adoption of environmental controls, highlighting the importance of appropriate and targeted regulation.

The BDA study also references other studies of landfill cost, including the Waste Management Association of Australia's 2005 estimate of $25 per tonne for large, best-practice landfill, the Wright Corporate Strategies estimate of $50 per tonne, Mt Gambier landfill cost of between $25 and $40 per tonne, Great Lakes Council landfill cost of $40–$150 and Hastings Council landfill cost of $16–$40.[34] The study notes that

> there are significant differences in the estimates of the private cost per tonne of waste to landfill provided in the literature. Some of these differences are due to the size of the landfill, whether a landfill is

Figure 3.4: Estimated national average costs for putrescible landfills in urban areas[36]

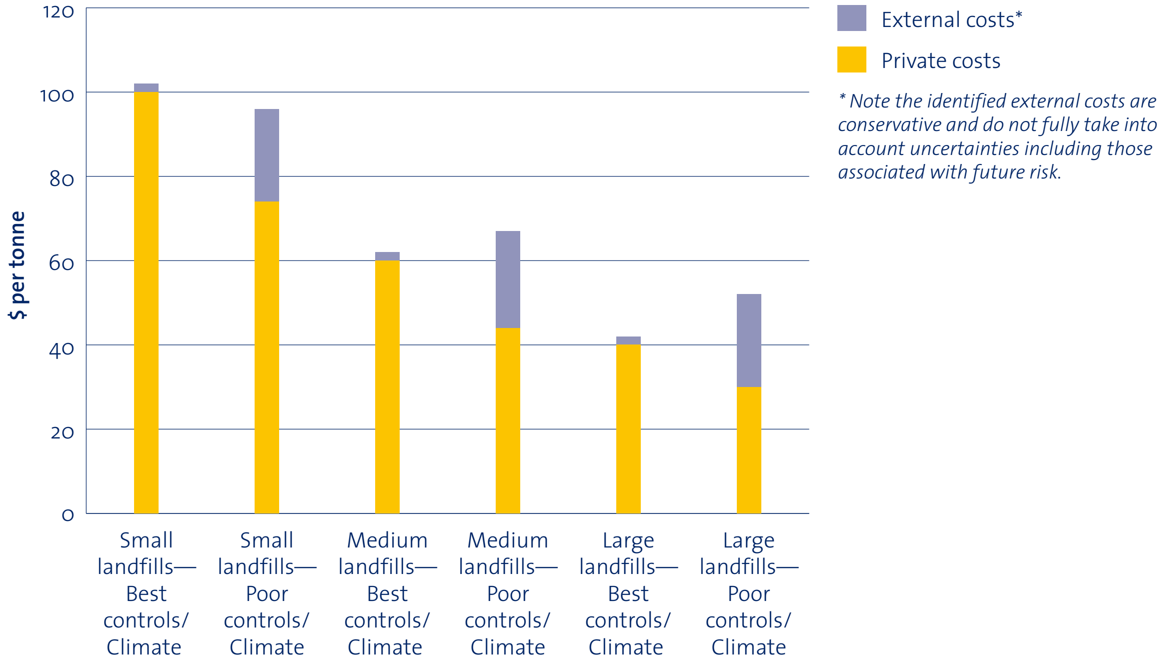
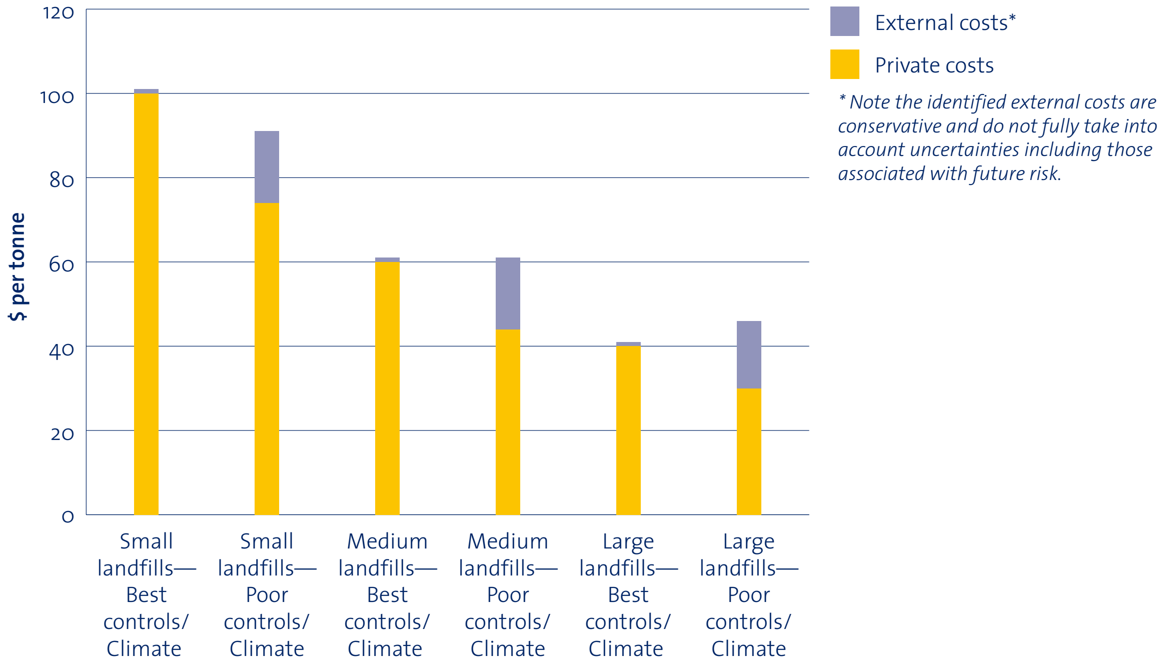


Figure 3.5: Estimated national average costs for putrescible landfills in rural areas[37]



Source: Figures are generated using data from the BDA Group, *The full cost of landfill disposal in Australia*, 2009, Chapter 7 and Attachment C.

Notes:

1. To guide cost estimates, landfills were classified according to the factors that influence the private and external costs of waste disposal such as their physical characteristics and management practices.
2. The terms 'small', 'medium' and 'large' refer to landfill capacity and assumed annual waste acceptance.
3. The term 'controls' covers the management practices in place or otherwise to control leachate, landfill gas and amenity impacts like dust and odour.
4. The term 'climate' refers to the prevailing conditions using relevant climate classifications—dry temperate, wet temperate and wet tropical—for each state/territory.

new or already operating, the value of land, and the management practices employed at the site.[35]

An independent review of the BDA study undertaken by Blue Environment Pty Ltd noted the report was rational and well-supported, but did not address the uncertainties associated with the valuation of externalities. It concluded that the single value estimates for externalities were low.[38]

There is a range of views and approaches regarding the costing of landfill and there are considerable uncertainties associated with measurement. This difficulty is, however, not unique to Australia. In the review of its 2007 Waste Strategy, the UK noted the difficulties in measuring the environmental impacts associated with landfills and opted to use the social cost of carbon as a proxy to compare the environmental impacts of landfill and other waste management options.[39]

Total cost of landfilling in Australia

The Productivity Commission report did not estimate the total cost of landfilling waste. Using the midpoint of BDA's 2009 estimates as a basis for calculating the cost per tonne for putrescibles waste and using \$6 per tonne for landfilling inert waste, the estimated cost of landfill activities in Australia in 2006–07 is \$1.044 billion.[¶] Applying the low estimate of \$42 per tonne gives an estimated cost of landfilling putrescible waste as \$584 million and—after adding costs for landfilling inert waste (\$43 million as above)—an estimated total yearly cost of landfill of \$627 million in 2006–07. Using the high estimate of \$102 per tonne, this gives an estimated cost of landfilling putrescible waste as \$1.417 billion and adding costs for landfilling inert waste (\$43 million as above) an estimated yearly cost of landfill of \$1.46 billion in 2006–07. This cost is likely to increase over time as a result of higher land purchase and operational costs, as well as increasing environmental controls required by jurisdictions.

However, cost is only one constraint on developing new landfill sites or expanding existing landfill sites. The report *Australian landfill capacities into the future* identified community opposition, environmental risk and regulation as constraints on the future supply of landfill sites.[40] Community opposition also increases when communities are asked to accept waste from other areas. A discussion of future capacity requirements for landfill is provided in **Chapter 4.7**.

Market-based approaches to landfill management

Over the past two decades, there has been a trend of increasing and stricter environmental regulation of landfills and the consolidation of small landfills into large landfills servicing a greater population. Concerns over the impact of landfill gas on surrounding communities and infrastructure and the financial incentives for landfill gas capture has increased the uptake of this technology, especially for large landfills. Landfill gas now competes with other renewable energy sources in a market created by the Australian Government's Renewable Energy Target legislation.

There are, however, overseas examples where a market-based approach has been introduced for waste disposal to landfill. In 2005, the UK introduced landfill allowance trading schemes (LATS) to enable it to meet the European Union's Landfill Directive targets for the reduction of biodegradable municipal waste sent to landfill. Under the Landfill Directive, the UK is required to reduce the amount of biodegradable municipal waste to 75% of 1995 levels by 2010, to 50% by 2013 and to 35% by 2020. LATS place a cap on the amount of waste that a local authority can landfill and provide for landfill operations to generate tradeable landfill allowances for any reductions below their cap. Local authorities have the opportunity to meet their cap under LATS by the adoption of alternative waste management

¶ Combining the BDA landfill costs with the data from the national modelling of landfill capacity demand can provide an indicative value for the total cost in a year of landfill waste disposal in Australia. Given that Australia sent 21.07 million tonnes of material to landfill in 2006–07, and assuming that 66% of that waste goes to putrescible landfills (based on landfill demand and capacity modelling), using a mid-point value from the BDA study of \$72 per tonne, the cost of landfilling putrescible waste for Australia in 2006–07 was \$1.001 billion. Assuming \$6 per tonne of cost for inert waste (not modelled by BDA), this would be an additional cost of \$43 million, bringing total yearly cost of putrescible and inert landfill disposal to \$1.044 billion.

practices or by purchasing landfill allowances or by a combination of both. Each administration in the UK (England, Scotland, Northern Ireland and Wales) has developed its own variations to take account of local circumstances and priorities. There are currently no plans for jurisdictions to adopt such a market-based scheme in Australia.

Conclusion

In Australia, 665 licensed landfills have been identified but there are likely to be some unidentified sites (including historical landfills). Gaps in our understanding of landfills include a lack of information on the impacts of leachate, landfill gas, and hazardous substances leaving landfill and entering the surrounding environment. Similarly there is little information on the social impacts of landfills, including loss of amenity.

Greenhouse emissions from landfills are likely to contribute 11 MT CO_2-e in 2020 and measures which capture landfill gas and divert organic waste from landfill will assist in reducing Australia's greenhouse gas emissions. Landfills located in coastal areas are likely to be affected by rising sea levels and storm events under greenhouse-induced climate change.

A review of the literature on landfill costs indicates that urban landfills cost between $41–$101 per tonne of waste deposited and rural landfills between $42–$101 per tonne of waste deposited.

Endnotes

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CHAPTER 3.2
RESOURCE RECOVERY AND RECYCLING

This chapter reports on the environmental benefits of recycling materials compared with virgin materials from studies using life cycle analysis. Data are presented on the recycling of common materials such as aluminium, concrete, paper/cardboard, food and garden organics, glass and plastics and on the issue of contamination of recycled material.

Resource recovery is the process of extracting materials or energy from a waste stream through re-use, recycling or recovering energy from waste. In Australia in 2006–07, 22.7 million tonnes or 52% of waste generated were diverted from landfills and either re-used or recycled.[1] The most common materials recycled include concrete/bricks/asphalt, metals (iron, steel, and aluminium), paper/cardboard, garden waste, glass, wood/timber and plastics.

Information about the disposal and recycling of waste materials and products is variable in scope and quality with some jurisdictions not collecting data and others having different waste categories. As a result, the national picture for most waste materials and products is indicative only. The following discussion draws on data from Hyder Consulting's *Waste and Recycling in Australia* report (amended 2009). Where other sources are used, references are provided.

Over 98% of Australian households undertake recycling activities, and there is strong support for recycling at work as well as at home. (Further details are provided in **Chapter 4.2**)

Resource recovery and recycling are generally considered to have a positive impact on the environment through saving resources, avoidance of impacts associated with the extraction of virgin materials for use in manufacturing, and the reduction of the impacts arising from landfill. A 'net benefits' assessment undertaken by the Australian Council of Recyclers (ACOR) estimated that in 2006 recycling in Australia reduced greenhouse emissions (8.8 MT CO_2-e), produced energy (202 TJ) and water (134 GL) savings, and conserved resources (e.g. 4MT of iron ore).[2]

The net environmental impact of resource recovery and recycling can be assessed using life cycle analysis (LCA) (also referred to as life cycle assessment), which quantifies the environmental impacts associated with the extraction of raw materials, their production into goods, the distribution and use of those goods, their collection as waste, transport, sorting and eventual re-processing. The LCA can measure at each stage the materials, water, and energy used, and the emissions to land, air and water.*

Environmental benefits of kerbside recycling

The 2001 Life Cycle Assessment for Paper and Packaging Waste Management Scenarios in Victoria assessed recycled materials found in a weekly kerbside collection of a typical household in Melbourne.[3] The quantity of recycled materials was 6.6 kilograms and included newsprint, paper/cardboard, liquid paperboard, glass, aluminium and steel cans, PET, HDPE and PVC plastics. Recycling benefits of these materials were assessed against the water and energy used, the solid waste generated, and the greenhouse gas and air pollutants emitted by an equivalent amount of virgin materials. The study found net environmental savings for recycled material on all these parameters: see **Table 3.4**.

The study also found significant energy savings for most recycled products compared with new products (see **Table 3.5**).

Following the Victorian study on the environmental benefits of recycling paper and packaging, the NSW Government in 2005 examined the greenhouse gas, energy and water savings associated with recycled product systems compared with virgin product systems for a mix of recyclable materials including paper/cardboard/liquid paperboard, glass, aluminium, steel, high density polyethylene (HDPE)

* It should be noted that LCA does not consider whether market-based instruments (eg emissions trading schemes or environmental taxes) internalise environmental impacts of price of goods.

and polyethylene terephthalate (PET). The study found that recycling 3.76 kilograms per week of the above mix of products avoided greenhouse gas emissions equivalent to 50% of the electricity used to light a standard home in a year or 40% of the electricity used for cooking. Kerbside recycling saved 928 kilowatt hours of electricity a year (or 15% of a typical household's total electricity consumption for a whole year). Water savings amounted to 3075 litres per household per year which on a state wide basis amounts to 6634 megalitres, or between three days and almost one week, of Sydney's water consumption.[4]

Table 3.4: Net savings per week from kerbside recycling of a typical Melbourne household[5]

Impact	Unit	Totals	Equivalence
Greenhouse	kg CO_2-e	3.2	This equates to 0.25% of a households total allocation of greenhouse gases from all sources.
Embodied energy	MJ	32.2	9 kWh or enough energy to run a 40 Watt light bulb for 72 hours (Accounting for electricity losses).
Smog precursors	Grams of C_2H_4 equivalent	1.3	Equivalent to the emission from 4.5 kms of travel in average post 1985 passenger car.
Water use	litres	92.5	The equivalent of 5 sink loads of dishes.
Solid waste	kg	3.6	Depending on the material, between 60% to 90% of the product placed for recycling will remain out of solid waste.

Table 3.5: Embodied energy savings per kilogram in the production of recycled product compared with an equivalent virgin product[6]

Product	Recycled (MJ)	Virgin (MJ)	Savings	Comment
Newsprint	33.7	50.9	34%	Product taken to the production of newsprint roll. Newsprint is usually a mix of recycled and virgin material in Australia.
Corrugated board—unbleached	27.7	35.7	22%	Product taken to the production of corrugated board. Corrugated board is often a mix of recycled and virgin material in Australia.
Steel slab	7.32	34.7	79%	Product taken to the production of steel slab. Steel scrap comes from many sources and this number relates to kerbside source material in Melbourne only. Steel is often a mix of recycled and virgin material in Australia.
Aluminium ingot	14.1	206	93%	Product taken to the production of aluminium ingots. Aluminium scrap comes from many sources and this number relates to kerbside source material in Melbourne only. Aluminium often includes a mix of recycled and virgin material.
HDPE	15.5	75.2	79%	Product taken to the production of HDPE granulate. Recycled product may have more limited uses than virgin. High energy savings are partly due to feedstock energy in virgin material.
PET	19.7	81.2	76%	Product taken to the production of PET granulate. High energy savings are partly due to feedstock energy in virgin material.
PVC	7.93	40.3	80%	Product taken to the production of PVC flake. High energy savings are partly due to feedstock energy in virgin material.
Glass	9.74	22.5	57%	Product taken to the production of molten glass (pre bottle formation). Glass is always a mix of virgin and recycled material.

Environmental benefits of recycled products

RMIT (2009) assessed the environmental benefits associated with recycling common materials in the waste stream for the then NSW Department of Environment and Climate Change. An excerpt of the results is provided in **Table 3.6**. For resource recovery to be environmentally beneficial on a whole of life cycle basis, the benefits associated with avoided resource use and landfill capacity need to offset the impacts associated with material collection and re-processing. Transport distances, the type of re-processing technology, avoidance of process flows for virgin products and existing landfill capacity will influence whether recycling is environmentally beneficial. These factors will vary considerably across regions. The analysis provided in the RMIT study presented below documents assumptions about both recycling process flows and avoided process flows. Different process assumptions will lead to different findings.

Aluminium

Not all jurisdictions collect data on recycling of aluminium (either in the form of cans or aluminium scrap). Some jurisdictions collect data on metals but do not break it down into ferrous and non-ferrous categories. The National Packaging Covenant estimated that in 2007 the recycling rate for aluminium beverage cans was 70% with 48 791 tonnes of aluminium cans consumed and 34 300 recovered.[7]

Aluminium can be recycled over and over again without loss of properties. Recycling aluminium saves up to 95% of the energy required for primary aluminium production,[8] making it highly economic to recycle. These energy savings also mean a reduction in greenhouse gas emissions. ACOR estimates that aluminium recycling saved 4.93 million tonnes of CO_2-e greenhouse gases each year, or over half of CO_2-e greenhouse gas savings generated by the recycling sector each year in Australia.[9] ACOR also found that aluminium recycling saved 73 million litres of water and conserved 1.56 million tonnes of resources.[10]

Concrete recycling

Only four states (NSW, Victoria, SA and WA) collect information on concrete disposal and recycling and it is usually part of a waste stream that includes bricks, asphalt and sand. In 2006–07, these four states disposed of a total of 2.92 million tonnes and recycled 6.73 million tonnes, giving a recycling rate of 69.8% for these materials.[11] A study of building products in 2005 found that 58 561 tonnes of concrete paving was generated, of which 14 597 were disposed to landfill, giving an overall recycling rate of 24.9%.[12]

Recycled concrete is used for road making, pavements, and slabs for buildings. The recycling rate for concrete varies greatly across jurisdictions, mainly because there are variations in end markets. Western Australia, which traditionally had a low recycling rate, has taken steps in recent years to test crushed recycled concrete as an alternative

Table 3.6: Net benefit of recycling 1 tonne of waste material (positive values are benefits, negative values are impacts)

	Global Warming (tonnes CO_2-e)	Energy (gigajoules) (low heating value)	Water (kilolitres)
Aluminium cans	15.85	171.10	181.77
Concrete	0.02	0.28	1.28
Cardboard/paper	0.06	9.32	25.41
Food and garden organics	0.25	0.18	0.44
Glass	0.56	6.07	2.30
Mixed Plastics	1.53	58.24	-11.37

Source: RMIT, *Extended Environmental Benefits of Recycling Project*, Draft Final Report, 25 May 2009 for NSW DECC based on Table 4, p14.

base-course to the commonly used crushed rock and develop a performance specification for local governments on the use of recycled concrete in local roads.

While the benefits in terms of global warming, energy and water are moderate for recycled concrete, there are considerable environmental benefits relating to the avoided extraction of the resources for making concrete and avoided landfill space.†

Paper/cardboard

Data on the use, disposal and recovery of paper in Australia are limited. This is because of commercial sensitivities of recyclers, unclear import and export data and inconsistent data sets.[13] It is estimated that in 2007 approximately 2.5 million tonnes of paper were recovered in Australia. Of this, approximately 1.5 million tonnes were recycled in the local paper-making industry and the remaining 1 million was exported. Overall, the estimated paper recovery rate for Australia was 59% in 2007.[14] Australia has a world-class rate of newspaper recycling. In 2007, publishers recycled 76% of newsprint, a diversion of over 500 000 tonnes of paper from landfill. This recycling rate has been made possible by investment such as a $130 million newsprint recycling plant built in Albury-Wodonga which manufactures newspaper with a recycled content of 20–55%.[15]

Although national data specifically on the environmental benefits of recycling paper are not available, combined data on paper/cardboard exist. A 2008 study by the Australian Council of Recyclers (ACOR) shows that the recycling activities of their members involving paper/cardboard result in the following environmental benefits:

- 1 215 448 tonnes of CO_2-e greenhouse gas saved
- 37 474 585 terajoules of energy saved
- 33 223 megalitres of water saved, and
- 2 992 212 tonnes of resources conserved.[16]

Food and garden organics

The amount of food and garden organics disposed to landfill is currently not measured in all jurisdictions. In 2006–07, there were an estimated 91 000 tonnes of food and 2.5 million tonnes of garden organics recycled across Australia.[17]

Recycled organic waste in the form of composted mulches and composted soil conditioners, can have environmental benefits through their application to agricultural land and their avoidance of greenhouse gas emissions in landfill. Benefits include increased soil fertility, improved water retention, and increased ability to sequester carbon. A more detailed discussion of the greenhouse impacts of organic waste is provided in **Chapter 3.4**.

A life-cycle assessment of composting systems was undertaken by the Recycled Organics Unit for the then NSW Department of the Environment, and Climate Change in 2003.[18] It examined the environmental impact of manufacturing composted products‡, transport of composted products to end-markets and users, and application of composted products to cotton crops and grapevines. The results were an increased cotton yield of 19.5 % and increased grape yield of 27%; savings of 0.13–0.16 ML per hectare per season for irrigated cotton and 0.95 ML per hectare per season for irrigated viticulture, and sequestering of 2.9–5.9 tonnes of carbon per hectare after ten years for cotton and 11.56 tonnes of carbon per hectare after 10 years for viticulture.

The study found a net environmental benefit associated with reduction in the use of fertilisers, herbicides, electricity and water. Avoiding these meant reductions in their release of:

- greenhouse gas emissions
- nutrients to the environment (e.g. causing eutrophication of water resources), and
- toxic chemicals.

These benefits offset the greenhouse gases, waste and toxic substances released into the environment

† It should be noted that environmental impacts relating to the extraction of resources for concrete production is dependent on the type of operation, the mining and transport practices adopted and regulatory controls in place.

‡ This study looked at windrow composting systems. Other organic waste processing systems, such as anaerobic digestion, vermiculture and in-vessel composting, would yield different results because of the different processing requirements

from the production and use of diesel and electricity required to make and apply composted products.

Glass

Three jurisdictions[§] collect information on the amount of glass disposed of to landfill and the amount recycled. A further two jurisdictions[¶] collect information on the amount of glass recycled and in the remaining three jurisdictions, quantities of glass landfilled and recycled are unknown. Given these constraints, in 2006–07 an estimated 371 000 tonnes were landfilled and 478 000 tonnes were recycled.[19] The mid-term review of the National Packaging Covenant estimated that signatories to the Covenant recycled 46% of their glass packaging, with 893 031 tonnes of glass consumed and 410 700 recovered.[20]

Glass can be recycled many times over without loss of properties. Recycled glass is sorted by colour and crushed to form cullet which can then be used for further glass making, to make building insulation, or to be used in road base. New glass can be made out of 100% cullet depending on the type and quality available, although most new glass contains between 40 and 70% cullet.[21]

There is a 57% energy saving associated with recycled glass compared with making new glass (see **Table 3.5** above). This is related to the transport costs associated with collection. A study by the Australian Council of Recyclers in 2008 found that glass recycling only remained positive in energy terms if recycling was within 100 kilometres of collection.[22] Recycling also avoids the environmental impacts associated with the extraction of the raw materials required to make glass.[**] It has been estimated that one tonne of glass produced from raw materials creates 845 kilograms of mining waste. Using 50% recycled glass cuts mining waste by 75%.[23]

§ NSW, Victoria, Western Australia

¶ South Australia and ACT

** It should be noted that the mining of the raw materials required to make glass is strictly regulated and that any potential environmental impacts relating to extraction of raw materials to make glass is dependent on the type of operation, the mining and transport practices adopted and regulatory controls in place.

Plastics

According to the 2008 National Plastics Recycling Survey, a total of 261 109 tonnes of plastics was recycled in 2007, with 168 282 tonnes re-processed locally and 92 827 tonnes exported for re-processing.[24] Total plastics consumption was 1 710 085 tonnes and therefore the recycling rate was 15.3%, a slight decrease on the 2006 rate of 15.9%. Total consumption of plastics for packaging applications was 626 787 tonnes, giving an overall plastics packaging recycling rate of 32.7%. Different types of plastics have different recycling rates with PET (1) having the highest recycling rate of 42.3%, followed by ABS/SAN (forms of styrene) at 19.8%, HDPE at 19.4% and polystyrene at 16.9%.

Recovery rates for plastics from municipal and commercial and industrial sources are likely to increase in the future due to current investments in collection and sorting infrastructure. A sorting and washing facility for post-consumer plastic film (including shopping bags, Gladwrap and shrink/stretch film) is being built in Sydney by WSN Environmental Solutions and should be completed by June 2010.[25] Traditionally this sort of plastic has been sent to landfill or baled as mixed plastic and sent overseas. The proposed facility aims to divert from landfill 11 700 tonnes of plastic film per annum and be of a standard suitable for re-processing.

As there is a range of plastics, the environmental and other impacts associated with their recycling will vary. Most recycled plastics have a net energy benefit but some plastics require greater water use in the recycling than in their original manufacture (see **Table 3.6** above).

Plastics that are common in the municipal waste stream usually have a Plastics Identification Code consisting of a number from 1 to 7 (see **Table 3.7**). Most local councils recycle plastics labelled 1, 2 and 3 in their kerbside recycling services and some councils have extended their recycling services to include those labelled 4 to 7.

Table 3.7: Plastics identification code††

Symbol	Chemical name	Selected applications
1 PET	Polyethylene Terephthalate **PET**	Carbonated soft drink and fruit juice bottles, pillow and sleeping bag filling, textile fibres.
2 HDPE	High Density Polyethylene **HDPE**	Shopping and freezer bags, milk bottles, bleach bottles, buckets, rigid agricultural pipe, milk crates.
3 V	Unplasticised Polyvinyl Chloride **UPVC**	Electrical conduit, plumbing pipes and fittings, blister packs, clear cordial and fruit juice bottles.
	Plasticised Polyvinyl Chloride **PPVC**	Garden hose, shoe soles, cable sheathing, blood bags and tubing, watch straps, rain wear.
4 LDPE	Low Density Polyethylene **LDPE** Linear: **LLDPE**	Garbage bags, squeeze bottles, black irrigation tube, stretch and shrink films, silage and mulch films, garbage bins.
5 PP	Polypropylene **PP**	Film, carpet fibre, appliance parts, crates, automotive applications, toys, pails, housewares / kitchenwares, bottles, caps and closures, furniture, plant pots.
6 PS	Polystyrene **PS**	Refrigerator bins & crispers, air conditioner, office accessories, coat hangers, medical disposables. Meat & poultry trays, yoghurt & dairy containers, vending cups.
	Expanded Polystyrene **EPS**	Drinking cups, meat trays, clamshells, panel insulation, produce boxes, protective packaging for fragile items.
7 OTHER	**OTHER:** Includes all other resins and multi materials (eg laminates). Eg acrylonitrile butadiene styrene (ABS), acrylic, nylon, polyurethane (PU), polycarbonates (PC) and phenolics.	Automotive, aircraft and boating, furniture, electrical and medical.

†† This table was extracted from a PACIA document entitled 'Plastics Identification Code', <www.pacia.org.au/DisplayFile.aspx?FileID=54> .

Contamination of recyclable materials

The environmental benefits outlined above are not achieved if recyclable material is contaminated by non-recyclable materials. ACOR defines 'contamination' to include non-recyclable packaging as well as other waste products disposed of incorrectly in recycling bins. For example, recycled materials collected through kerbside recycling can be contaminated by hazardous and non-hazardous articles and materials. Common contaminants include waxed coated boxes, greasy pizza boxes, dirty nappies, motor oil containers, polystyrene cups, meat trays, take away food containers, plastic bags and plastic film. Contamination occurs in all three waste streams (MSW, C&I and C&D waste).

There are various estimates of the amount of waste materials sent to landfill from recycling processes. The extent of contamination of kerbside recyclates was reported in the National Packaging

Covenant Mid-Term Review in 2008 to lie between 3% and 11%.[26] Applying this range to the quantity of municipal solid waste recycled in 2006–07 (5 082 000 tonnes), generates an indicative level of contamination for recycled MSW of between 152 000 and 560 000 tonnes. Further quantities of contaminated recyclates would be generated in the C&I and C&D waste streams. Another source, the Australian Council of Recyclers, estimates that alongside the 12 990 000 tonnes per annum recycled, around 671 000 tonnes of residual material is landfilled by its members, from all three waste streams.[27] Accurate information is not available on the total quantity of contaminated recyclates that are landfilled.

While it is difficult to quantify the extent of contamination on recyclates at a national level, audit studies at the local or facility level provide some indication of the extent of the problem. Locally, it is likely that the extent of contamination of kerbside recycling bins will vary due to a variety of factors including the method of recycling, whether recycling services have changed recently, the information available to users of recycling bins and seasonal factors. A recycling inspection program by Moreland City Council in Victoria found that 28% of a sample of 1000 kerbside recycling bins presented for collection contained contamination.[28] Contamination included hazardous items, rubbish, plastic bags and recyclables in plastic bags. Plastics were high on the list of contaminants and have resulted in the Council now accepting all rigid plastic bottles and containers with codes 1–7 printed on them.

The different types of plastics that are commonly used present a considerable recycling challenge. Each type of plastic is recycled differently and the presence of another type can contaminate the recyclate. For example, polyvinyl chloride plastics in the recycling process of polyethylene terephthalate (PET) cause the recycled plastic to become brittle and yellow making it unacceptable for many high-value end-use applications.

The presence of hazardous items in the municipal waste stream may also, if not properly managed, have a significant detrimental impact on the amount of material recycled and impose social and financial costs. For example, discarded gas cylinders which have been used for barbeques, camping stoves and other domestic appliances may end up in a metal recycling facility. Cylinders may then explode in the facility's metal shredding equipment causing physical damage to expensive equipment and resulting in shut-down periods. According to one metal recycling business in Sydney, such incidents have eroded the trust of local communities and local governments, added significant costs and made it more difficult for the facilities to operate.[29] In another example lead acid batteries have been disposed into and contaminated domestic garbage. That waste may then be received by Alternative Waste Treatment facilities where recyclable materials are extracted before residual material is processed into compost and energy. Contamination of compost by lead has been a problem for such facilities.[30] Further discussion about these potential impacts is in **Chapter 3.3**.

Conclusion

Resource recovery and recycling can offer significant environmental and social benefits. The extent of benefit or cost depends on an assessment of the full life-cycle impacts of recycling which include collection and transport to the recycling facility, the technology used in re-processing or recycling and the associated energy, water and resource use required, the extent of contamination of the waste being recycled, and the quantity of waste generated by the re-processing or recycling. Contamination of waste streams significantly reduces the material that can be recycled or the quality of the recycled end product, which in turn affects end markets and the confidence of potential users of the recycled product. These matters are discussed in more detail in **Chapter 4.3**.

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25 <http://www.packagingcovenant.org.au/page.php?name=optimisingthevalueofplasticfilm>

26 National Packaging Covenant Mid Term review 2008, p. 18, <http://www.packagingcovenant.org.au/documents/File/National_Packaging_Covenant_Mid_term_Review_10.11.08.pdf>, accessed 16 October 2009.

27 Australian Council of Recyclers, from a presentation delivered nationally at capital city seminars throughout September and October 2006 by ACOR to launch the updated post-consumer Kerbside Material Specifications, <http://www.acor.org.au/recycling_at_a_glance.html>, accessed 16 October 2009.

28 <http://www.moreland.vic.gov.au/about-council/news-media/media-release/recycling-contamination.html>.

29 Department of the Environment and Heritage, *Submission to the Productivity Commission Inquiry into Waste Generation and Resource Efficiency*, February 2006, <http://www.environment.gov.au/settlements/publications/waste/deh-submission.html>.

30 Ibid.

CHAPTER 3.3
HAZARDOUS WASTE AND HAZARDOUS SUBSTANCES

This chapter examines the hazards associated with waste. It explains the terms 'hazardous waste' and 'hazardous substance' (including how international conventions and domestic legislation define hazards). It briefly describes consumer waste hazard issues, the amount and types of hazardous waste generated within Australia, and the quantities of hazardous waste imported to and exported from Australia. Finally, it examines the domestic transport, storage, treatment and disposal of hazardous waste, and how hazardous substances are monitored.

It does not examine the physical impacts of waste when it ends up as litter, which are examined in **Chapters 3.5** and **3.6**.

What defines a waste or substance as hazardous?

A key purpose in classifying or defining hazards, and identifying hazardous waste, is to provide guidance on and regulate how substances, materials, products or wastes are managed so as to protect the environment and human health.

The properties which make a substance, product or waste hazardous are physical, chemical and biological. Hazard is defined under international conventions and national regulations by certain characteristics (such as explosivity and ecotoxicity), and by listings of specific substances and wastes and of waste groups. State, territory and national regulations determine the day-to-day management of such wastes.

The United Nations Recommendations on the Transport of Dangerous Goods Model Regulations[1] identify a substance or a waste as hazardous if it is, among other things:

- explosive
- flammable
- corrosive
- infectious
- poisonous
- toxic and/or ecotoxic.

These classifications feature in many international, national[2] and state and territory approaches to defining the hazardous properties of a waste. However, additional classification guidance is also provided in various policies, instruments and regulations in order to meet different aims or objectives of those initiatives.

International approaches to defining hazard

The following provides a snapshot of how the major international policy instruments and classifications define hazard.

United Nations (UN) classifications. The UN classifications are primarily aimed at ensuring the safe transport of dangerous goods. The UN classifies substances based on hazardous properties including the seven properties listed above; it also identifies individual dangerous goods by type (e.g. lead sulphate).

The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (the Basel Convention). The Basel Convention aims to ensure the environmentally sound management of hazardous wastes so as to protect human health and the environment. A waste is defined as hazardous if it belongs to a particular waste stream (e.g. waste oils/water, hydrocarbons/water mixtures, emulsions); if it is identified in a list of wastes with hazardous constituents (e.g. mercury or lead); if it is identified as a waste that requires special consideration (e.g. household waste); or like the UN Recommendations on Dangerous Goods, if it is a waste that possesses hazardous characteristics (e.g. ecotoxity).

The *Stockholm Convention on persistent organic pollutants* (the Stockholm Convention). The Stockholm Convention aims to protect human health and the environment from the impacts of persistent organic pollutants and products containing them. The Convention lists 21 substances or families of substances (e.g. polychlorinated biphenyls) according to chemical identity, specific chemical properties such as persistence, bio-accumulation, potential for long-range environmental transport, and adverse effects to human health or to the environment.

The *Montreal Protocol on Substances that Deplete the Ozone Layer* (the Montreal Protocol). The Montreal Protocol aims to phase out global production and consumption of ozone depleting substances. The Convention has introduced control measures for specific ozone depleting substances including chlorofluorocarbons, halons, carbon tetrachloride, methyl chloroform and hydrochlorofluorocarbons.

The *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*. The Rotterdam Convention aims to protect human health and the environment from potential harm by facilitating information exchange about the characteristics of specific chemicals and by providing for a national decision-making process on their import and export. Forty chemicals are listed in the Convention and subject to the prior informed consent procedure—these include 25 pesticides, 4 severely hazardous pesticide formulations and 11 industrial chemicals.

As can be seen from the above examples, a variety of approaches is used to define hazard. Further details are provided on two of these international instruments referenced in this chapter—the Basel and Stockholm Conventions.

International hazardous waste obligations–explanation

Australia is a signatory to the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* which came into force on 5 May 1992.[3] It is concerned with the generation and movement of hazardous waste between countries. A central goal of the Convention is 'environmentally sound management' (ESM), the aim of which is to protect human health and the environment by minimising hazardous waste production whenever possible.

In its first 10 years, the Basel Convention focused on setting up a framework to control the 'transboundary' movements of hazardous wastes. In its second ten years (2000–2010), it is focusing on minimising the generation of hazardous waste.

Under articles 4.2(a), (b) and (c), Australia is to take appropriate measures to:

- ensure that the generation of hazardous wastes, and other wastes within Australia (including household wastes) is reduced to a minimum, taking into account social, technological and economic aspects
- ensure the availability of adequate disposal facilities for the environmentally sound management of hazardous and other wastes, that shall be located, to the extent possible, within Australia, whatever the place of their disposal, and
- ensure that people involved in the management of hazardous wastes or other wastes within Australia take such steps as are necessary to prevent pollution due to hazardous wastes and other wastes arising from such management and, if such pollution occurs, to minimise the consequences thereof for human health and the environment.

As a signatory to the Convention, Australia is required to report annually, including on:

- transboundary movements of hazardous wastes or other wastes and efforts to reduce the amount of hazardous wastes or other wastes subject to transboundary movement
- statistics about the effects on human health and the environment of the generation, transportation and disposal of hazardous wastes or other wastes
- disposal options within its jurisdiction, and
- measures undertaken to develop technologies for the reduction and/or elimination of production of hazardous wastes and other wastes.

International obligations on persistent organic pollutants (POPs)–explanation

Australia is a signatory to the *Stockholm Convention on persistent organic pollutants*[4] which is concerned with chemicals or POPs which remain intact in the environment for long periods, become widely distributed geographically, and accumulate in the fatty tissue of humans and wildlife. POPs are used in many consumer products and materials and these substances inevitably find their way into waste streams and require appropriate management at end of life.

The Stockholm Convention came into force on 17 May 2004, and 165 countries are now parties to it. The Convention aims to protect human health and the environment from the impacts of POPs, and through it, increasingly stringent controls are being placed on POPs and products containing them. The Convention requires that countries identify stockpiles containing listed chemicals, products and articles in use, and wastes consisting of or contaminated with these chemicals, and manage these stockpiles in a safe, efficient and environmentally sound manner.

The Stockholm Convention originally listed 12 POPs. Australia has banned the production and import of ten of these, with controls on the remaining two (dioxins and furans) being implemented through state and territory legislation. In May 2009, international agreement was reached to add nine chemicals to the Convention. These substances were identified after rigorous scientific evaluation by a Review Committee, a group of 30 chemicals experts nominated by Parties to the Convention.

The treaty amendment to control these nine POPs has yet to take effect in Australia. Of the nine, six are already controlled in Australia. Acceptance of the treaty action in Australia would include obligations in relation to the remaining three as well as wastes containing any of the listed chemicals.

National approaches to defining and managing hazard

The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (the Act). This legislation implements Australia's obligations under the Basel Convention and mirrors the Convention's classification system.

Australian Dangerous Goods Code (ADG Code)[5]. This Code adopts the definitions of the United Nations Recommendations on the Transport of Dangerous Goods Model Regulations, while retaining Australia-specific provisions. Like the UN Code, the ADG Code classifies substances based on hazardous properties and also identifies individual dangerous goods by type.

Movement of Controlled Waste National Environment Protection Measure (Controlled Waste NEPM).[6] This NEPM was created under the *National Environment Protection Council Act 1994* to manage the interstate movement of hazardous waste. It identifies specific hazardous waste streams such as mercury or mercury compounds, as well as wastes having particular constituents or particular characteristics (i.e. those characteristics identified under the UN and national dangerous goods codes, above).

The National Pollutant Inventory (NPI) is the national mechanism for monitoring and measuring toxic emissions to air, land and water. It identifies pollutants some of which are hazardous, and therefore could assist in meeting reporting requirements under the Basel Convention.

State and territory approaches to hazard

Different Australian jurisdictions have adopted different definitions of 'hazardous wastes' and the items and materials grouped under those definitions therefore vary. Some jurisdictions list the materials, while others undertake a risk assessment process on a case-by-case basis. 'Hazardous waste' covers a range of materials and waste articles. A summary of jurisdictional approaches to waste classifications is presented in more detail in **Appendix C**.

The hazardous components of waste

Where these wastes are found

Materials and products containing hazardous substances are found in all waste streams:

- C&I waste contains waste material and articles that are specifically identified as hazardous under Australia's international obligations such as the Basel and Stockholm Conventions, such as medical waste and waste from the surface treatment of metals and plastics.
- MSW contains household chemicals and articles incorporating hazardous chemicals, biowaste (including medical waste) and nanoparticles.
- C&D waste includes treated timber, floorings, plastics, paints, polymers, coatings, solvents and adhesives which contain hazardous materials.
- Outside those streams, biosolids*, particularly sewage sludge, may be contaminated by a range of household chemicals, heavy metals and pharmaceuticals.

Hazardous consumer waste

In a submission to the 2008 Senate Inquiry into Australia's Waste Streams, the Australian Bureau of Statistics (ABS) noted that over the past decades there has been a large increase in the number and diversity of products available in Australia, along with an increase in the diversity, toxicity and complexity of waste. The ABS noted in its submission that one type of complex waste, electronic waste, is growing at more than three times the rate of general municipal waste. It also observed that in some cases, a range of hazardous chemicals in electronic waste may migrate into landfill leachate. Where there is poor leachate control (for example, when landfills are not lined or the liners fail), contaminants may escape into the wider environment including soils, groundwater and adjacent waterways.[7]

Some of the hazardous substances found in electronic waste are shown in **Table 3.8**.

In 2007–08, 138 000 tonnes (31.7 million units) of new televisions, computers and computer products were sold in Australia. In the same year 106 000 tonnes (16.8 million units) reached their end of life. In the future, waste volumes can be expected to increase as a result of shorter life spans of products and increasing ownership of electrical products.

The volume of television and computer products reaching end of life each year is expected to increase at a much higher rate than sales of these products.

* The term 'biosolids' refers to solid waste material generated by humans and animals. Some jurisdictions (e.g. South Australia) use the term biosolids to refer to the solids that are stabilised for re-use and from which the hazardous components have either been removed or reduced to acceptable levels.

Table 3.8: Hazardous nature of electronic waste articles[8]

Component	Equipment containing it	Substances of concern
Cathode ray tube	Personal computer monitors and television	Lead, antimony, mercury, phosphors
Liquid crystal display	Laptops, mobile phones, some desktop computers	Mercury
Circuit board	Telephones, personal computers, laptops, televisions, radios, audio amplifier, CD/DVD players, handheld games machines and mobile phones	Lead, beryllium, antimony, brominated flame retardants (BFRs), cadmium and arsenic
Batteries	Telephones, personal computers, laptops, mobile phones, handheld games machines	Lead, lithium, cadmium, mercury
Power or external cables	Most electronic and electrical equipment	Phthalates
Glass screens	Computer monitors, TVs, microwaves	Lead
Plastic housing	Most electronic and electrical equipment	Brominated flame retardants

Sales would grow by about 1% a year, while products will reach their end of life at a rate of 5% a year. As a result, the volume of televisions, computers and computer products reaching their end of life is expected to grow to 181,000 tonnes (44.0 million units) by 2027–28.[9]

Hazardous waste generation

Understanding the overall level of hazardous waste generated will allow for more accurate reporting under international instruments, as well as improved analysis of whether Australia has adequate treatment capacity and capability to manage the hazardous waste that will be generated in the future. It will also inform our understanding of the types and characteristics of the waste being landfilled.

Australia reports annually on hazardous waste exports, imports and waste generation to the Basel Convention and the Basel Convention Secretariat publishes data through its website.[10] Trends since 2001 are shown in **Figure 3.6**. Based on these figures, the amount of hazardous waste generated appears to have doubled between 2001 and 2005 and then stabilised at about 1.1 million tonnes per annum.

Figure 3.6: Reported total amount of hazardous waste generated annually in Australia, using Basel Convention categories, 2001–2007

Types of hazardous waste generated

The Basel Convention requires that member countries report on the generation of specific types of waste and on 'waste with hazardous constituents'. In 2007 Australia's hazardous waste generation figure comprised 699 140 tonnes of waste by the type of source (63%) and an additional 418 000 tonnes of waste classified according to specific hazardous constituents (37%).

Australia's reporting to the Basel Convention reveals that the greatest quantities of hazardous waste generated by the type of source were:

- waste oils/water, hydrocarbons/water mixtures, emulsion (250 000 tonnes)
- waste mineral oils unfit for original intended use (150 000 tonnes)
- residues arising from industrial waste disposal operations (159 000 tonnes), and
- clinical wastes from medical facilities and pharmaceutical production wastes (59 000 tonnes).

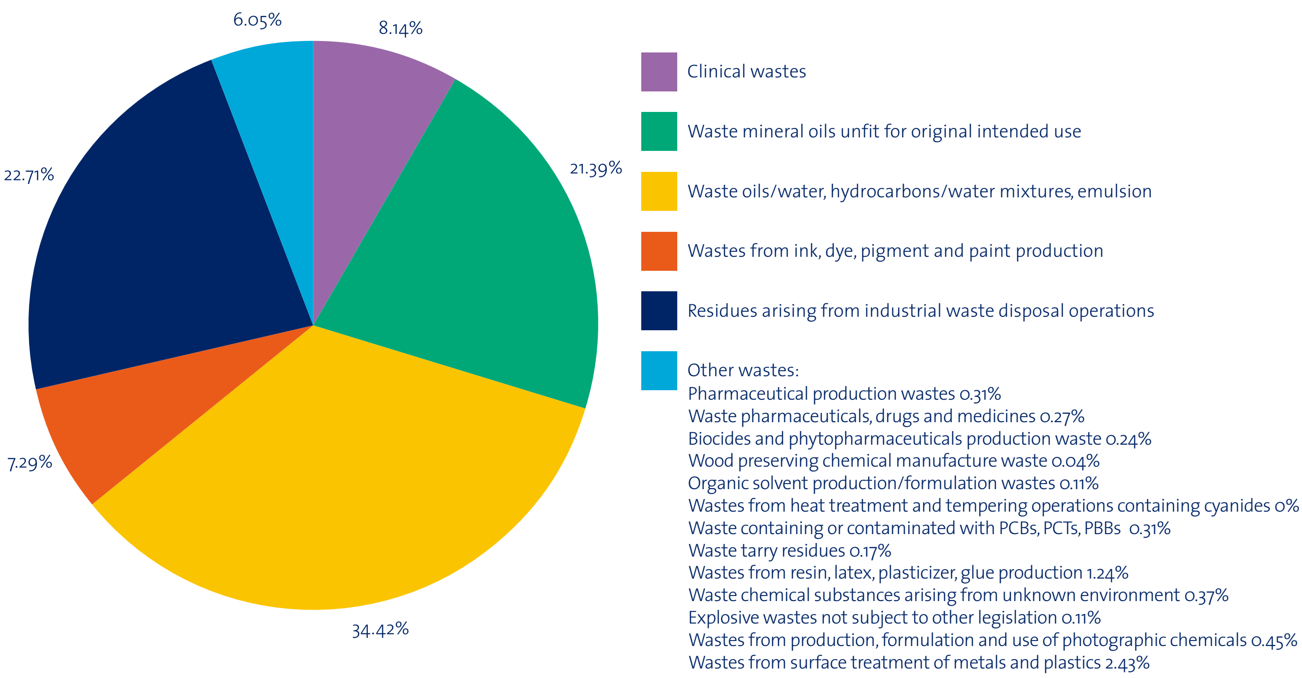
Figure 3.7 gives more detail on the types of waste generated according to source which was 37% of the reported amounts.

Reporting to the Basel Convention also reveals that additional quantities of hazardous waste were generated which had specific hazardous constituents. The five largest categories of waste generated were:

- asbestos dust and fibres (110 412 tonnes)
- acidic solutions or acids in solid form (85 991 tonnes)
- basic solutions or bases in solid form (84 570 tonnes)
- lead and lead compounds (60 840 tonnes), and
- zinc compounds (36 326 tonnes).

The reporting does not capture all types of hazardous waste generated, including consumer waste such as electronic waste, products containing flame retardants or clinical waste disposed by households. While the quantities of these wastes may be relatively small, they are significant in that they may present particular hazards to the environment and to human health which need to be managed. They include wastes containing the two brominated flame retardants, pentabromodiphenyl ether and octabromodiphenyl ether, which need

Figure 3.7: Relative amounts of hazardous waste generated in Australia, by type of source (2007)



to be managed as a result of obligations under the Stockholm Convention. They are found in:

- polyurethane foam which is used in furniture and upholstery used in domestic furnishing and in automotive and aviation components, and in
- plastic products such as housings for computers, automobile trim, telephone handsets and kitchen appliance casings.[11]

The information above is a first step towards providing a picture of hazardous waste generation in Australia but is not comprehensive. The quality of information and reporting could be improved by addressing the following:

- Some jurisdictions do not define as hazardous waste all of the materials that the Basel Convention defines as hazardous. This can lead to the exclusion of data on articles such as televisions, computers, mobile phones, fluorescent lamps and some batteries
- The above figures are based on a compilation of state reported data which are based largely on the *Movement of Controlled Waste National Environment Protection Measure*; that NEPM is intended to track controlled waste being transported interstate rather than waste generation within a state
- Some facilities which generate or transport hazardous wastes may not be providing information to the relevant jurisdiction
- Not all states or territories are reporting the level of hazardous waste generated within their jurisdiction.

For these reasons, it is likely that the reporting for the Basel Convention underestimates the quantity of hazardous waste generated in Australia.

ABS survey data from November 2009 confirm that households dispose of hazardous waste into the municipal solid waste (MSW) stream.[12] Findings covering the 12 months to March 2009 show that:

- household batteries were the most common hazardous waste item disposed of, with 68% of households disposing of these during the 12 months to March 2009;
- medicines, drugs or ointments were the second most common, with just under one-third (32%) of households disposing of these items;
- the most common way of disposing hazardous waste was to have the waste collected as part of the usual (non-recycled) garbage from the house, accounting for 82% of households;
- the majority of households that did not use appropriate hazardous waste disposal services or facilities said this was because they did not generate enough materials to warrant use of these services or facilities (67%).

Also, MSW is largely derived from household waste and because of the potential for contamination with hazardous substances, household waste is classified under the Basel Convention as requiring special attention. The proportion of household waste in MSW is difficult to determine but preliminary estimates indicate that it is around 90%.[13] Thus, combining 90% of the 2006–07 municipal solid waste generation rate with the reported hazardous waste generation rate, using Basel Convention definitions, would mean that Australia (at least nominally) generated up to 12.6 million tonnes of hazardous waste in 2007.

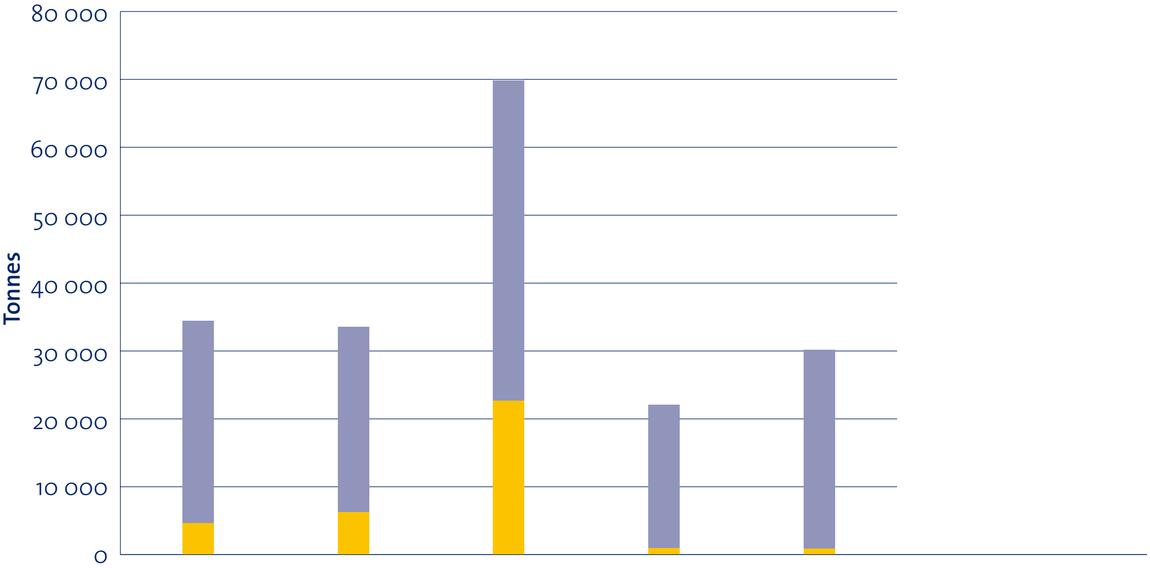
Accurate and more comprehensive data are needed to better quantify the level of hazardous waste generated and to inform the choice of appropriate strategies to manage the hazardous waste generated, including that found in the MSW, C&I and C&D waste streams.

Hazardous waste imports and exports

Australia has sound data on the quantities of hazardous waste exported and imported, as a result of national legislation to regulate the transboundary movement of hazardous waste. **Figure 3.8** shows that across five years, an average of around 30 000 tonnes of hazardous waste was exported each year, and around 7000 tonnes imported.

Figures 3.9 and **3.10** show the composition of the exports and imports of hazardous waste. Key wastes are identified and the category named 'other' covers a range of different types of hazardous wastes. These include various copper, lead and zinc wastes, non-halogenated solvents and industrial catalysts (e.g. palladium and nickel-molybdenum catalysts).

Figure 3.8: Reported imports and exports of hazardous waste



Reporting year	2003	2004	2005	2006	2007
Amount exported	29 838	27 352	47 119	21 090	29 240
Amount imported	4 621	6 245	22 708	963	893

Figure 3.9: Reported exports 2003–07 (total 154 639 tonnes)

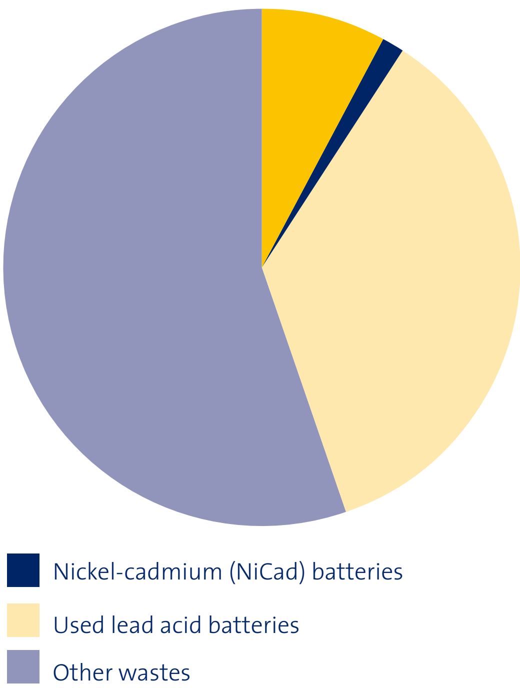
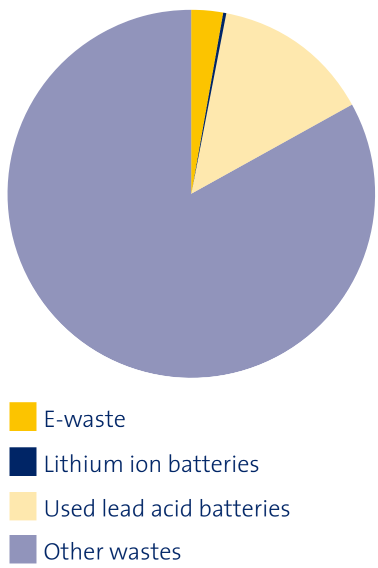


Figure 3.10: Reported imports 2003–07 (total 35 400 tonnes)



Controlling imports

Australia imports many of the chemicals, products and articles (particularly electronic goods[†]) it uses. Border control assists in managing the import of hazardous or potentially hazardous items.

There are several legislative restrictions on the import of hazardous chemicals:

- the *Industrial Chemicals (Notification and Assessment) Act 1989* applies to industrial and agricultural and veterinary chemicals;[14]
- the *Agricultural and Veterinary Chemicals Act 1994* applies to agricultural and veterinary chemicals;[15]
- the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* covers ozone-depleting substances;[16]
- the *Trade Practices Act 1974* regulates product safety and product labelling;[17]
- the *Customs (Prohibited Imports) Regulations 1956* identify banned chemicals.[18]

As an example, the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* provides a nationally-uniform control on the import of stratospheric ozone-depleting substances and synthetic greenhouse gases. The Act facilitates and validates Australia's compliance with its obligations under the Montreal Protocol, including by maintaining high quality statistics which quantitatively demonstrate that Australia is more than meeting its obligations.

The European Union's *Directive 2002/95/EC* on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) restricts the amount of four metals and two brominated flame retardants that can exist in certain products. Australia does not have similar restrictions, but completed a preliminary environmental and economic assessment of its RoHS policy in 2007.[19] That assessment recommended a more detailed analysis should be undertaken in a range of areas, including:

- further stakeholder consultation, particularly targeting smaller enterprises to ensure a more comprehensive understanding of the impacts, costs and benefits of an Australian RoHS policy;
- cost-benefit analysis issues including the environmental benefits and financial costs of phasing out particular hazardous materials;
- a range of exposure issues, including a national analysis of emissions from landfills, both in terms of landfill characteristics and emissions attributable to different waste types.

† A study released in 2007 (Preliminary Environmental and Economic Assessment of Australian RoHS Policy) noted Australian Bureau of Statistics data which showed that Australia is a net importer of electronic equipment totalling around $30 billion in 2005. See <www.environment.gov.au/settlements/publications/waste/electricals/>

Transport of hazardous waste within Australia

Interstate transport

In Australia, the states and territories have legislative responsibility for the road and rail transport of dangerous goods including the interstate transport of hazardous wastes. At present, the movement of hazardous waste in Australia is managed under the *Australian Dangerous Goods Code*[20] and the *Controlled Waste National Environment Protection Measure* (NEPM)[21] to ensure uniformity and consistency across jurisdictions.

The *Movement of Controlled Waste* NEPM aims to ensure the consistent movement of controlled wastes between states and territories. This is done via proper identification, transportation and handling in ways that are consistent with environmentally sound practices. Management systems include:

- tracking systems, which provide information to assist agencies and emergency services, and ensure that controlled wastes are directed to and reach appropriate facilities;
- prior notification systems, which give participating states and territories access to information by which they can assess the appropriateness of proposed movements of controlled wastes, and can select appropriate facilities;

- the licensing and regulation of generators, transporters and facilities so that tracking and notification functions are compatible with participating state and territory requirements.

State and territory agencies which administer the *Movement of Controlled Waste* NEPM consider that it works well and needs little revision. Some national firms which transport hazardous waste indicated in their submissions to the National Waste Policy that there are major differences in waste classifications, haulage requirements and tracking mechanisms among jurisdictions. A review of the *Movement of Controlled Waste* NEPM which began in 2009 may identify whether these are significant problems which require action.[22]

Storage, transfer and drop-off

Facilities for the storage, transfer and drop-off of hazardous wastes are widespread and operated by the private and public sectors. While most are for household hazardous materials, some facilities accept industrial materials and large volumes. Some examples are:

- *New South Wales*—the NSW Department of Environment, Climate Change and Water delivers the Household Chemical CleanOut Program in partnership with Local Government. Through the establishment of publicised temporary collection sites, CleanOut enables householders to dispose of common household hazardous materials responsibly while reducing community and environmental exposure to chemicals, radiation and waste.
- *South Australia*—the SA Government operates the Hazardous Household Waste Depot which allows householders and farmers (not businesses) to dispose of hazardous wastes free of charge, one day per month. The depot accepts waste pesticides, pharmaceuticals, solvents, thinners, paints, oils, fuels, batteries and unknown chemicals. Ammunition, asbestos, gas cylinders, explosives, radioactive materials, tyres and empty pesticide containers are not accepted. Some councils also operate periodic one day collection services for these materials, often with Zero Waste SA through the Household and Farm Chemical Collections Program.
- *Tasmania*—the Tasmanian Government operates a similar program to that in Victoria, with ChemSafe Tasmania co-ordinating drop-off days with local government authorities.
- *Victoria*—Sustainability Victoria co-ordinates a program with local government for a rolling schedule of drop-off days at different locations around the State, as well as working with private sector organisations for permanent drop-off sites.
- *Western Australia*—in Perth the Eastern Metropolitan Regional Council (EMRC) provides hazardous waste drop-off and storage services. The EMRC operates a storage facility and provides a series of drop-off locations and drop-off days across the region.

Treatment and disposal

Hazardous waste is generally more costly to manage than non-hazardous waste. Treatment, transport and disposal costs are likely to be higher, and additional occupational health and safety measures are usually required. In addition, communities near management, treatment or disposal facilities are likely to resist having such waste stored, disposed to landfill or processed locally. Facilities for handling, storing, treating or disposing of hazardous wastes are generally required to be licensed under state laws.

Australia relies in part on disposing of hazardous waste (including hazardous consumer waste) to landfill. For example, most Australian jurisdictions currently allow electrical equipment such as computers and televisions to go to landfill. These items may contain the two brominated flame retardants now classified as POPs and listed by the Stockholm Convention. Under the Convention, the chemicals and objects containing them, on becoming hazardous waste, must be

> … disposed of in such a way that the persistent organic pollutant content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of persistent organic pollutants or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option.[23]

Whether the current practice of disposal to landfill meets these conditions or whether this requirement can met by the other waste disposal facilities currently available in Australia has not been determined. The proposed national television and computer product stewardship scheme should assist Australia in meeting its obligations under international instruments such as the Stockholm Convention.

It is expected that international developments will continue to produce further challenges in managing hazardous waste disposal. For example, if the current negotiations to develop a legally binding international agreement on mercury result in a ban on its use, long-term storage facilities for mercury are likely to be needed.

Treatment facilities and service providers

A comprehensive listing of the facilities available for treating hazardous waste in Australia is not available, but research undertaken for this report shows that there are around 100 hazardous waste facilities nationwide, including 39 hazardous waste and 54 liquid waste facilities[24].

As with the waste industry generally, the management of hazardous and liquid waste—and especially collection, transport and consolidation—appears to be serviced by a small number of large providers although there are no published figures available to confirm this conclusion. The major companies are listed in **Table 3.9**.

There are also specialised facilities which process hazardous wastes. Among these are the few 'boutique' facilities widely scattered around the country, which deal with most current production of highly hazardous chemical wastes, such as

- persistent organic pollutant wastes such as polychlorinated biphenyl wastes
- mercury wastes
- used oils including lubricating oil
- biohazardous waste, and
- chemicals and paints.

There are no suitable facilities to deal with some highly hazardous legacy chemicals such as the 16 000 tonnes of hexachlorobenzene (HCB) waste at the Orica Australia facility in Botany, New South Wales, and some small stockpiles of intractable waste pesticides.

Although Australia is a relatively wealthy OECD country and has a strong industrial capacity in areas such as mining, its chemical industry is quite small, producing little intractable hazardous waste. Australia's annual production of chlorinated wastes, and wastes it accepts from countries in the region

Table 3.9: Major hazardous and liquid waste management companies

Business Name	Waste types managed
JJ Richards	• Liquid waste collection and processing in NSW and Queensland • Clinical and medical waste collection and processing in mid and far north Queensland and the Northern Territory
SITA Environmental Solutions	• Solid hazardous, medical and liquid waste collection nationally • Company offers a used battery collection and recycling service for householders
Transpacific Industries (includes subsidiary WS Environmental Solutions)	• National solid hazardous waste, liquid and medical waste collection and processing including chemical fixation and solidification • Operates at least seven liquid waste processing facilities • Operates a hydrogenation facility to refine used oils into premium grade lubricant base stocks • Through a subsidiary company (Cleanaway) offers used battery collection and recycling service
Veolia Environmental Services	• Offers national network of collection services for solid hazardous, liquid and medical wastes • Company owns and operates nine liquid waste treatment facilities in NSW, WA, SA, Victoria and Tasmania • Operates a medical and quarantine waste processing facility and depot in SA • Operates six landfills in Queensland, NSW and South Australia

lacking facilities, can generally be dealt with by its existing domestic waste treatment facilities, which are small and relatively specialised to suit the wastes produced from the local market. These facilities, which are private sector, commercial operations, have been established to deal primarily with these small continuing waste streams rather than legacy chemicals no longer produced.

Within Australia there are some stockpiles of legacy chemicals requiring destruction. These are mainly old pesticides that were collected from farms during clean up programmes. A survey carried out in early 2008 indicated that these pesticide stockpiles amount to only 94 tonnes with the largest, 64 tonnes, located in Victoria. These figures exclude small but unquantified amounts of waste being stored in some jurisdictions awaiting treatment in facilities located in other states (see below) and they also exclude the hexachlorobenzene waste stockpile at Botany, NSW.

Treatment capability across jurisdictions

During 2009 some stakeholders indicated the need for interstate cooperation on the transport and treatment of some types of hazardous waste. Some of the smaller jurisdictions especially indicated the need to rely on treatment capacity in the larger states. A report prepared for Tasmanian government agencies, including the Department of Tourism, Arts and the Environment, the consultancy firm Sustainable Infrastructure Australia highlights this need:

> There is considerable uncertainty as to whether or not interstate authorities will continue to accept Tasmania's controlled waste for treatment and disposal at mainland facilities in the future. There have been mixed reports from stakeholders on this issue.
>
> ...
>
> Action by the Tasmanian State Government to maintain open dialogue with neighbouring States and Territories is required, in order to preserve trade agreements for the transboundary movement of controlled wastes (under the Interstate Waste Movement NEPM), and secure future management opportunities at interstate facilities. However if, for whatever reason, interstate transport can no longer be relied upon by Tasmania as a management option, greater waste volumes and diversity of waste types will require appropriate treatment and disposal at Tasmanian facilities.[25]

No data are available presently on the quantities of hazardous waste being stockpiled in the smaller jurisdictions like Tasmania. Further analysis of current treatment capacity, future waste arising, and future treatment capability would provide a more comprehensive picture.

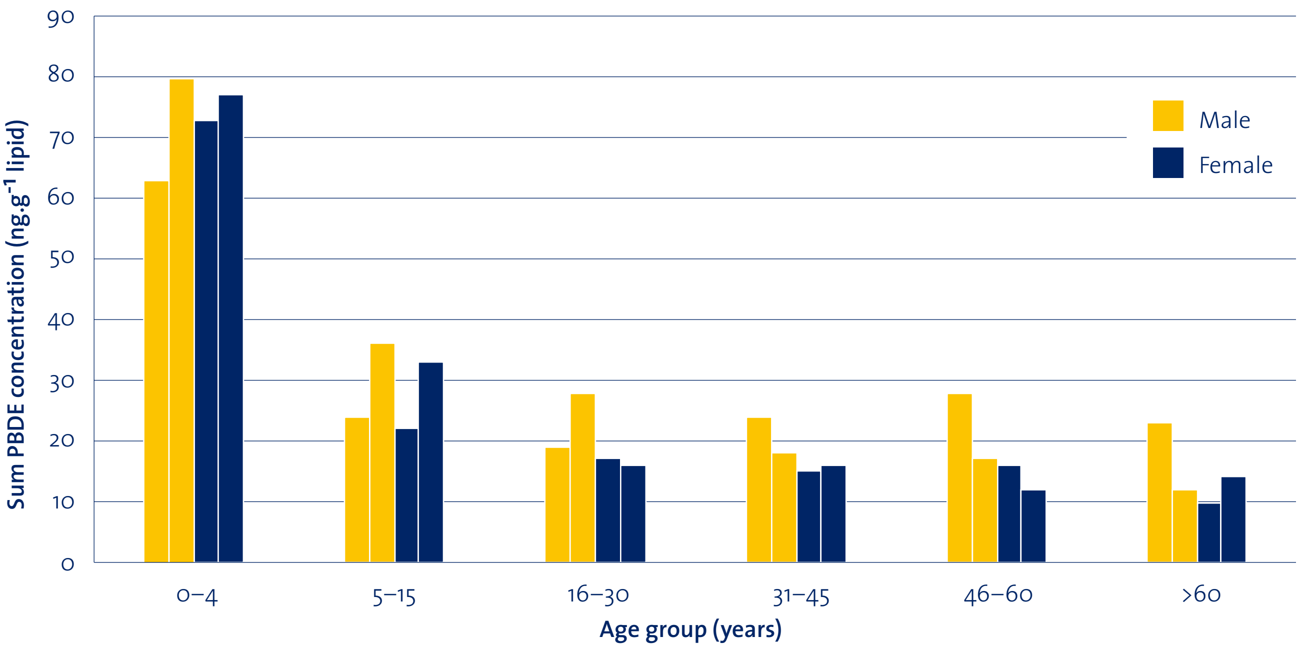
Monitoring the fate of chemicals and hazardous substances

A part of the Stockholm Convention involves participation by member countries in the Global Monitoring Plan, which requires ongoing environmental sampling and human bio-monitoring for persistent organic pollutants (POPs). This will provide the information needed to inform strategies to manage these POPs and wastes containing POPs.

The limited monitoring undertaken to date suggests that some substances found in hazardous wastes are present in the air and on surfaces in most Australian homes, and in the wider natural environment. For example, brominated flame retardants found in such items as electrical goods and home furnishings are present in most Australians, based on 8000 blood samples collected for the National Dioxins Programme in 2004–05.[26] The highest levels were in children under four years old (**Figure 3.11**) although it should be noted that the concentrations of BFR in blood from the Australians in the youngest age group were higher than children in Norway and lower than the concentrations found in children from North America[27]. A key uncertainty with BFRs relates to their toxicology and particularly effects related to potentially chronic exposure.

Perhaps more surprisingly, brominated flame retardants have been found in native wildlife such as Tasmanian devils[28] and eastern grey kangaroos,[29] including populations remote from human settlements. Some persistent organic pollutants, such as hexachlorobenzene, are transported so readily in the environment that they have already achieved global coverage. This ability to migrate is

Figure 3.11: Mean ΣPolybrominated Diphenyl Ether concentration in lipid (ng.g^{-1} lipid) by gender and age for 2004–05



an important reason for the Stockholm Convention's requirement that wastes containing listed chemicals be destroyed.

Resource recovery and waste contamination issues

There are many different types of contamination of recovered resources and these affect recycling processes and markets for recovered materials. Some waste and recyclables are contaminated with hazardous material; some recyclable materials are contaminated with non-recyclable materials. Both may have occupational health and safety, environmental and/or market efficiency implications.

In its submission to the 2008 Senate Inquiry into Australia's Waste Streams, the ABS noted:

> Advanced waste processing and treatment technologies designed to decrease the volume of waste disposed of to landfill are largely dependent upon the minimisation of the input of hazardous waste into the domestic waste stream. Campbelltown City Council has recently entered into a contract for the construction of an advanced waste processing and treatment facility which is expected to result in the re-use or recycling of 88% of domestic waste. However, the success of this project, like any other of its kind, will depend on minimising inputs such as paints, oils, treated timber, computer hardware, motor vehicle tyres and batteries. The presence of hazardous waste in the municipal waste stream can contaminate otherwise re-useable waste.[30]

In a 2007 presentation, staff from the Global Renewables Alternative Waste Treatment facility at Eastern Creek, NSW, highlighted the risks represented by waste contaminants, noting:

> In the more than two years since Global Renewables Alternative Waste Treatment facility at Eastern Creek, NSW, began accepting [municipal solid waste] from Sydney's Fairfield and Blacktown city councils, it has become clear that hazardous materials are consistently present in the waste stream and must be separated to ensure product quality. As acknowledged by the recent Productivity Commission Inquiry, these toxic and hazardous materials can include
>
> - lead acid batteries
> - mobile phones, televisions and computers that contain toxic and heavy metals
> - pesticide, paint and household chemicals
> - gas cylinders
> - clinical waste from health services, and
> - asbestos.

> An audit of waste received at the Eastern Creek Facility from a Sydney Council area revealed hazardous materials made up an average of 3.17 % of the household rubbish received over five days. Materials included batteries, insecticide containers, motor oil, medicines, syringes, tubing used for dialysis, computer equipment and gas cylinders.[31]

Some of the potential hazards include: contamination of waste and processed compost by lead and mercury, which can result in lost value of the compost; occupational health and safety hazards from substances and articles such as clinical waste; and the explosion hazard of potentially explosive articles such as gas cylinders that inadvertently find their way into metals recycling processes.

In its submission on the *National Waste Policy Consultation Paper* during 2009, the Australian Council of Recyclers (ACOR) identified several specific contamination issues including those that relate to gas cylinders, lead acid batteries and compact fluorescent lamps.[32] ACOR noted that this contamination may create environmental harm, injure the public and employees, damage equipment and affect the products of resource recovery activities.

Australia has a good record of compliance under international conventions on hazardous waste and chemicals. There is now considerable international activity about the effective management of hazardous substances, some of which are contained in everyday consumer products. The forthcoming obligations under the Stockholm Convention and the proposal for a Legally Binding Instrument on Mercury will require new management strategies. This will prove challenging given the lack of reliable and robust data on the transport, management and disposal of hazardous waste and chemicals and the absence of comparable classification systems.

Conclusion

Hazardous waste generation doubled from 0.65 to 1.17 million tonnes per annum between 2001 and 2007, and now appears to have stabilised at between 1.1 and 1.2 million tonnes per annum. In 2007, this was around 2.5% of all waste generated within Australia.[‡] Most of this waste was managed within Australia either by treatment or disposal to landfill. An average of about 30 000 tonnes of hazardous waste was exported for treatment overseas between 2003 and 2007.

Existing and emerging international obligations require policies which ensure that hazardous waste management and treatment capacity are capable of meeting those obligations within Australia's boundaries. Improved data gathering about hazardous waste in Australia will assist the process.

‡ As defined under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

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CHAPTER 3.4 ORGANIC WASTE

Organic waste represents a significant proportion of Australia's waste stream, and contributes to Australia's greenhouse gas emissions profile. This chapter presents information on organic waste, including estimates of the amount of organic waste generated, landfilled and recycled by waste stream and estimates of the amount of food waste generated. The benefits of recycling organic waste and the technologies used for recycling are also discussed. Case studies describe initiatives aimed at re-using or recycling organic waste and food waste.

What is organic waste?

Organic waste includes food waste, cardboard, paper, wood, green waste, sewage sludge and other putrescible waste. In 2006–07, an estimated 20.06 million tonnes of organic waste were generated of which 6.43 million tonnes were diverted from landfill and 13.64 million tonnes were landfilled (64.72% of all waste landfilled).[1]

Information about the generation, disposal and recycling of organic waste is variable in scope and quality with some jurisdictions not collecting data and others having different waste categories. As a result, the national picture presented here is indicative only and draws on data from the Hyder Consulting's *Waste and Recycling in Australia* report (amended 2009). Where other sources are used, references are provided.

Some data exists on the specific volumes of organics recovered from particular streams and jurisdictions, but there is no comprehensive national dataset on organics recovery specific to MSW, C&I and C&D. National scale data on organics recovery from the annual survey of recycled organics products includes inputs from sources additional to MSW, C&I and C&D, such as some agricultural wastes.

Organic waste by waste stream

The proportion of organic waste in each waste stream can be estimated using the *National Greenhouse and Energy Reporting (Measurement) Determination 2009* (NGER).[2] This determination states that organic waste constitutes 72% of landfilled municipal waste, 62.5% of commercial and industrial waste and 11% of construction and demolition waste. **Table 3.10** shows estimates of the amounts of organics generated and recovered based on the NGER Determination and Hyder Consulting 2009 Amended Report data.[3] **Figure 3.12** uses the above methodology to estimate the organics generated and recovered by jurisdiction.*

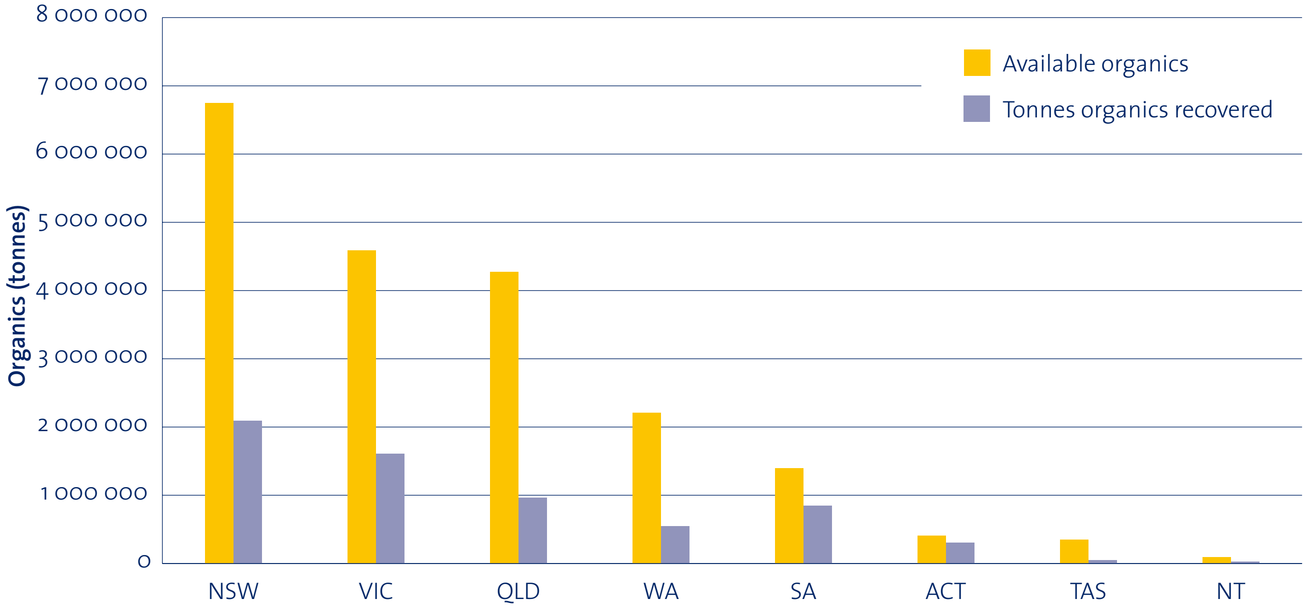
* Figure 3.12 takes Hyder 2009 data on total generation in MSW C&I and C&D wast for the jurisdictions and applies the NGER 2009 % of organics values to each of the three streams. This then produces estimates of available organics with each stream for each jurisdiction,

Table 3.10: Estimates of organic waste generated, recovered and landfilled in 2006–07

Stream	Total waste generated (tonnes)	Organics in generated waste%	Available organics (tonnes)	Organics recovered (tonnes)	Organics landfilled (tonnes)	Organics recovery %
Municipal solid waste (MSW)	12 728 000	72%	9 164 160	2 071 000	7 093 160	23%
Commercial and Industrial (C&I)	14 533 000	62.5%	9 083 125	4 138 000	4 945 125	46%
Construction and Demolition (C&D)	16 518 000	11%	1 816 980	219 000	1 597 980	12%
Total	**43 777 000**		**20 064 265**	**6 428 000**	**13 636 265**	**32%**

Note: All figures have been rounded. Minor discrepancies may occur between stated totals and sums of the component items, as totals are calculated using the component values prior to rounding. Not all organics data takes into account mass loss in recovery processes, such as evaporative loss during composting. Paper and cardboard recovery data from C&I and C&D streams are not available for all States and Territories.

Figure 3.12: Estimated Organic waste generation and recovery by jurisdiction[4]



There is considerable scope in all waste streams to improve organics recovery. However, given the collection systems in place, actions targeting the commercial and industrial waste stream and the municipal waste stream are likely to prove beneficial in reducing the amount of organic waste sent to landfill. Separate bins for the kerbside collection of garden waste are a common feature of municipal waste services in major centres. Some local governments are trialling different collection methods for food waste but this service is not widespread. In the commercial and industrial sector, supermarkets, restaurants and food processing plants are taking a range of approaches to recycling organic waste (see later Case Study—Supermarket waste diversion).

Environmental benefits of organic waste recycling

There are a range of environmental benefits associated with organic waste recovery and diversion from landfill. Organic waste can be processed into compost, mulches or soil conditioners such as biochar or digestate. The application of these products to land improves soil fertility, assists in water retention, and aids soil carbon sequestration. The application of one tonne of composted mulch can sequester approximately 0.025 tonnes of carbon dioxide.[5] Organic waste recovery therefore offers the double benefit of avoiding greenhouse emissions from land while at the same time avoiding greenhouse gas emissions created by the decomposition of organic material in landfills.

As mentioned in **Chapter 3.2**, the anaerobic decomposition of organic waste in landfill produces landfill gas which consists of about 55% methane. Methane has a global warming potential 25 times that of carbon dioxide, assessed over a 100 year timeframe. Reducing the amount of organic waste going to landfill will assist in reducing greenhouse emissions.

The solid waste or landfill sector accounted for 11 Mt CO_2-e in 2008 and is projected to also be around 11 Mt CO_2-e in 2020. The projections are based on increasing diversion of organic waste from landfill and increasing gas capture.[6]

Diverting organic waste from landfill and developing quality, fit-for-purpose compost or soil conditioners is a potential abatement strategy that also produces a range of environmental co-benefits. There are, however, a number of market barriers that would need to be overcome. Organic waste is often contaminated with household waste which may contain hazardous substances (e.g. lead acid batteries, paints, solvents) or act as a reservoir for viable weed seeds and pathogens if not properly processed. Current collection methods may not sufficiently address the issue of contamination. The absence of standards or quality assurance in some jurisdictions for organic waste products limits the options for end markets and without demand, there will be little investment in organic recycling facilities.

Technology for recycling organic waste

Overall future recycling performance will be significantly influenced by the availability of proven technology to address the organic portion of all waste streams.

Proven technologies exist for recycling and recovery of these types of organic waste, including:

- *Composting:* techniques range from home compost bins to open air windrow, enclosed or semi-enclosed tunnel composting, in-vessel composting bins (with a variety of mechanical treatments including aeration and agitation) and in-vessel vermiculture units;
- *Anaerobic digestion:* biological treatment of organic waste in the absence of oxygen;
- *Gasification:* the partial oxidation of organic material which results in synthetic gas (also known as syngas—a mixture of carbon monoxide, hydrogen, carbon dioxide and methane);
- *Pyrolysis:* the chemical decomposition of organic material by heat in the absence of oxygen;
- *Bioconversion to alcohol fuels:* conversion of waste to alcohol by micro-organisms;
- *Biodrying:* drying organic waste to produce refuse-derived fuels (RDF);
- *Microwave:* use of industrial microwave technology to convert wood and other biomass to biochar;
- *Bioreactor landfill:* enhancement of microbiological processes to accelerate the decomposition of organic waste in a conventional landfill. Leachate recirculation, waste shredding, nutrient addition and temperature management are some of the enhancements that can be used.

State and territory policies have led to increased investment in systems for organic waste recovery, particularly for municipal waste over the past few years. There are also significant opportunities for organics recovery in the C&I waste stream, including from restaurants, cafes and supermarkets. Complementary strategic policies may be necessary to encourage organics diversion from landfill. The Waste Management Association of Australia has argued that a carbon price under the CPRS of \$60t/CO_2-e would be necessary to do this.[7]

Food waste

There has been increased attention on the impacts of food waste and the action to re-use, recover and recycle food waste during the past decade. Wasting food is also a waste of the resources, water, and energy used in the production, transport and supply of food in addition to the greenhouse gas emissions caused by the decomposition of food in landfills. There are no estimates on the amount of water and energy that was used to make the food that was wasted and there is little information on the amount of greenhouse gas emissions generated by household food waste. The Australia Institute in its report *What a Waste* estimates that that household food waste was responsible for 5.25 Mt Co_2-e emissions in 2004 (or 33%) of emissions from solid waste in landfill. This level of emissions is similar to the total emissions involved in the manufacture and supply of iron and steel in Australia in that year.[8]

National data on food waste is inferred from waste audits and other sources. Food waste constitutes 35% of municipal waste (4.45 million tonnes) and 21.5% of commercial and industrial waste (3.12 million tonnes).[9] In 2006–07, 238 000 tonnes of organics were recovered from municipal waste streams and 91 000 tonnes food waste from the commercial and industrial waste stream. Using the available data, Australians generate an estimated 361 kilograms of food waste per person per year or approximately 936 kilograms per household per year. Food waste can contain disease organisms hazardous to human and animal health, and recycling and recovery technologies must ensure sterilisation of any potential pathogens present.

Food waste in the municipal waste stream.

The Australia Institute estimates that currently Australians are disposing of food worth \$5.2 billion a year, with the average household disposing of an estimated \$616 worth of food a year (which equates to $239 per person). The comparable figures for the United Kingdom are that householders throw out an estimated £12 billion worth of food and drink and the cost of avoidable food and drink waste is typically £480 per year rising to £680 a year for families with children.

The Australia Institute also found that household size and income has a direct influence on levels of food waste, with higher income households with low numbers of occupants generating the greatest amount of food waste per person. The report points out that the demographic factors of rapid population growth and declining household size combined with rising incomes is likely to increase the amount of food waste generated in Australia.

A number of jurisdictions have investigated the viability of kerbside waste collections services for food waste as part of a combined organic waste collection service. A report by the then NSW Department of Environment and Climate Change on kerbside collection trials of food waste found that food waste diversion was between 1.24 kg to 2.4 kg per household per week. The trials found that

- the provision of kitchen containers increases diversion and participation rates
- weekly combined organics collection services appear to provide the highest diversion and participation rates
- less frequent residuals collection increases diversion rates
- contamination is minimised where the collection contractor is responsible for meeting contamination levels, and
- processing should be integrated into the service contract or be informed by the collection contract to ensure compatibility with the collection system.

Zero Waste SA also conducted a review of domestic kerbside collection of food and garden waste to help councils evaluate waste strategy options. Key barriers to the implementation of kerbside food/green waste collection were

- cost
- lack of external funding
- need for cost/benefit justification
- problems of uptake by residents
- contractual issues
- legislation changes required in some councils, and
- contamination e.g. with plastic bags.[10]

Food waste in commercial and industrial sector

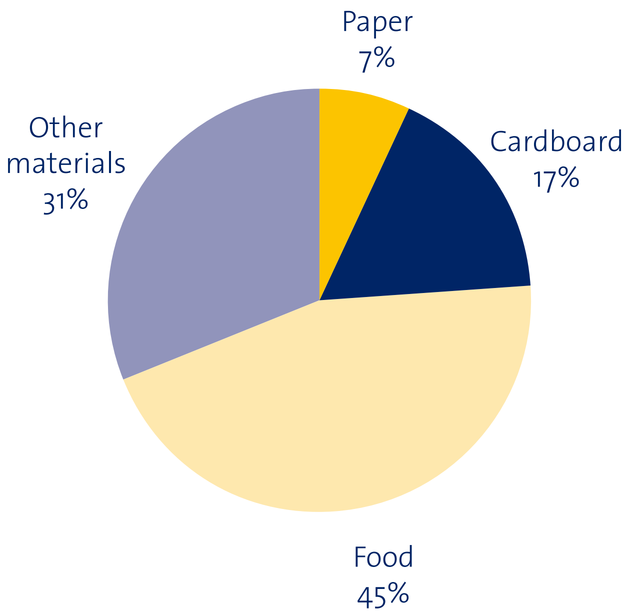
A variety of sources exist for food waste in the commercial and industrial sector including supermarkets, restaurants and cafes and food processors. The amount of food waste in the commercial and industrial sector is inferred from waste audits and there is little detailed information of the contribution of different sources to the overall quantity of food waste in the sector. Hyder Consulting estimates that the typical supermarket generates 46% packaged food waste, 27% food waste, 22% other waste, 3% paper and 2% cardboard.[11] Most major supermarket retailers separate, crush and bale their paper and cardboard waste for collection and recycling. Action on food waste is not as far advanced, although some work has been done by Woolworths and Coles to divert food waste to composting and alternative waste treatment facilities.

Case study—Supermarket waste diversion

In 2006, Woolworths began the diversion of food waste in 53 Sydney stores. The waste is sent to EarthPower, a facility which processes it into compost, fertiliser and electricity. In its *Sustainability Strategy 2007–2015*, Woolworths notes that it aims to increase the number of Sydney stores using the EarthPower facility. It plans to investigate using similar facilities within Australia but notes that presently there are a limited number of appropriate facilities external to Sydney.[12] Similarly, Coles supermarkets are trialling organic waste recovery in stores in New South Wales and Victoria.[13]

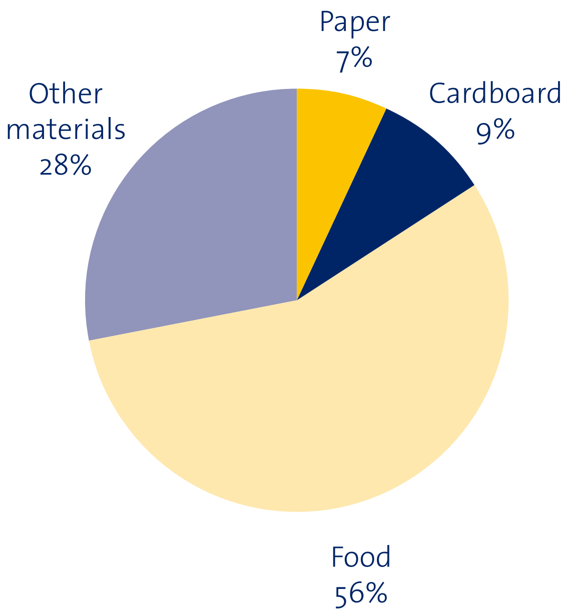
Information on food waste generation from restaurants and cafes is similarly scant. A study of commercial operators within Melbourne CBD (a large proportion of which would be restaurants and cafes) provides an indication of material being disposed of and indicates a large proportion of food waste and other organics.

Figure 3.13: Breakdown of waste stream from audits of waste from commercial operators in a CBD location (includes material disposed of to landfill and material recovered for recycling)



Source: Hyder Consulting 2009

Figure 3.14: Breakdown of disposal to landfill stream from audits of waste from commercial operators in a CBD location



Source: Hyder Consulting 2009

There is a number of initiatives being taken by the private and public sector to recover, re-use and recycle food waste from the commercial and industrial sector. No comprehensive survey exists of the range of initiatives. The examples of FareShare and Foodbank in the following case studies are only a sample of what is currently taking place.

Case study—FareShare

Non-profit community organisation FareShare is a leading example in how to reduce edible food waste in the commercial sector. FareShare redistributes surplus food to the hungry and the homeless in Victoria using food donated by businesses.

This benefits the environment by reducing food waste going to landfill, helping to cut methane pollution and reducing demand for new food products. This also benefits the community by distributing food to those in need.

With the help of volunteers, individual donations and funding from philanthropic, corporate and government bodies, FareShare collects food from donors (including corporate offices, delis, restaurants, function centres and caterers) and distributes the food to at risk communities, at no cost to either the food donors or recipients.

Benefits of the FareShare approach include:

- a reduced amount of edible food going to landfill
- provision of food to those in need
- charities that are supported with food are able to divert funding to other activities, and
- there is reduced embodied energy associated with producing and distributing food.

Figure 3.15: FareShare in action.

Photo courtesy of Julian Pang and FareShare.

In 2008, FareShare redistributed 260 000kg of food (560 000 meals).[14] An analysis conducted by FareShare found that every kilogram of food rescued (on average) results in a saving of 1.5kg of CO_2 emissions and 56 litres of water. These figures take into account the water and energy savings associated with displacing the need to produce and supply alternative food for one third of the meals supplied, as it is estimated that the other two thirds of recipients would otherwise have gone without a meal.

Case study—Foodbank Australia

National relief organisation Foodbank Australia reduces edible food waste in the commercial sector by distributing food and grocery industry donations that are surplus to commercial demand to welfare agencies.

This not only benefits the environment by reducing food waste going to landfill but also benefits the community by distributing food to those in need.

Foodbank Australia collects, stores and delivers fresh and non-perishable foods to welfare agencies in five states across Australia for a small fee from the donor company. In the past year it distributed 16 million kilograms of donated food and groceries. Donations comprise food and groceries that would otherwise go to waste including items that are short dated, slow moving or are in excess to demand.

Figure 3.16: Foodbank stocks

Photo courtesy of Foodbank Australia (http://www.foodbank.com.au).

Case study—VARRI

The Victorian Advanced Resource Recovery Initiative (VARRI) is a Victorian Government initiative aimed at improving organic (food and garden) waste recovery in metropolitan Melbourne. VARRI will facilitate the introduction of new Advanced Resource Recovery Technologies (ARRT) for processing metropolitan Melbourne's municipal solid waste. Establishment of ARRT facilities will enable more waste to be diverted from landfill. In Melbourne, these facilities will focus on processing organic waste.

Re-processing waste using ARRT facilities not only reduces material to landfill but also delivers additional environmental benefits. Different ARRT facilities can produce useful end products ranging from clean renewable energy to enriched compost and fertilisers. In addition, re-processing organic waste will help to reduce Victoria's greenhouse gas emissions from landfills.

The recently released *Metropolitan Waste and Resource Recovery Strategic Plan* recommends the establishment of up to eight facilities that use ARRT to service the growing waste management needs of metropolitan Melbourne. VARRI is the first step in achieving this goal. Victoria is currently developing a business case to explore a range of ARRT options.

Case study—City to Soil—Groundswell

In 2004, the then NSW Department of Environment, and Climate Change and the Queanbeyan City Council initiated a project called 'City to Soil'. This project demonstrated that high quality organic waste from urban communities can be collected, composted and used in agriculture with positive environmental and economic results for farmers. City to Soil also demonstrated a high level of willingness and capacity by the community to participate in source separation of organics. The overall environmental and social benefits of the project were significant.

In 2007, the project was extended to become 'Groundswell'. Under this program, Goulburn Mulwaree, Lachlan, Queanbeyan City and Palerang Councils introduced a City to Soil food scrap and garden waste collection service to households already receiving a council waste service. Food scraps and garden waste collected through the program are composted using the no-shred / Vital Resource Management (VRM) activated process. The collected material is picked over to ensure no contamination, then is sprayed with a composting solution that contains a diverse range of microbial elements including yeasts, fungi, phototrophic bacterial and lactobacillus. The material is then piled into windrows, covered with polytarps, and left for four to six weeks to decompose. After this time, they are uncovered, mixed, resprayed, piled and covered for another four to six weeks. At the end of this time, the material is exposed to sunlight to cure. The compost is ready for use when moisture levels drop to 23%.

City to Soil provides the opportunity for councils to divert 50–70% of kerbside residual waste from the waste stream and transform it into a premium compost product. The project will result in farmers and councils working together to pull urban organic waste out of the cities and back into agricultural land, simultaneously reducing organic waste to landfill and increasing organic levels in agricultural soils.

Conclusion

Australia generated an estimated 20.06 million tonnes of organic waste in 2006–07 with a large proportion (64.72%) landfilled. There is scope to recover and recycle organic waste and this will bring environmental benefits. Organic waste can be turned into compost, mulches and biochar which have agricultural benefits and assist in sequestering carbon in the soil. A range of technologies exist for recycling and recovering organic waste. Food waste is a component of organic waste and attracts substantial economic costs. The Australia Institute estimates that Australians currently dispose of $5.2 billion worth of food. There is a growing number of initiatives to recover and recycle organic waste from municipal kerbside collections as part of alternative waste treatment or composting, and to re-use food waste through distribution to community organisations.

Endnotes

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CHAPTER 3.5
LITTER

This chapter describes the regulation of litter, its costs to the community, the materials that are most frequently littered, and the results of a range of litter studies.

Litter is waste that has been disposed of incorrectly. It is a highly visible form of pollution and can include cigarette butts, drink containers, food wrappers, plastic bags, bill posters, junk mail, poorly secured material from a trailer and illegal dumping.

Legislative and administrative frameworks

State and territory governments have primary responsibility for legislation on litter and are also involved in education and clean-up activities. Non-government groups play a key role in education, awareness raising and clean-up activities.

Litter is addressed in all states and territories through legislative or administrative frameworks that are supported by enforcement activities. Littering offences are similar across jurisdictions and commonly include general littering, littering from a vehicle, illegal dumping, insecure delivery of advertising material and dangerous/aggravated littering. The legislative frameworks of most jurisdictions enable a number of different types of officers to issue littering fines.[1] Victoria's litter reporting program allows members of the public to make reports which are then acted on by EPA Victoria. Over 19 000 fines for littering were issued as a result of the program in 2008–09.

Table 3.11 identifies the main legislative instruments in each jurisdiction.

State, territory and local governments also undertake a range of education, awareness raising and clean-up strategies. These are varied and even within a single state or territory, diverse approaches are used by local councils. Strategies address matters such as cigarette butts, illegal dumping, roadside littering and public place/event recycling.

For example, between 2002 and 2004 the NSW Government provided funding through the *Illegal Dumping Clean Up and Deterrence Grants Program* to assist local councils overcome illegal dumping issues. NSW local councils used the funding to develop a variety of different approaches to manage their council specific problems. The councils

Table 3.11: Legislative and administrative frameworks in states and territories to address litter[2]

Jurisdiction	Legislative and Administrative Frameworks
NSW	*Protection of the Environment Operations Act 1997*
Vic	*Environment Protection Act 1970* Towards Zero Waste Strategy 2005 Victorian Litter Strategy 2009
Qld	*Environmental Protection Act 1994*
WA	*Litter Act 1979* *Environmental Protection Act 1986*
SA	*Environment Protection Act 1993* *Local Government Act 1993* *Zero Waste Act 2004* Zero Waste Strategy 2005–2010
Tas	*Litter Act 2007*
ACT	*Litter Act 2004* Magistrates Court (Litter Infringement Notices) Regulations 2004
NT	*Litter Act* 2007 Re-thinking Waste Disposal Behaviour & Resource Efficiency Interim Action Plan

reported that after their activities, illegal dumping was reduced. The activities included the following:

- The City of Canada Bay in Sydney used the funding to deter night-time dumping in a particular location, by installing solar powered lighting and signs that identified the illegal dumping problem and the penalties. It also developed an education campaign to inform local businesses and residents about the issue, and Council law enforcement officers patrolled the area regularly.[3]
- The Parramatta City Council used its funds to reduce illegal dumping and promote community responsibility through a community education campaign. It contracted a marketing consultant to develop bi-lingual promotional materials including a brochure, posters, magnets, stickers and newspaper advertisements. Using these materials it developed an education kit which was distributed to their target audience which included 3700 residents living near bush reserves, 14 000 residents in units and 1200 corporate bodies. Residents were also invited to participate in community clean-up days.[4]

NSW continues to work with local councils and other stakeholders on littering and illegal dumping issues, with on-going support from Regional Illegal Dumping (RID) Squads and through Aboriginal Lands Cleanup Grants. In 2008, litter prevention campaigns were funded across 90 council areas and across 72 council areas in 2009. These education activities are supported by guidance materials and campaign kits and enforcement action.

In Victoria, amendments to the *Tobacco Act 1987* in 2007 required licensed venues to become smoke-free. It was expected that littering of cigarette butts would increase as a result, and a dedicated mitigation campaign, *Don't be a Tosser—Bin your Butts*, was developed which included advertising to increase public awareness, provision of information toolkits to 8000 licensed venues, and rebates to assist venues install butt bins. The campaign resulted in a reduction in butt litter. Prior to the campaign, 42% of smokers binned their butts; after its inception this increased to 66%.[5]

Costs of litter

Cleaning up litter has a significant economic impact for Australia. State, territory and local governments spend significant amounts on litter management every year. For example, in South Australia, a survey of 31 councils revealed they had spent an estimated total of $2 489 500 on the removal and disposal of illegally dumped items during 2005–07.[6] It has been estimated that councils in Victoria spend approximately $72 million annually on managing and cleaning up litter.[7]

Community organisations and volunteers donate time and labour to cleaning up litter and providing education to mitigate its effects. The Keep Australia Beautiful National Association estimates that 90 000 volunteers contribute up to $100 million in voluntary labour each year through the projects entered into their awards programs.[8] Clean Up Australia estimates that since 1990, Australians have volunteered over eight million hours to cleaning up litter on Clean Up Australia Day, and have removed over 200 000 tonnes of rubbish from the environment.[9]

Litter also represents a loss of potential resources and greenhouse benefits.[10]

Litter data sources

The two key sources of national litter data in Australia are the Keep Australia Beautiful National Litter Index and the Clean Up Australia Day Rubbish Report.

The National Litter Index

Since the 1970s, Keep South Australia Beautiful (KESAB) has been collecting litter data for South Australia on a quarterly basis.[11] In 2005 the Keep Australia Beautiful National Association (KABNA),[12] which had collected and reported on national litter data irregularly to that date,[13] adopted KESAB's litter count methodology and applied it to Australia-wide data collection to produce an annual National Litter Index. This was the first time that base-line national data had been produced, enabling state to state and year to year litter trend comparisons.

In total, 983 sites equal to an area of 1 499 791m^2 are surveyed. The sites fall into eight categories: residential, beach, industrial, car park, shopping centre, retail precinct, recreational park and highway. Results for the average *number* of littered items and *volume* of litter per 1000 square metres (1000m^2) are reported.

Clean Up Day Rubbish Report

Clean Up Australia has been collecting national data on the litter collected through Clean Up Australia Day since 1991, reporting the results annually via the Clean Up Day Rubbish Report.[14] The Rubbish Report presents data obtained from sampling the contents of a number of the bags collected on Clean Up Australia Day.

In the 2008 Rubbish Report, 1058 sites (out of 6000) and a total of 363 854 items were analysed.[15] As the survey is voluntary, the sites and the number of surveys conducted at each site category, or within each state/territory, vary from year to year. Sites are classified into eight different categories, being river/creek, roadway, park/waterfront, public bushland, beach/coastal, school grounds, outdoor transport and shops/malls.

Litter levels

The National Litter Index shows that litter levels within Australia have remained relatively stable between 2005–06 and 2008–09. Overall, the 2008–09 data points to a decrease in litter nationally compared with results from previous indexes (**Table 3.12**). Similarly, the 2008 Rubbish Report revealed 15% less litter than in the previous year.

Both the number of items and the volume (litres) per 1000m^2 have decreased across the majority of jurisdictions between 2006–07 and 2008–09. While some states and territories experienced increases in the 2007–08 Index (NSW, SA and WA for *number* of items and WA for *volume*), 2008–09 figures are lower overall than those reported in the 2006–07 index.

Some states/territories showed small increases from the 2007–08 index to the 2008–09 index. Tasmania experienced a slight increase in the *number* of items and *volume* of litter per 1000m^2, while Western Australia had a slight increase in the *number* of littered items but a decrease in *volume* of litter. It is interesting to note that the Northern Territory showed an increase of 40% in *number* of items between the latest two surveys, yet the average *volume* of litter decreased.

Victoria had the most change in litter levels between 2006 and 2009 for both number of items and volume per 1000m^2. The *number* of items almost halved between 2006–07 and 2008–09. The *volume* of litter has been reduced by an even greater factor, 7.74 litres in 2006–07 to 2.87 litres in 2008–09.

Table 3.12: Average number of items and volume (litres) of litter in Australia (per 1000m^2) from 2006–07 to 2008–09[16]

	Items per 1000m^2			Volume (litres) per 1000m^2		
Jurisdiction	**06–07**	**07–08**	**08–09**	**06–07**	**07–08**	**08–09**
NSW	71	77	65	14.69	11.90	12.13
Vic	80	48	43	7.74	4.19	2.87
Qld	86	76	59	7.59	7.44	5.60
WA	83	85	87	12.19	13.06	11.93
SA	61	68	57	11.08	9.55	8.02
Tas	70	61	64	6.68	5.90	7.73
ACT	68	56	56	7.04	6.06	4.77
NT	64	60	84	5.32	7.24	6.00
National	74	68	63	9.68	8.59	7.73

Key items in the litter stream

Nationally, cigarette butts are the highest contributor to litter in every jurisdiction (**Table 3.13**). The numbers per 1 000m^2 ranged from 19 in South Australia up to 41 in Western Australia. This was reflected on Clean Up Australia Day 2008, where cigarette butts were the most frequently counted item and made up 14.5% (by number) of the total rubbish counted.

The volume of littered paper/paperboard food containers and utensils and glass alcoholic beverage containers increased over the period 2006–07 to 2008–09. Illegally dumped items contributed the highest overall *volume* of litter in Australia (**Table 3.14**). There has been a decrease in the average *volume* of illegally dumped items nationally over the last three years (see **Table 3.15**).

Table 3.13: Main objects in litter in Australia, by number of items per 1000m^2 [17]

	Number per 1000m^2		
Object	**06–07**	**07–08**	**08–09**
Cigarette butts (total)	35	32	30
Paper/paperboard (other)	10	10	9
Plastic (other)	10	6	6
Plastic (food container or utensil)	5	5	5
Metal (other)	4	3	3
Miscellaneous (total)	4	2	2
Paper/paperboard (food container or utensil)	1	1	1
Plastic (non-alcoholic beverage container)	2	1	1
Glass (other)	1	1	1
Paper/paperboard (Cigarette packs)	1	1	1
Metal (alcoholic beverage container)	2	1	1
Glass (alcoholic beverage container)	1	1	1

Table 3.14: Main objects in litter in Australia, by volume (litres) per 1000m^2 [18]

	Volume (litres) per 1000m^2		
Object	**06–07**	**07–08**	**08–09**
Illegal dumping (total)	2.96	2.10	1.96
Plastic (other)	1.53	1.49	1.18
Paper/paperboard (food container or utensil)	0.75	0.82	0.86
Plastic (non-alcoholic beverage container)	0.99	0.89	0.80
Glass (alcoholic beverage container)	0.41	0.44	0.46
Paper/paperboard (publication)	0.49	0.44	0.36
Metal (alcoholic beverage container)	0.54	0.42	0.32
Metal (non-alcoholic beverage container)	0.30	0.29	0.29
Paper/paperboard (non-alcoholic beverage container)	0.36	0.33	0.29
Plastic (plain water container)	0.23	0.21	0.20
Plastic (food container or utensil)	0.30	0.18	0.19
Paper/paperboard (cigarette packs)	0.23	0.21	0.18

Table 3.15: Volume of illegally dumped items in Australia, 2006–07 to 2008–09[19]

Jurisdiction	Volume of illegally dumped items (litres) per 1000m² 06–07	07–08	08–09
NSW	7.15	5.26	5.58
Vic	1.80	0.45	0.40
Qld	0.64	1.12	0.91
WA	2.34	2.37	1.12
SA	5.39	2.57	2.62
Tas	1.44	0.60	2.29
ACT	1.14	2.07	0.83
NT	0.93	1.96	1.45
National	2.96	2.10	1.96

Key material types in the litter stream

Nationally, the averages for the *number* and *volume* of items per 1000m² for most materials in the litter stream reduced steadily over the last three years. Comparing material by the *number* of items per 1000m², cigarette butts were consistently the most littered material and glass the least littered across all states and territories. By *volume*, plastics were the greatest contributor. **Table 3.16** gives details for each material type in the three survey periods.

Table 3.16: Average number of items and volume (litres) of littered materials in Australia, 2006–07 to 2008–09[20]

Item	Items per 1000m² 06–07	07–08	08–09	Volume(litres) per 1000m² 06–07	07–08	08–09
Cigarette Butts	35	32	30	0.004	0.004	0.003
Glass	2	2	2	0.56	0.59	0.59
Metal	6	5	5	1.10	0.96	0.84
Paper/paperboard	13	13	12	1.91	1.88	1.77
Plastic	15	13	12	2.99	2.79	2.39

Key brands in the litter stream

In 2005–06 and 2007–08, KABNA undertook a Branded Litter Study as part of the National Litter Index count, to determine which brands and types of branded items were most frequently littered.

The study concluded that once cigarette butts are removed from the count, 24% of the total litter stream consists of branded items. Non-alcoholic beverage containers and packaging made up the highest percentage of branded litter, at 21.4%. Other high scoring categories were alcoholic beverage containers and packaging (19.5%), snack wrappers and packets (17%), and take-away food and drink containers and packaging (15.3%). An average of 12 544 branded litter objects and 1226 individual brands were recorded in the 2007–08 survey.[21] **Table 3.17** shows the percentages of the ten most common brands identified in the litter.

Table 3.17: Key brands in the litter stream nationally

Brand	Percentage of overall count
Coca Cola	9.96%
McDonalds	9.85%
Cadbury	3.75%
Winfield	3.20%
Victoria Bitter	2.74%
Tooheys	1.93%
Hungry Jack's	1.81%
Extra	1.57%
Nestle	1.56%
Carlton	1.55%

Conclusion

All jurisdictions undertake enforcement activities to reduce litter and many fund education campaigns and clean-up activities. The cost of litter nationally is unknown, but councils in Victoria estimate they spend approximately $72 million annually on managing and cleaning up litter.

Two community organisations, Keep Australia Beautiful and Clean Up Australia, provide annual national data on litter. The *2008–09 National Litter Index Report* from Keep Australia Beautiful highlights a decline in national litter levels. Between 2006–07 and 2008–09, the average number of items littered in Australia decreased from 74 to 63 per 1000m^2. Similarly, the average volume of litter dropped from 9.68 to 7.73 litres per 1000m^2. Clean Up Australia reports that in 2008 the most common form of litter was cigarette butts, followed by paper/paperboard, plastic and plastic food containers.

Endnotes

1 Environment Protection and Heritage Council, *Litter Management in Australia*, November 2008, pp. 5–12.

2 Ibid, pp. 5–13.

3 <http://www.environment.nsw.gov.au/warr/illdumpcanadabay.htm>, accessed 31 August 2009.

4 <http://www.environment.nsw.gov.au/warr/illdumpparramatta.htm>, accessed 31 August 2009.

5 <http://www.sustainability.vic.gov.au/resources/documents/LIT_A4_Brochure.pdf>, accessed 29 September 2009.

6 McGregor Tan Research, *KESAB Illegal Dumping Survey 2008*, July 2008, p. 44.

7 Victorian Litter Action Alliance and Sustainability Victoria, *Creating cleaner, safer places—working together to remove litter from Victoria's environment 09*, August 2009, p. 10. Note the $72m cost estimate covers all clean up tasks including municipal street sweeping that would continue regardless of the presence of litter.

8 Keep Australia Beautiful National Association, Submission in response to A National Waste Policy: Consultation Paper, 2009, p.1.

9 <http://www.cleanup.org.au/au/About/the-clean-up-story.html>, accessed 7 September 2009.

10 Victorian Litter Action Alliance and Sustainability Victoria, 'Creating cleaner, safer places—working together to remove litter from Victoria's environment 09', 2009, p. 10.

11 KESAB environmental solutions, Submission to the Senate Inquiry into the Management of Australia's waste streams and the Drink Container Recycling Bill, May 2008, p. 4.

12 KESAB environmental solutions, Submission in response to A National Waste Policy: Consultation Paper, May 2009, p. 16.

13 National data were published in reports such as KABNA Inc, The Litter Stream—its content, sources and dynamics, 1992, and KABNA Inc, Looking at Litter and what's being done about it; A survey of Litter in Australia, 1996.

14 <http://www.cleanup.org.au/au/NewsandMedia/rubbish-report.html>, accessed 17 December 2009

15 Clean Up Australia, *Clean Up Day: Rubbish Report 2008*, <http://www.cleanup.org.au/PDF/au/rubbish-report2008_final.pdf>.

16 Keep Australia Beautiful National Association, *National Litter Index: Annual Report 2008/2009*, p. 2.

17 Ibid, p. 26.

18 Ibid, p. 27.

19 Ibid, pp. 27, 41, 55, 69, 82, 94, 107, 120, 133.

20 Ibid, pp. 22–24.

21 Keep Australia Beautiful National Association, *Branded Litter Study: Annual Results 2007/08*, p. 2.

CHAPTER 3.6
MARINE DEBRIS

This chapter outlines the sources, composition, distribution and quantity of marine debris in Australia and other parts of the world. It describes the impacts of marine debris, particularly on wildlife, and summarises Australia's approach to preventing and managing marine debris.

Marine debris is defined as the pollution of the marine environment by human generated objects.[1] It is a significant form of waste for Australia given its extensive coastline and it is also a significant global issue causing negative ecological, economic and social impacts. It is increasing in quantity and geographic spread. Even the remotest oceans are affected, with tonnes of plastics and other debris washing ashore on the Southern Ocean's sub-Antarctic islands every year. Plastic particles have been found in carcasses of dead snow petrel chicks and the scats of seals in Antarctica.[2]

The existence of an accumulated 'soup' of plastics and other materials in the North Pacific and the North Atlantic Ocean gyres, and other gyres not yet studied,[3] has contributed to increased attention on the scale of the effect of human activity on the marine environment.

The London Convention 1972 prohibits the dumping of garbage and persistent plastics at sea. 'Dumping' is defined in the Convention as the deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other artificial structures, as well as the deliberate disposal of these vessels or platforms themselves. The 1996 Protocol to the London Convention introduced a blanket prohibition on dumping of all waste. Only specified wastes may be dumped from certain-vessels and at specified distances from land, and even then only with a permit.

Composition and sources of marine debris

Aside from materials legally dumped at sea, marine debris include:

- land-sourced items, such as bags, bottles, ropes, fibreglass, piping, insulation, and plastic pellets (nurdles), that are blown, washed or spilled into the sea;
- abandoned or lost fishing gear from recreational and commercial fisheries, such as nets, crab/shrimp pots, strapping bands, synthetic ropes, floats, hooks, fishing line and wire;
- items lost from stationary platforms (offshore oil and gas platforms) such as plastic drill pipes, hard hats, gloves and storage drums;
- contents lost from containers that spill or are lost overboard from cargo ships and other vessels;
- ship-sourced, solid, non-biodegradable floating materials disposed of at sea, such as fibreglass and insulation.[4]

A 1996 review by the Australian and New Zealand Environment and Conservation Council (ANZECC) noted that although a large number of surveys have been conducted around Australia, the major sources of marine debris in the environment were not clear, and that substantial discrepancies existed between the findings of most surveys. The composition of debris varied greatly around the Australian coastline and generally reflected proximity to land-based sources (cities, other population centres, beaches with access, catchments) or to maritime activities. Fisheries are the most significant source of beach litter on remote coasts, while coastal and offshore shipping are important sources near the approaches to ports and along coasts and islands in heavily trafficked areas.[5] Surveys of materials swept onto Australia's sub-Antarctic islands conclude that the amount of material is directly proportionate to the level of commercial fishing in the area, although the mix of materials included domestic items such as shoes and bags.[6]

Analysis of material trawled in the North Pacific Ocean gyre concluded that 80% of mid-ocean debris had originally been discarded on land[7] and predominantly comprised the materials from plastic bags, bottle caps, water bottles and styrofoam.[8] Surveys show that plastic typically comprises 60–80% of marine debris, and up to 95% in some places.[9] However, other items can be particularly problematic in some areas because of local winds, currents and topography. For example, derelict fishing nets are a common concern in the Gulf of Carpentaria.

Quantity and distribution of marine debris

Data on the spatial distribution and quantity of marine debris is often patchy and inconsistent. Plastic litter in the marine environment is quite mobile and will not be confined to the area in which it was lost or discarded. Studies of lost cargo have shown litter can travel thousands of kilometres around the world's oceans. For example, 20 shipping containers of plastic ducks were lost overboard in 1992 from a ship travelling in the north Pacific from China to Seattle; by 1994 some had been tracked to Alaska; others reached Iceland in 2000. The ducks have been sighted in the Arctic, Pacific and Atlantic Oceans.[10]

Around 95% of the nets collected in the Gulf of Carpentaria by the Ghost Nets Program can be identified as types not used by Australian fishermen, suggesting that the nets were discarded outside Australian waters and brought into the Gulf by currents.[11]

In 2005, the United Nations Environment Program estimated that about 5.8 million tonnes of marine litter are disposed of in the oceans and seas each year. Of the estimated 8 million items that end up in oceans and seas every day, approximately 5 million are thrown overboard or lost from ships. Furthermore, it has been estimated that between 13 000[12] and 50 000[13] pieces of plastic are floating on every square kilometre of ocean surface today. Trawling in the North Pacific Ocean gyre in 1999 revealed an area where 334 271 pieces of plastic (5.1kg) per square kilometre were recorded.[14] The ratio of plastic to plankton there was shown to be 6:1 (by weight) in 1999, and the preliminary observation from the 2008 survey program is that the ratio is now significantly higher.[15]

The 1996 ANZECC review estimated that of debris generated by marine activities and vessels across Australian waters each year

- around 13 800 tonnes of waste were generated aboard ships
- around 2 400 tonnes of fishing gear were lost or discarded, and
- that as only around 9 800 tonnes of debris are collected when ships dock, up to 6 500 tonnes of waste per year are lost or discarded overboard.[16]

Beach surveys provide much of the information available about marine debris, although there are some inherent biases such as the differential removal of litter items by beachcombing, cleanups and beach dynamics.[17] Results can be influenced by whether the survey is annual (where litter will be collected to prevent double counting) or occasional (where litter may have accumulated over a number of years). The Keep Australia Beautiful 2008–09 National Litter Index Annual Report surveyed 104 beach sites in Australia. The sites revealed an average of 73 items, or 4.57 litres of litter/1000m^2. The litter source (marine or land deposition) was not differentiated.* The National Litter Index surveys have shown a seasonal correlation for beach litter since 2005, with generally higher counts in November compared to the counts in May, but the result for May 2009 did not follow this trend, rising above the previous November count. Nonetheless, the surveys since 2005 show a national decline in the volume of beach litter, down from 7.97L/1 000m^2 in 2005–06, although the trends differ in each state and territory.[18]

While plastic typically constitutes approximately 10% of land-based waste, it represents a much greater proportion of the debris accumulating on shorelines.[19] The 2008–09 National Litter Index survey showed plastic comprised around 28% by number and 32% by volume of litter items found on beaches, although there were wide seasonal and geographic variations.[20] In the first survey in 2005–06, plastic comprised 31% by number and 55% by volume of litter items on the surveyed beaches.[21]

* Sixteen beach sites were surveyed in each larger State and 8 sites in Tasmania and each Territory (lake frontage in ACT). Keep Australia Beautiful National Association, *National Litter Index Annual Report 2008/2009*, July 2009.

Other surveys suggest comparatively high concentrations of debris on parts of the coastline, including coasts adjacent to urban centres and remote areas of northwestern Cape York, Groote Eylandt, northeast Arnhem Land, the far north Great Barrier Reef, parts of South Australia including Anxious Bay, parts of Western Australia, southwest Tasmania, and Australia's sub-Antarctic Islands. Up to 400 kilograms of debris per kilometre have been found along remote parts of the northern Australian coast.[22]

Effects

Marine debris is a significant threat to marine and coastal wildlife and can be detrimental to human economic activity and enjoyment of the environment. Wildlife, marine and shore-based, is affected in multiple ways:

- Entanglement occurs when animals feed on organisms attached to or associated with marine debris, they swim into debris floating at sea, or become caught in beach debris. Entanglement can lead to strangulation, infection of bodies, flippers or flukes, restricted mobility, protracted amputation of limbs, and death through drowning, starvation or smothering.[23]
- Ingestion occurs when marine wildlife confuses debris with prey species, or when prey species are attached to or associated with debris. Ingested debris may result in starvation, blockage of the digestive tract, impairment of nutrition by displacement of food or false satiety, internal wounds or ulceration, buoyancy (which inhibits the ability to dive), and absorption of heavy metals or toxins.
- Destruction of fragile habitats (e.g. coral reefs) and littering of beach-based breeding grounds (e.g. turtle nesting sites).
- The accumulation of plastic debris on the sea floor can inhibit the gas exchange between the overlying waters and the pore waters of the sediments, and the resulting hypoxia or anoxia in the benthos can interfere with the normal ecosystem functioning, and alter the make-up of life on the sea floor.[24]
- Human-made marine debris provides a vector or transport mechanism for non-native and potentially invasive species.[25]

In 1997 it was shown that at least 267 species, including 86% of all sea turtle species, 44% of all seabird species, and 43% of all marine mammal species, are affected by marine debris.[26] This is likely to be an underestimation, as most victims are likely to go undiscovered over vast ocean areas, as they either sink or are eaten by predators. The study also did not consider invertebrates affected by microplastics.

Available information suggests that at least 77 species of marine wildlife found in Australian waters have been impacted by entanglement in, or ingestion of, plastic debris during the period 1974–2008. A 2009 study for DEWHA[27] found that the affected species included:

- 6 species of marine turtle
- 12 species of cetaceans
- at least 34 species of seabirds
- dugongs
- 6 species of pinnipeds
- at least 10 species of sharks and rays, and
- at least 8 other species groups—fish, crabs, crocodile and snakes.

Turtles and humpback whales dominate the existing entanglement and ingestion records, with pelicans and cormorants also frequently reported.

Figure 3.17: A crocodile, belly up, caught in marine debris (a net) at Cape Yorke.

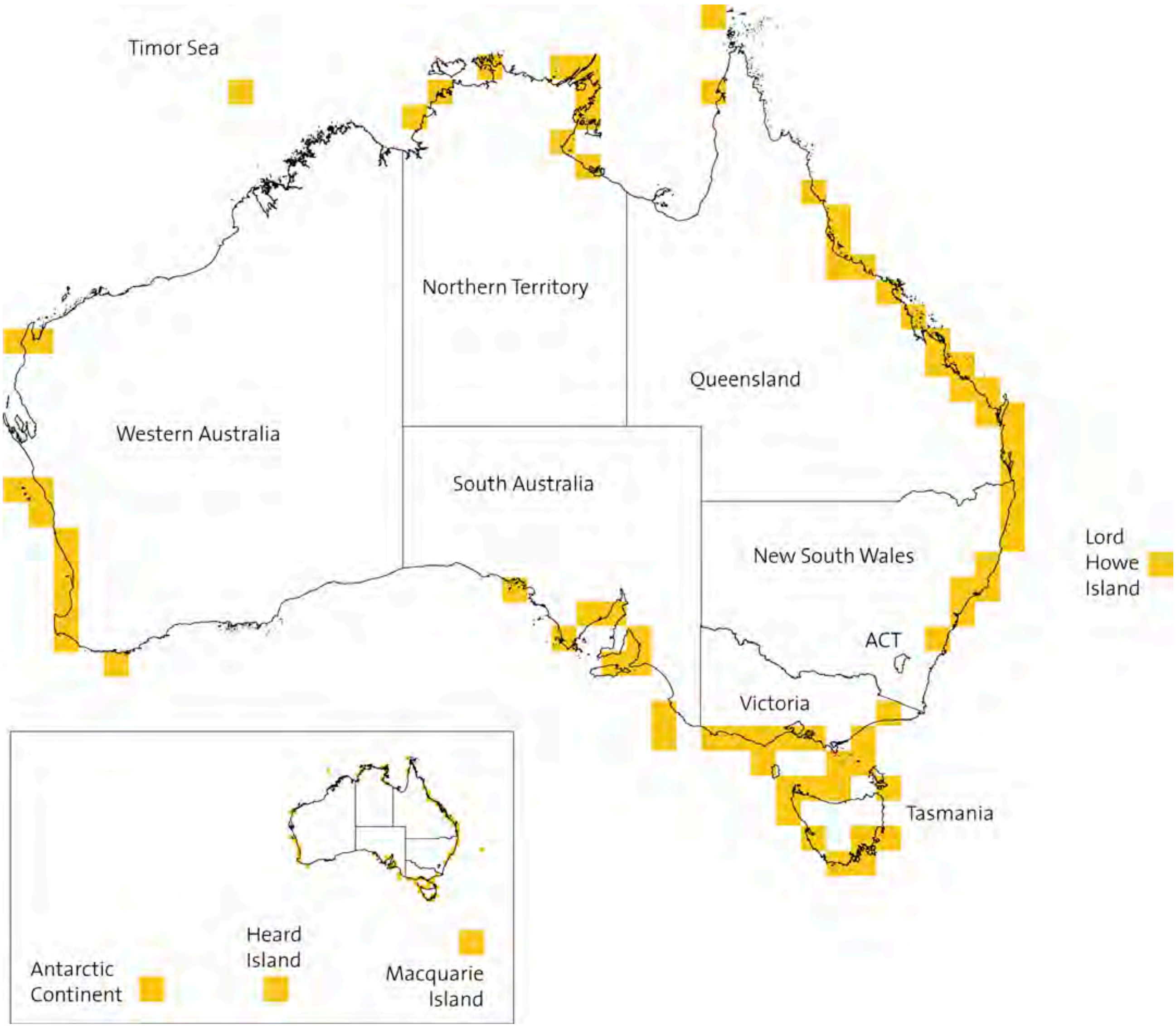
Photo courtesy of the Carpentaria Ghost Nets Programme, photographed by Jacky Castellain.

The *Impacts of Marine Debris on Australian Wildlife* study noted that it is likely that available data represent a significant under-estimate of the interactions of marine wildlife with plastic debris, as a large proportion of the injured or dead wildlife may never be observed or recorded, especially in remote or offshore islands.[28] **Figure 3.18** illustrates the distribution of known records (between 1974 and 2008) of interactions between plastic debris and marine wildlife in Australian waters.

It is clear from the literature on marine debris that human activity is also affected.

- Marine debris is a navigation hazard. Entanglement of ropes, netting or wire with propellers, rudders or engine intakes can cause significant damage and is costly and time-consuming to repair. This is a particular problem for commercial shipping and fishing vessels.
- Commercial fisheries resources can be diminished by habitat destruction and ghost fishing.
- Intakes of sea water, such as for desalination plants and cooling water for power stations, can be plugged by debris.

Figure 3.18: Distribution of known records (between 1974 and 2008) of interactions between plastic debris and marine wildlife in Australian waters.



Source: C&R Consulting, *Impacts of Marine Debris on Australian Marine Wildlife: Final Report*, Report prepared for the Department of the Environment, Water, Heritage and the Arts, June 2009, Figure 1.

- The amenity of beaches and estuaries and the associated tourism, recreational fishing and other activities, are affected by debris brought in by the sea. Debris can be a threat to public health and the cleanup costs can be considerable.

Australia's approach to preventing and managing marine debris

Australia is a party to several international conventions and regional agreements that refer to marine waste including the London Convention, the International Convention for the Prevention of Pollution from Ships, 1973 as amended by the Protocol of 1978 relating to it (MARPOL), and the United Nations Convention on the Law of the Sea (UNCLOS) Part XII—Protection and preservation of the marine environment

At the national level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Environment Protection (Sea Dumping) Act 1981* are the primary pieces of legislation that relate to the management of waste in our marine environments.

Threat Abatement Plan (TAP) for the impacts of marine debris on vertebrate life

The EPBC Act provides for the development of Threat Abatement Plans (TAPs) for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities. A TAP for the impacts of marine debris on vertebrate marine life is in place and provides a co-ordinated national approach preventing and mitigating the impacts of marine debris on vertebrate life. It identifies a range of actions that aim to:

- contribute to the long-term diminution of harmful marine debris
- remove existing harmful marine debris from the marine environment
- mitigate the impacts of harmful marine debris on marine species and ecological communities, and
- monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.

The TAP is available at <http://www.environment.gov.au/biodiversity/threatened/publications/tap/pubs /marine-debris-threat-abatement-plan.pdf>. Implementation of actions is to commence within two years, with responsibility shared between Commonwealth and state and territory governments.

Other activities

State and territory governments also play a part in preventing and managing land-based sources of debris in their respective jurisdictions. This is done chiefly through legislation governing waste management, pollution, environment protection and litter. In addition, New South Wales has listed 'entanglement in or ingestion of anthropogenic debris in marine and estuarine environments' under its *Threatened Species Conservation Act 1995*, and Victoria has listed 'the discharge of human-generated marine debris into Victorian marine or estuarine waters' under its *Flora and Fauna Guarantee Act 1988*. This listing identifies a suite of pelagic and inshore fauna (notably birds and mammals) that are negatively impacted by marine debris.[29]

The Australian Maritime Safety Authority is working with the States and Territories to improve the level of consistency of implementation of the MARPOL convention.

Several government and non-government organisations collect data on marine wildlife interactions with marine debris, either as part of marine debris surveys or other research activities, or as part of their role in wildlife rescue and rehabilitation. The *Impacts of Marine Debris on Australian Wildlife* report noted that data is held by at least 38 organisations or individuals throughout Australia. However, data is inconsistent and there is variation in the detail of the records and geographic coverage. A number of actions under the TAP aim to address this, including through development of nationally consistent data collection protocols and survey methods and national approaches to mapping of the spatial distribution and concentration of marine debris over time.[30]

The Australian Government is also funding a number of activities that progress the actions of the Threat Abatement Plan, including research by CSIRO into plastic degradation, and various on-ground projects. A number of Indigenous groups are undertaking wildlife surveys and rescue activities, as well as threat abatement work to clear coastal waters and beaches of nets and other debris. The Carpentaria Ghost Nets program is a well known example, but there are similar projects in Western Australian and Queensland communities.

There are also numerous coastal community groups and organisations that conduct education and awareness raising activities, beach clean-ups and litter surveys, or implement and maintain litter abatement infrastructure and strategies.

Figure 3.19: An olive ridley turtle entangled in a net.

Photo courtesy of GBRMPA.

Conclusion

Marine debris causes negative ecological, economic and social impacts. Increasing in quantity and spreading around the world, it is a major threat for wildlife, damages ecosystems, and impacts on human economic production and enjoyment of the natural environment. At least 77 species of wildlife in Australian waters and coastal areas have been affected by entanglement in, or ingestion of, plastic debris between 1974 and 2008.

For those reasons, as well as because Australia is party to several international conventions and regional agreements covering marine waste, all levels of government work to prevent and manage land-based sources of debris, chiefly through legislation governing waste management, pollution, environment protection and litter. Community groups and organisations conduct education and awareness raising activities, beach clean-ups and litter surveys, as well as carrying out litter abatement activities.

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Chapter 4
How Australians manage waste

This chapter describes the way Australians manage waste, and covers:

- a short history of waste management
- community values and behaviours in relation to waste reduction, and the role of education
- the size and growth of the waste and recycling services industry, how it generates employment, and potential economic benefits of resource recovery
- policies and legislation to manage waste
- approaches to avoiding waste
- waste management in regional and remote areas, and
- current waste infrastructure, future needs, and developments in technology.

CHAPTER 4.1
HISTORY OF WASTE MANAGEMENT AND RESOURCE RECOVERY IN AUSTRALIA

This chapter provides a brief overview of the history of waste management and resource recovery in Australia.

Colonial era

In the early years of European settlement, the small number of colonists and the scarcity of new items meant that there was very little waste and considerable recycling. The settlers re-used and repaired clothing, tools and household products, while putrescible wastes were fed to livestock, buried or thrown into waterways. As the population grew so did the problems associated with waste. By the 1820s, the Tank Stream on which Sydney had depended, had become so polluted that it could not be used for domestic water.[1] In Victoria, Batman's Swamp—a lake with clear water and abundant wildlife—became "a receptacle for the industrial and household waste of expanding Melbourne" and by the 1860s was foul-smelling and dangerous.[2]

Re-use and repair of products and materials were practised throughout the 1800s in the Australian colonies, often by necessity due to distances from markets for replacement products. Many everyday products, such as clothing and furniture, were repaired or re-made over time to ensure that they lasted.

Most household waste was putrescible and was largely dealt with on-site. An archaeological investigation of the slums in Little Lonsdale Street, Melbourne, which dated from the 1850s, found the remains of cess pits* and rubbish pits. Finds included organic wastes, clothing, shoes, coins, broken pottery and bottles.[3]

In many cities and towns, household waste that could not be disposed of on-site was taken to small landfills on the urban fringe. Australia's first site for dumping communal wastes was in Sydney at what is now known as Moore Park. While the *Sydney Corporation Act 1850* provided for the systematic and regular removal of garbage, waste was allowed to build up in backyards and was often thrown into the street.[4]

The nineteenth century saw significant public debate about waste, including the risks to public health of unmanaged wastes. The population, 5000 in 1800, had grown to 3.7 million by 1900.[†5] Odour and disease were becoming a major concern in the cities. While germs were not well understood in the nineteenth century, medical authorities believed that the 'bad air' (miasma) emanating from rotting garbage and overflowing cess pits was causing disease.[6] In 1858, a petition from butchers had been received by the NSW Parliament, "praying for the completion of the abattoirs at Glebe Island"[7] but in 1873 a community petition was presented advocating the closure and relocation of the Glebe Island Abattoir, which in the intervening years had become the subject of public health concerns, focusing on waste issues (including odour).[8]

A range of regulatory reforms was introduced in the late nineteenth century, which in NSW for example empowered local councils to deal with garbage collection and disposal. Each council employed an 'Inspector of Nuisances' to deal with problems of waste disposal. In his work diary for July 1895, Mosman's inspector noted that the majority of Mosman's drains were in a "state of filth", clogged up with soapsuds, fat, tea leaves, potatoes, rice and "other things".[9]

The *Public Health Act 1896* gave the NSW Board of Health the power to force all local councils to take action to protect public health, and 'Inspectors of Nuisances' were renamed 'Inspectors of Sanitation'. While some councils complained about the legislation, they changed their view in 1900 following the outbreak of bubonic plague spread by rats coming from the waterfront to the Rocks and other inner-city suburbs, which prompted the government to instigate a major cleansing

* The term 'cess pit' is sometimes used to refer to a hole in the ground to dispose of rubbish, but in an Australian context is normally used to describe a sewage pit.

† These figures do not include the Aboriginal population. Census records did not account for Aboriginal people until the 1900s, and then the census was not comprehensive.

program. Residents became involved in disinfecting, burning or demolishing homes in the area, and the wharfs and docks were cleared of silt and sewage.[10] Manly municipality responded by establishing a garbage tip at Curl Curl (now Manly) Lagoon. This tip represented best practice at the time, because garbage was buried in trenches and covered. By the late nineteenth century, garbage collection was considered a "necessity of urban life",[11] although landfill management was not to modern standards, resulting in long term environmental damage.[12]

Figure 4.1: A rubbish tip in the Rocks in the early 1900s, when parts of Sydney were cleared and disinfected in response to the bubonic plague.

Photo source: State Records NSW.[13]

Elsewhere in Sydney, a common practice was to take garbage out to sea for dumping. The City of Sydney and other councils in built-up areas began barging waste out to sea in 1891 when burning in the Moore Park tip became unacceptable and there was little vacant land available to dump rubbish. This continued for several decades, despite the fact that household waste, dead animals and offal washed ashore.[14]

Litter also began to emerge as a problem in some areas during this period. Manly and Mosman, for example, were popular destinations for day visits in the 1880s and 1890s. Manly's Inspector of Nuisances noted that he had put up notices to try to combat "refuse being thrown on the ground" in parks, had installed bins for rubbish and sometimes spent most of the day cautioning people about litter.[15]

In Melbourne, household waste water, horse manure, sewage from overflowing cess pits and blood and offal from abattoirs flowed through open drains into natural water courses.

A history of the Melbourne Board of Works notes:

> Melbourne stood ankle deep in its own wastes. It had done so for many years, but by the end of the 1880s, tolerance gave way to a growing repugnance and a desire for something better. The metropolis was on the nose ... To the obvious stinks from noxious industries, open sewers and manure depots was added 'less perceptible but constantly present ... emanations from the thousands of pans' ... Homes went up on former swamps and holes filled with garbage and sewage sludge [were] barely covered with clean soil.[16]

A typhoid epidemic in the late 1880s resulted in the Victorian Government building an underground sewerage system to clean up the city.

The modern recycling industry had its origins in the nineteenth century. Rag and bone collectors took household wastes to factories for conversion into products, and used wholesalers, peddlers and store keepers as waste middlemen. Rags were sold to paper mills, and bones were used to manufacture products as diverse as buttons, fertiliser, soap, glue, sizing and gelatine. Australian Paper Manufacturers (now Amcor) built the first paper mill in Melbourne in 1868, and was the first company to start collecting waste paper with a horse and cart.[17] A paper mill was also built in the same year in Liverpool, NSW. Both mills used rags, straw and waste paper as their raw materials.[18]

Twentieth century waste and recycling

A critical factor throughout the twentieth century was major and rapid advances in knowledge which alerted people to the health and other risks of poor waste practices. Waste management practices improved in the early part of the century partly in response to public health concerns and following the introduction of legislation giving local councils responsibility for garbage collection and disposal.

In NSW, the *Local Government Act 1906* gave the state government more control over local government and compelled councils to provide better services such as the management of parks and reserves, the supply of water, and the collection and disposal of 'nightsoil' (sewage) and garbage.[19]

Most waste was deposited in local 'tips', which were often located in old quarries, sand pits, gullies or wetlands. In Sydney, low-lying areas along the coast were considered ideal for tipping waste because this allowed the land to be 'reclaimed' for another use. Once filled, the sites were often used for parks and sporting fields because the long term degradation of putrescible wastes made them too unstable for building. The disposal of waste in built-up areas or along beaches generated odour and was often unpopular with local residents. A report on disposal of household garbage illustrates the poor standard of waste management in the 1920s:

> Of all the recent exhibitions of lost ideals in civic control, that at Balmoral beach is the worst. The tip is at the busiest part of the beach frontage and is surrounded by refreshment rooms ... the stench from rotten garbage was so bad that it was impossible to get as far as the gateway without a gas mask ... For a long time the council has employed two men to spread the garbage over the beach to fill up the holes. This could have been levelled with clean sand but that would have meant finding another place to dispose of the contents of garbage tins ... The public demands that the beaches shall not be used as garbage tips, nor shall open tips be authorised in residential areas.[20]

The 'sanitary landfill' method (covering waste on a daily basis, preferably with compaction) was promoted by the NSW government but often not used, either because of a lack of fill material or a lack of equipment for compaction. By the 1960s many of the landfill sites around Sydney were considered to be an 'environmental disaster', with leachate and liquid wastes seeping out of old tipping sites into natural waterways.[21]

In Perth, local government landfill sites were operated along the Swan River until at least the 1960s, and as was customary at the time, neither lined to prevent leakage nor regulated to control what was dumped in them. Chemicals leached into groundwater and then the river, and recently appear to have affected river dolphins.[22]

As well as landfill, incineration was a common disposal technique in the early twentieth century. While this reduced the amount of material going to landfill, there was public concern about the siting of incinerators and the impacts on urban air quality. By the 1930s there was public resistance to any new incinerators being built because of the air pollution they caused.[23] One solution was the new 'reverberatory' incinerator, which was invented by Australian John Boadle (then Sanitary Engineer for Melbourne City Council) in 1926. The technology was marketed by the Reverberatory Incinerator and Engineering Company (REICo), which became the most successful municipal incinerator company in Australia.[24] The reverberator was more efficient and less polluting than previous incinerators, and the heat from the furnaces was often used to heat water to create steam for a bitumen boiler or to sterilise household sanitary pans.

As a result of opposition to the siting of a municipal waste incinerator in Moonee Ponds, Melbourne, the City of Essendon made the design of a suitable building a mandatory requirement of the contract, which was awarded to REICo. The company engaged Walter Burley Griffin to design a building of architectural merit and in keeping with the residential area, and the incinerator was built in 1930.

With Eric Nicholls, Burley Griffin designed another 12 incinerators in Australia.[25] One of these, in Glebe NSW, significantly improved waste management in the area when it was built in 1933:

> Prior to building the incinerator, Glebe Council used to load garbage onto barges at the council depot in Forsyth Street, tow it 10 kilometres out to sea and dump it: this resulted in beaches being polluted by refuse carried in by the currents. Griffin and Nicholls promoted their incinerators as hygienic, efficient and aesthetically pleasing.[26]

Figure 4.2: The Burley Griffin and Nicholls incinerator at Glebe, NSW.

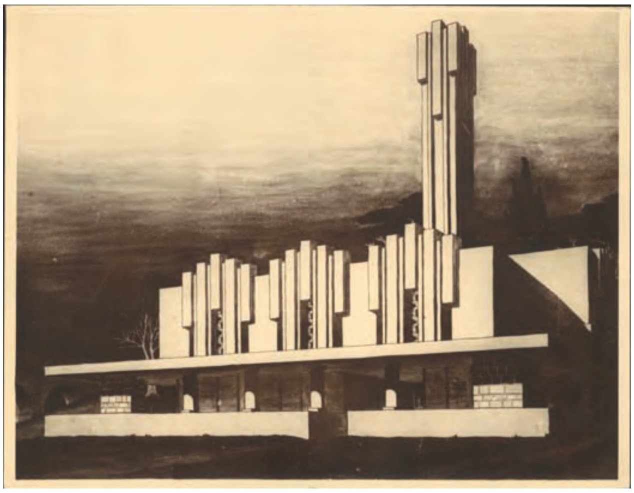

Photo source: Eric Milton Nicholls Collection [picture] 1930–1939, Glebe Incinerator, PIC/9929/976 LOC Album 1092/6. Original copy owned by the National Library of Australia.

Incineration was phased out as a major disposal technique by the 1970s as it was regarded as too polluting and expensive. The City of Adelaide disposed of its garbage by incineration until 1955, when unsatisfactory air pollution and increasing amounts of garbage stopped the practice. After the incinerator closed the council disposed of its solid waste in a sanitary landfill at Wingfield.[27] One of the last incinerators to be built was the Waverley-Woollahra incinerator at Waterloo in Sydney, which opened in 1973. While a new wave of incinerators was being built in Europe and the US, landfill was regarded as a cheaper option in Australia.[28] The Waterloo incinerator closed in 1997 after the NSW Environment Protection Agency (EPA) revoked its licence. This followed many years of opposition from neighbours and environmental groups and an investigation by the EPA which found it was breaching international air emissions standards.[29]

Backyard incinerators were also widely used to dispose of household waste. These were inefficient and were a common source of sooty particulates, and as a result their use was being phased out in most cities by the 1970s. In Sydney this was a slow process, with many councils choosing to limit rather than ban the use of incinerators. In the early 1980s the NSW State Pollution Control Commission reported that backyard burning, including incinerators and open burning, accounted for 35–40% of photochemical smog. However, a total ban on domestic open burning was not introduced until 1990.[30]

Recycling

Some recycling of paper and packaging had been underway since the late nineteenth century, driven by commercial businesses looking for raw materials rather than by environmental concerns. Early waste paper collections from Melbourne households commenced in the 1920s, but became more common for Australian homes in the 1940s (mainly for newspaper, which was re-used or recycled into packaging material).[31] Businesses could make money from recycling paper, as an extract from a 1917 Adelaide newspaper reveals:

> A POST-OFFICE ECONOMY
> Melbourne February 20
> The Postmaster-General (Mr Webster) reports that as a result of his decision to sell the waste paper that accumulates in post-offices, instead of paying to have it burnt, a total saving will be made of £500, including £49 in South Australia.[32]

Glass beverage bottles were all refillable until the 1960s. Empty bottles were collected by waste contractors and independent ‘bottle merchants’ and sold back to beverage manufacturers. Some manufacturers charged a deposit which was then repaid to consumers when they returned their empty bottles.

Tin cans were a common form of packaging but there was no systematic recycling program and they were not suited to disposal through incineration. Large numbers of tin cans passed through the Manly incinerator largely intact and accumulated on-site. In 1936, the Timbarra Holding Co paid £5 a year to salvage cans from the incinerator’s tipping area.[33]

Waste became a bigger public issue in the second half of the twentieth century, with increasing quantities of waste being generated and more concern about the environmental impacts of incineration and landfill. Litter also emerged as a significant environmental and social issue. Consumption was increasing as a result of population growth, rising income levels and demographic changes. Supermarkets, which used more packaging, were replacing small retail stores. Single-use containers made from glass, plastics and liquid paperboard also began to replace refillable bottles for most beverages.

The litter problem and increasing quantities of used packaging being disposed to landfill in the 1960s and 1970s led to an increased focus on recycling as a waste reduction strategy. Cardboard, glass and aluminium were also in demand as raw materials for the manufacture of new packaging. Australian Consolidated Industries (ACI) and Australian Glass Manufacturers began setting up drop-off centres for glass bottles in 1967 and later supported house-to-house collections.[34] Comalco began its aluminium can recycling program around 1971 and Alcoa in 1977, and by the late 1980s both companies were involved in promotional programs and house-to-house collections.

Recycling programs for steel and plastic packaging were established later in response to government and consumer concerns about the environmental impacts of packaging. Brickwood Holdings, the largest manufacturer of high density polyethylene (HDPE) milk bottles, built a re-processing facility in Melbourne in 1990 as a joint venture with its polymer supplier, Kemcor. ACI Plastics Packaging established a pilot recycling plant for polyethylene terephthalate (PET) in Sydney in 1988 and a commercial plant in Wodonga in 1991. The other major supplier of PET, Smorgon Plastics, built the first mixed plastics recycling plant in Melbourne in 1989. The largest manufacturer of polyvinyl chloride (PVC) resin, ICI Australia, established a PVC recycling program in 1990. Kerbside collection and recycling of steel cans from households was also established by BHP and steel can manufacturers during the 1990s.

During this period local councils in all of the capital cities and many regional centres introduced kerbside collection services for mixed packaging and paper. Woven sacks were gradually replaced by plastic crates, and later by mobile garbage bins. Baulkham Hills Council in Sydney introduced the state's first 'wheelie' bin recycling service—a fortnightly 240 litre bin taken to Cleanaway's new Materials Recovery Facility.[35]

Recycling had shifted from an ad hoc and industry-run activity, mainly for aluminium cans and glass bottles, to an essential service provided by local government and paid for by ratepayers. Local or export markets were available for most commonly used packaging materials and paper, although the value of materials fluctuated in line with movements in commodity prices. The increasing exposure of local governments to financial risks associated with recycling prompted debates about who should be responsible for the costs of recovery, i.e. ratepayers (through local government) or packaging companies and brand owners.

South Australia introduced Container Deposit Legislation (CDL) in 1975 in response to concerns about litter and other environmental impacts of single-use packaging, and remains the only jurisdiction with deposit legislation in place. While other states and territories have investigated the feasibility of introducing their own schemes, most have opted for voluntary agreements based on a 'shared responsibility' approach. The earliest shared responsibility agreements were between state government agencies and the beverage industry. These agreements have provided funding for litter reduction campaigns since the late 1970s. The NSW government launched the 'Do the Right Thing' campaign in Sydney in 1978 with funding from the beverage industry. The campaign was later extended to other jurisdictions.

At a national level, the Australian New Zealand Environment and Conservation Council (ANZECC) developed the *National Waste Minimisation and Recycling Strategy 1992*. This called for a 50% reduction in total waste and a 50% reduction in the quantity of domestic waste going to landfill by the year 2000, based on 1990 levels. The *National Kerbside Recycling Strategy 1992* contained a number of waste minimisation and recycling targets for packaging materials to complement the national 50% waste reduction targets. Voluntary agreements between ANZECC and packaging industry associations to achieve these targets were eventually replaced by the National Packaging Covenant (1999–2005). The Covenant was later extended for 5 years (2005–2010).

With kerbside recycling programs for packaging well established, many local councils shifted their focus to the organic component of the household waste stream. In 1993 Concord Council in Sydney introduced a weekly garden organics collection, initially providing residents with a re-usable sack. Over time other councils across Australia followed suit, with many shifting to a standard 240 litre mobile bin for garden organics or mixed (garden and food) organics. Landfills and transfer stations were also being transformed into 'resource recovery centres' which provided drop-off facilities for a wide range of recyclable materials such as garden organics, timber, concrete, batteries, gas bottles, tyres and whitegoods.

During the 1980s and 1990s small, local landfills were replaced by larger, regional facilities. These were required to meet much higher standards for environmental management, including measures for the management of leachate and landfill gases (carbon dioxide and methane). Newer landfills are now lined; earthmoving equipment is used to cover and compact the waste each day; and there are guidelines for rehabilitation after closure. New technologies for the management of solid waste are gradually being introduced, including bioreactor landfills and anaerobic digesters (see **Chapters 3.4** and **4.7**).

Conclusion

Management of waste since European settlement has been subject to many factors, the most significant being increasing awareness of the impacts of poor waste practices on public health and amenity. This awareness was largely informed by improvements in scientific knowledge.

Greater community and official awareness led to rapid and major change in waste management, particularly in the twentieth century, assisted by new technology developed around the world. A strong challenge for agencies managing waste in recent years has been to keep pace with rapid change in the nature of waste itself, as well as meeting community demands for safer and more sustainable and effective management options.

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CHAPTER 4.2
VALUES, CHOICES AND EDUCATION

Against a background of recent investigations into the waste disposal practices of Australians and their attitudes to recycling and re-use of materials, this chapter examines ways in which values can be fostered and behavioural changes promoted. Overcoming ingrained habits and lack of knowledge is one of the biggest challenges. Examples are given of some innovative ways in which education is contributing to change.

Re-use and recycling

A 2009 ABS survey found that 98% of Australian households had recycled some waste in the previous 12 months, and 86% had re-used waste during that period. In all, 99% of households engaged in some form of re-use or recycling.[1] This rate has remained steady since 2006, having risen from 85% in 1992 and 91% in 1996.[2]

The items most commonly recycled or re-used were paper/cardboard, plastic bottles and glass, all of which are collected through kerbside services available to at least 91% of households. This high level of recycling reflects the widespread availability of kerbside recycling services (up by 4% overall since 2006, with the most dramatic rise being in the Northern Territory, where it increased from 60% in 2006 to 83% in 2009) and the increasing number of materials being collected.[3] It also reflects strong community utilisation of kerbside recycling.

In 2004, a survey by the Victorian Government showed that:

- 85% of respondents agreed with the statement "It's very important the amount of waste going to tips is reduced"
- 81% agreed with the statement "I'm very conscious of the need/importance of recycling", and
- 42% of respondents agreed with the statement "I'm sure we could be doing more to recycle".[4]

The main reasons given in this survey for recycling were "helping the environment" (65%) and "being socially responsible" (26%), although habit (14%) and the availability of kerbside recycling services (14%) were also important.[5]

There was support for extending recycling facilities beyond households to public places and workplaces. According to the Victorian survey, 92% of people would like to see more recycling bins in places like parks and shopping areas.[6] A national survey for Planet Ark found that only 52% of people have access to recycling facilities for plastic, steel/aluminium cans and glass at their workplace, but that 79% of employees would like to see more recycling bins for plastic packaging in the workplace, and 77% would like more paper recycling bins.[7] Another national survey, involving 1122 working Australians in 2009, found that 89% of respondents said it was important to be able to recycle in the workplace in the same way as at home.[8]

The 2009 ABS report noted that 65% of Australian households were re-using or recycling garden waste and 51% were re-using or recycling kitchen or food waste.[9] These rates have remained relatively stable since the survey was initiated in 2000. The most common recovery methods used were kerbside recycling services or re-use at home for compost or mulch (**Table 4.1**).

Table 4.1: Recovery methods for food and garden waste (% of Australian households)[10]

	Garden waste	Kitchen or food waste
Collected from the house	41	11
Took it to a special collection area/point	7	<1
Re-used at home, including as compost or mulch	67	91
Other	1	2

These results are consistent with state surveys: 52% of Victorian households and 60% of NSW households have reported that they compost food or garden waste at home often or sometimes.[11] The NSW survey found that home composting was least common in Sydney and became more common as communities became smaller. In Tasmania, 66% of households recycled or re-used kitchen and food waste compared with the national average of 51%.[12]

One of the main reasons given in the ABS survey for not re-using or recycling particular products was the lack of a service or facility, as illustrated in **Table 4.2**. Another contributing factor may be the public's lack of certainty about which materials can be recycled. The Victorian survey found that some respondents were unclear about whether materials such as broken glass, ceramics, ice cream containers, steel cans and plastic bottles could be recycled.[13]

Packaging choices

A survey of shoppers in 2004 for the National Packaging Covenant found that only 3% considered the environmental aspects of packaging when choosing products.[14] On the other hand, recent surveys in Victoria and NSW showed that most shoppers often or sometimes avoided the use of plastic bags, or avoided products with lots of packaging (see **Table 4.3**).

Campaigns by government agencies, environment groups and retailers have been very effective in reducing consumption of single-use bags and increasing the use of durable alternatives, such as the 'green bag'.[15] The willingness of consumers to switch to durable alternatives is strongly influenced by the price of single-use bags. Stores that charge for plastic bags have a higher percentage of

Table 4.2: Reasons given for not re-using or recycling (% of Australian households that report not re-using or recycling each material*)[16]

Material	Does not use any / enough materials to warrant recycling	No service / facilities available	Not interested / too much effort	Other
Paper/cardboard/newspapers	28	55	18	4
Glass	46	38	13	5
Aluminium cans	75	18	6	3
Steel cans	68	22	8	4
Plastic bottles	37	48	15	4
Plastic bags	63	22	11	7
Kitchen or food waste	52	25	18	9
Garden waste	75	13	9	5
Electronic equipment	90	4	2	5
Motor oil	88	5	2	6
Total	**95**	**25**	**14**	**13**

* Numbers do not add to 100% because respondents could give more than one reason.

Table 4.3: Survey of shopping attitudes, Victoria and NSW[17]

	Victoria (2008)	NSW (2006)
Avoided using plastic bags to carry shopping home—often or sometimes	76%	71%
Avoided buying products with lots of packaging when doing the shopping—often or sometimes	53%	66%

transactions involving re-usable bags or no bags (73%) than those that give the bags away.[18] Since its entry into Australia in 2001, ALDI has not provided free plastic bags to customers, therefore many bring their own bags or purchase re-usable bags. ALDI estimates that in a single year this prevents the disposal of 150 million disposable plastic bags.[19]

Qualitative research in South Australia identified a high level of awareness of the environmental impacts of plastic bags and strong support for a reduction in plastic bag use. This research found that the main barriers to change were practical ones, such as the difficulty of remembering to take re-usable bags when shopping, and finding alternatives to using plastic shopping bags as bin liners.[20]

A national survey of retail carry bag use in 2006 and 2007 showed that the number of single-use plastic shopping bags issued in Australia fell from 5.9 billion in 2002 to 3.9 billion in 2007.[21] South Australia fully implemented a ban on single-use plastic shopping bags from May 2009, which is expected to reduce their use by around 400 million bags per annum.[22]

More generally, many Australians consider that consumer items are over-packaged, or packaged in materials that were difficult to recycle or re-use. A 2008 survey for the National Packaging Covenant found that:

- 81% of people claim that they often or always recycle packaging that can be recycled
- 60% of people think that there is not enough emphasis placed on reducing the environmental impact of packaging. Of those who felt the emphasis on environmental packaging was too low, 39% felt this was due to over packaging products, 25% felt that too much plastic was used, 21% felt that a lot of packaging still isn't recyclable, and 15% felt that manufacturers are more concerned about how a package looks than the impact of its packaging materials.[23]

Hazardous waste disposal choices

An ABS survey covering the 12 months to March 2009 showed that most households (82%) disposed of their hazardous waste materials in the usual (non-recycled) garbage collection. **Table 4.4** shows a downward trend in some particular types of hazardous or potentially hazardous items being disposed through normal garbage collection since the previous survey in 2006.

Medicines, drugs or ointments were primarily disposed of in the usual garbage collection (55% of households) while 14% of households poured them down the drain.

Other materials were disposed of mainly through a business, shop or central point other than a waste transfer station, including waste tyres (90%, up from 89% in 2006) and car batteries (56%, up from 50%).

Where households reported that they did not use appropriate hazardous waste disposal services or facilities, 67% said this was because they did not generate enough materials to warrant use of these services or facilities, while 18% had no reason, 6% were not interested at all, and 3% nominated the cost of disposal as a deterrent.[24]

Table 4.4: Proportions of households disposing of hazardous or potentially hazardous waste items through the usual (non-recycled) garbage collection—2006 and 2009[25]

Type of item	2006 (%)	2009 (%)
Household batteries	95	91
Oven cleaners/their containers	90	78
Fluorescent lighting	82	77
Garden chemicals/their containers	71	53

Electronic waste disposal choices

The 2009 ABS survey showed that 22% of households disposed of electronic equipment* by putting it in the municipal kerbside recycling bin, 16% took it to a general or special area at the dump or waste transfer station, and 13% took it to a business, shop or central point. The usual household garbage collection accounted for 23% of disposal and the 'buried/gave away/sold' category accounted for another 25% of disposal.[26]

Consumers' interest in recycling televisions, computers and other electronic goods is reflected in a willingness to pay for them to be recycled. One analysis found that the average household is willing to pay between $18 and $27 per item to achieve a 50% recycling rate, and between $33 and $50 per item to achieve a 90% recycling rate, if those costs were incorporated in the price of the item at the point of sale.[27]

Littering behaviour

Most litter consists of food and drink packaging and cigarette butts.[28] (A more detailed analysis of litter and its effects can be found in **Chapter 3.5** of this report). The most comprehensive behavioural study for littering in Australia is a longitudinal survey undertaken for the beverage industry in 2004. The report noted that littering is a complex problem and that people do not fall into stereotypical categories of 'litterers' and 'non-litterers'. While almost all survey respondents (95%) agreed that litter is a 'very important' issue, 85% admitted that they had littered at some point in their lives.[29]

The main reasons given for littering were that there was no bin or ashtray nearby, or that the respondent was 'too lazy' to dispose of the item correctly.[30] Other reasons were habit, accident, and 'not thinking'.

* In the ABS survey electronic equipment includes mobile phones, TVs, fax machines, scanners, personal computers, servers, monitors, hand-held devices, printers, associated external components such as cable, mouse ,keyboards, stereos and DVD players.

Waste education

There are many diverse programs and activities to encourage waste minimisation and resource recovery. Some of these are in the formal education sector—primary schools, secondary schools, vocational education and training (VET) and universities—while others are run by state government agencies, local councils, companies and community organisations. They use different approaches, ranging from simple communications through to engagement and capacity building.

Local councils and recycling service providers began to employ waste educators in the mid-1990s. Since then educators have also been employed by regional organisations of councils, large businesses, universities and state government agencies. There are continuing efforts to develop models or guidelines for the design and implementation of successful waste education programs, and to share experiences through formal networks such as the Association for Waste and Resource Education (AWARE).[31]

The focus for waste educators was the waste hierarchy, rubbish and litter. This is now shifting to 'learning for sustainability', which focuses on sustainable consumption and the conservation of resources (materials, energy and water), and converting community concerns about issues such as climate change into personal action.[32] Environmental education now promotes 'learning for sustainability':

> Learning *for* sustainability' (also referred to as 'education for sustainability' or 'education for sustainable development') ... attempts to move beyond education *in* and *about* the environment ... to focus on equipping learners with the necessary skills to be able to take positive action to address a range of sustainability issues. ... Learning for sustainability aims to go beyond individual behaviour change or single actions often associated with education for the environment. It seeks to implement systemic change within the community, institutions, government and industry.[†33]

† This approach is promoted nationally through *Living sustainability: the Australian Government's national action plan for education for sustainability* (2009).

Schools

One of the leading programs is Waste Wise Schools ('Waste Wise'), developed in Victoria in the late 1990s by the Gould League and EcoRecycle Victoria. Its aim was to support schools and their communities in reducing waste through changes to curriculum and school operations. It educated teachers on how to integrate practical waste minimisation and recycling practices into the curriculum, and how to effect behavioural change at an individual and whole-of-school level. The program was later licensed to WA, SA and the ACT.

By early 2005 more than 900 Victorian schools and their communities were involved in 'Waste Wise'. Participating schools reported that changes to purchasing, re-use and recycling practices had contributed to reductions in waste to landfill of 25–60%.[34] An evaluation of the program in WA also reveals its value in promoting waste prevention and minimisation behaviours amongst the families of school students and the broader community.[35]

Many schools that participated in 'Waste Wise' extended their programs to address other sustainability issues, such as water, energy and biodiversity.[36] This broader approach was formalised in 2002 through the development of the Australian Sustainable Schools Initiative (AuSSI) as a partnership between the Australian Government and state and territory governments. This program "involves participants in a whole-of-school approach to explore, through real-life learning experiences, improvements in a school's management of resources and facilities including energy, waste, water, biodiversity, landscape design, products and materials" as well as social and financial issues.[37] Two thousand schools are now involved in the program, with some schools reporting waste diversion of up to 80%.[38]

NSW applies the 'whole school' approach to education for sustainability, through Sustainable Schools NSW (SSNSW), which includes waste avoidance and management activities. SSNSW has currently 1100 registered schools and was the pilot state for the development of the Australian Sustainable Schools Initiative. The Environmental Education Policy for Schools requires all NSW Government schools to have a School Environmental Management Plan (SEMP) that links school administration and grounds management with curriculum plans.[39] Areas covered by these plans might include assessing, reducing and monitoring use of resources including, water, energy, products, materials and waste, and using opportunities to avoid and manage waste in the school and grounds as learning experiences. Practical local support to schools is also provided through programs run by the NSW Waste Boards on areas such as green waste, waste audits and recycling.

Wipe Out Waste (WOW) is a South Australian state-wide educational program aimed at encouraging schools to reduce waste and increase learning about waste and resource recovery. The program commenced in September 2006, and by March 2009 more than 470 kindergarten, primary and high school staff had participated in WOW workshops at over 280 sites, covering 23% of schools and kindergartens in the state.

Colleges and universities

Many training institutions, colleges and universities have introduced 'campus greening' programs, which include initiatives such as recycling, energy and water efficiency and green building programs. These are used to reduce the environmental impact of operations and to raise awareness among staff and students about environmental issues. The University of Technology Sydney (UTS), for example, has a comprehensive environmental sustainability program which combines operational measures such as recycling and purchasing with research and teaching programs on sustainability. In June 2000, a waste audit found that at least 60% of their waste could be recycled but they were only recycling about 4%. UTS currently recycles around 80% of all waste generated on site.[40] The Australian National University in Canberra has a well-established waste management system which results in a large proportion of organic materials from its daily activities being transformed into compost and used on the University's grounds. (See **Chapter 4.6** for a fuller account of this system).

TAFE colleges are starting to promote waste minimisation and recycling through government-supported programs. For example, several NSW colleges are involved in the State

Government's Sustainability Advantage program. Colleges in SA are implementing a number of environmental programs under the 'Greening of Government Operations' (GoGo) framework.[41] These are designed to reduce waste generated by the institutions and to encourage individuals to change their behaviour at work and at home.

Case study—Zero Waste SA and TAFE

Regency TAFE is the largest hospitality training facility in the southern hemisphere. Its operations, which include cookery, bakery, butchery and brewing, generate over half of all waste materials from the seven TAFE campuses in northern Adelaide. Zero Waste SA's Resource Efficiency Assistance Program has worked with Regency TAFE to institute a recycling and food waste pilot program. It began in February 2009 and in its initial months reduced waste to landfill by 22% by weight as a monthly average, and captured recyclable and compostable resources. Further work funded by Zero Waste SA is fine-tuning the operation of this system with a view to implementation at other TAFE campuses.

Education for sustainability is being integrated across all TAFE courses in NSW. One of the more innovative programs is run by Petersham TAFE Outreach. This program uses participation in community gardens to teach adults and school students about growing food, composting, re-use and other aspects of sustainable living. Like 'Waste Wise' and AuSSI, the program involves the wider community and is expected to have a 'ripple effect' through its influence on family and community members.[42]

Integration of practical sustainability, including waste minimisation and recycling, into university and college vocational and higher education courses is well underway, with an increasing focus on the need to train students and employees in the skills required for 'green jobs' of the future.[43]

Universities also have an important role in waste management and related research. Zero Waste SA and the University of South Australia have entered into a partnership to form the Zero Waste Centre. The Centre will build expert knowledge in waste-related research, including the following areas:

- behavioural change and the psychology of consumption;
- measuring consumption and the ecological footprint;
- resource efficiency and life-cycle measurement;
- decision making in economic, social and environmental modelling.[44]

Business

Businesses can access support for waste reduction activities through some regional waste management groups and state government programs. For example, a number of regional waste management groups in Victoria have run successful waste reduction seminars and workshops for businesses.[‡] Victoria's Waste Wise Program, which was originally developed by EcoRecycle Victoria (now Sustainability Victoria) and implemented through regional waste management groups, has assisted companies to develop and implement an action plan to reduce waste. Reflecting Sustainability Victoria's broader focus, the Waste Wise Program was replaced in late 2009 with a new program called '5 Star ResourceSmart', an on-line tool to assist companies to measure environmental impacts and implement a resource efficiency program.

Under the NSW Government's Sustainability Advantage program, businesses receive expert assistance to help them develop an action plan and to implement improvements in several areas including resource efficiency (energy, water and materials).

‡ These are documented in *Awareness*, an annual publication of the Association for Waste and Resource Education, at <www.aware.asn.au>.

The Zero Waste SA Industry Resource Efficiency Assistance Program is designed to help businesses take a systematic approach to managing water, energy, waste, climate change, and human and financial resources. Accelerating the uptake of more efficient environmental practice is also the focus of the Business Sustainability Alliance (BSA), a cross-agency South Australian Government initiative. The BSA links business to South Australian Government services providing tools and expertise that can help ensure the long-term, sustainable growth of business. A BSA web portal was launched during 2008–09.

Waste minimisation and recycling are also promoted by some industry associations through broader sustainability programs. The NSW Business Chamber, for example, has released a series of 'Sustainability Toolkits' for offices, manufacturing and hospitality, which cover waste as well as energy, water and transport.[45] These documents provide background information, practical advice and audit tools. Another approach, developed by the Motor Trades Association of South Australia, is 'Ecomapping', which engages staff to map the water, energy, waste, noise, soil contamination and environmental risks of a business.[46] The Master Builders Association of South Australia offers a Green Living training program to equip builders with the necessary tools to adopt sustainable practices in construction.[47]

Community

Community education activities designed to encourage waste minimisation and resource recovery are provided by many different groups, including state, regional and local government organisations, environment groups and businesses. Community education can take a number of forms including information sharing, social marketing,[§] community involvement and capacity building.[48] Sustainability Street mixes these within an approach that aims to bring communities together and foster a culture of ecological sustainability.

§ "The application of commercial marketing technologies to the analysis, planning, execution, and evaluation of programs designed to influence the voluntary behaviour of target audiences in order to improve their personal welfare and that of their society." Aimed at encouraging people to 'purchase', not just products, but ideas and behaviours. Jones, SC, Iverson, DC, Penman, A and Tang, A, 'A practical application of theory: using social marketing theory to develop innovative and comprehensive sun protection campaigns', p. 1, in Faculty of Health & Behavioural Sciences, Papers, University of Wollongong, 2005 at <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1077&context=hbspapers>, accessed 16 December 2009.

Case study—The Sustainability Street Approach to waste reduction

The Sustainability Street Approach (SSA) is a training program that educates and engages community members in sustainable living practices and initiatives. Any local community area such as a street, workplace or school that wants to come together to learn practical ways to achieve sustainability at a local level, can become a Sustainability Street Village. Participants are actively involved not just in learning about sustainability principles and putting them into practice, but also in the ongoing evaluation of outcomes as they occur; the latter is achieved through:

- "Bill data analysis" where all participants are asked to fill out a consent form that allows their household's energy and water data history to be accessed. This provides reliable long-term data on household energy and water consumption.
- The "Mulch-Grow-Harvest-Sow (MGHS)" process which involves community participants actively evaluating the program with their Mentor.
- The "Mentor Harvest and Sow Diary" where Mentors seek individual and group insights as contributions to the "Harvest and Sow Diary" in each community.[49]

Environmental educators Vox Bandicoot are involved with Sustainability Street communities that are now into their third year and which are starting to mentor new groups in their neighbourhoods. There are more than 30 Sustainability Street communities in Victoria and NSW and the program is soon to be piloted in the United Kingdom.[50] Vox Bandicoot founder Frank Ryan, says:

Sustainability Street is like the ecological and social development equivalent of the slow food movement. It is a quiet revolution at a very local level, but it gathers a great deal of momentum and achieves big outcomes.[51]

Figure 4.3: A Sustainability Street working bee.

Photo courtesy of Vox Bandicoot.

Participating households achieved, on average, waste reductions of 15–20% (from an already low base), energy savings of 30–40% and water savings of 25%.[52] Survey results from participating households show increases in waste avoidance behaviour, including

- use of 'bring your own' shopping bags increased by 35%
- households with a compost bin increased by 63%, and
- households with a worm farm increased by 135%.[53]

In addition, participants report that they have gained new friendships and local connections through the creation of local projects such as community gardens.[54]

In NSW, Earth Works is a community-based education program based on adult education and community development principles, which aims to build community knowledge and skills in waste minimisation.[55] The program has tips for living with less waste, and provides training guides which have been adapted to meet the needs of specific participants such as people from non-English speaking backgrounds, schools, workplaces and rural communities. The program was targeted to local councils during its pilot phase, and local government continues to play a primary role in supporting and delivering the program, which has now been adapted to cover broader sustainability issues, and to reflect local priorities.

Many litter reduction and recycling education campaigns involve a one-way flow of information. Litter campaigns have traditionally used messages promoting responsible or ethical behaviour, such as 'Do the Right Thing'.[56] Environment groups such as Planet Ark and Clean Up Australia have also employed strong calls to action, such as 'Say no to plastic bags'.[¶57]

Businesses and consumers can keep abreast of packaging design issues, such as over-packaging or non-recyclability, and learn about the performance of different organisations, through the 'DUMP' (Damaging and Useless Materials in Packaging) and 'KEEP' (Kerbing the Environmental Effects of Packaging) awards, initiated by environmental groups. They release an annual report which rewards companies for packaging designs which are perceived to be particularly sound, and also highlights poor packaging designs. This report is used to promote messages about responsible design and packaging, and helps consumers make sound choices.[**58]

Some campaigns aim to inform and motivate people through collective activities, such as cleaning up a beach or a town (Clean Up Australia and Keep Australia Beautiful are clear examples). Planet Ark provides tips for consumers, retailers and towns interested in being 'plastic bag free'.[59] A campaign for Cohuna (Victoria) to become bag-free was supported by the Central Murray Regional Waste Management Group, the Trader and Progress Associations, retailers and school students. A combination of strategies including written commitment forms signed by retailers, the promotion of alternative bags, community events, signage and certificates of recognition were used during the campaign. Over a period of two years the town was able to eliminate the two million plus bags that would previously have been used in that time.[60]

Community workshops are used by many local councils to build skills in waste reduction and resource recovery. Wollongong City Council (NSW), for example, runs workshops on topics such as composting, worm farming, recycling and green cleaning.

Community-based organisations and schools can collect materials for recycling or re-use. The Zero Waste SA School and Community Grants program targets charities, community groups, service clubs and other not-for-profit organisations involved in the recovery or recycling of re-usable resources. In 2008–09 the program was extended to schools (including metropolitan and regional high schools and kindergartens) taking part in the Zero Waste SA WOW program. All projects help reduce the waste going to landfill by providing infrastructure to support the efficient and safe storage of materials and by encouraging capacity building within the community.

Conclusion

Evidence shows that more Australians have come to value waste reduction, recycling and re-use over recent years, but many people feel that they do not know enough to make informed choices about what they should discard or divert from landfill, how, and where. To help overcome this, there is a case for making waste management processes simpler and easier to access. People also lack information about the implications of their purchasing choices for waste management. Here, education across the full spectrum from formal to on-the-ground and

¶ Clean Up Australia has run an active campaign with funding support from the Australian Government and the Australian Retailers Association, which includes a web site, a 'toolkit' for retailers and an advisory hotline.

** Note the $72m cost estimate covers all clean up tasks including municipal street sweeping that would continue regardless of the presence of litter.

modelling of desirable behaviour has a powerful role to play. Initiatives to raise awareness, increase knowledge, and broaden the capacity of people, businesses, organisations and communities to meet changing community expectations, have been introduced around the nation with notable success. They have involved all levels of formal education, communities, governments, business and not-for-profit organisations. Early figures demonstrate that this educational activity has led to direct benefits as well as flow-ons to the wider community. Monitoring the outcomes of existing and new programs over a longer period will show whether the changes in attitudes and behaviour have become embedded.

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CHAPTER 4.3
WASTE AND RECYCLING IN THE AUSTRALIAN ECONOMY

This chapter describes aspects of waste and recycling, including the size and concentration of the waste and recycling services industry, in the context of the Australian economy. It outlines opportunities for economic benefit arising from the way we manage waste and recycling to improve productivity, support economic growth and grow employment.

Introduction

The waste and recycling services industry in Australia has been valued in the range of $7 to $11.5 billion a year. This was up to 1.2% of total Gross Domestic Product (GDP) in 2006–07. Compared with landfill disposal, recycling can provide gains in employment within the economy, with 9.2 jobs per 10 000 tonnes of waste recycled, compared to 2.8 jobs for landfill disposal.

However, taking a narrow industry or sectoral analysis approach produces an incomplete picture of the actual and potential costs and benefits of waste and recycling across the entire economy. Businesses and organisations in all sectors of the economy have opportunities to produce financial, economic and environmental benefit through enhanced materials efficiency, reduced waste generation, reduced hazard within waste, and profitable use of recovered resources.

Experience in Australia and in other countries such as the United Kingdom has found that significant productivity and profit benefits can flow from better management of waste and materials within the economy, including through more efficient and effective market and government settings. Research conducted by Curtin University has estimated that if total economic benefit from improved efficiency (including materials efficiency), is 1–3% of annual turnover of businesses, then across 35 sectors and 18 000 businesses, the projected total economic opportunity would be $4.5 billion per year.[1] Improved materials use efficiency has the potential to deliver major productivity improvements at the scale of the individual firm and beyond. In turn, enhanced productivity growth can increase national GDP and GDP per person. Using Treasury projections from the 2007 Intergenerational Report, if an improvement in average materials use efficiency across the Australian economy increased productivity growth by 0.25% to 2% per year, this could lead to an increase in the level of real GDP per person of around 10% by 2046–47.[*2]

The waste and recycling services industries

In 2006–07, Australia generated 43 777 000 tonnes of municipal solid waste (MSW), commercial and industrial (C&I) waste, and construction and demolition (C&D) waste. Of that generation, 52% was recycled (22 707 000 tonnes) and 48% (21 069 000 tonnes) was disposed to landfill. Using a common scope, waste generation increased 7% a year between 2002–03 and 2006–07.[†] Waste disposed to landfill has increased over that period, but less so than the rate of increase in total generation. This is due to significant additional recovery and recycling of a range of waste streams and materials across most parts of Australia.

The growth in generation, disposal and resource recovery has led to significant growth in the industry sectors providing waste management and recycling services. A report produced for the

* While this analysis does not take into account the growth impacts (including productivity growth) of the 2008 Global Financial Crisis, the link between productivity growth increases and levels of real GDP per person will hold. It should also be noted that the 2007 Intergenerational Report does not directly address materials efficiency and materials productivity.

† The common scope referred to here excludes WA, NT and Tas from the 2002–03 and 2006–07 years, which still covers 87% of the Australian population. General data available for 2006–07 include non-metro WA, NT and Tas generation data that were not available for the 2002–03 year.

Australian Council of Recyclers (ACOR)[‡] puts the value of the recycling industry's contribution to the economy at $11.5 billion in 2006, which amounted to 1.2% of GDP. That report found the recycling industry employed 10 900 people directly in 2006, which produced indirect employment for a further 27 700 Australian workers.[3]

The Australian Bureau of Statistics (ABS) data for 2006–07[§] indicated that the value of waste collection, treatment and disposal services is around $2.6 billion, with income from sales and services $6.89 billion and employment 27 347. It suggested that this income had increased from 2005–06 by $214 million (9%).[4]

Research by IBISWorld (2009) found that industry revenue for waste disposal services in Australia in 2006–07 was $7.7 billion. This was projected to rise to $8.2 billion for 2008–09.[5] IBIS define waste disposal services to include aspects of resource recovery and recycling.[¶]

While the accuracy of IBISWorld's analysis in relation to waste volumes and their impact on growth for recent years is likely to have been limited by the use of older (pre-2006) data, it does give some insight into growth over time and the distribution of revenue. It estimates that revenue from recycled material has grown by 8% since 2002–03 and it would that there has been steady growth in both employment and revenue from 26 617 in 2004–05 to 33 170 in 2008–09. This may have mirrored growth in demand for waste and resource recovery services as volumes of waste grew by an estimated 35% between 2002–03 and 2006–07,[6] but may also relate to changes in government policies driving greater diversion or treatment of waste. Both of which may have added financial value and higher demand for some of the materials recovered from the waste stream.[**]

Data from the Australian Bureau of Statistics (ABS) suggest that in 2002–03 approximately 1700 organisations were delivering waste management services.[7] This includes companies in the private sector, government business enterprises and some operating entities of local governments. Local governments run approximately 600 of those organisations.[8]

Within the remaining 1100 organisations (a mix of privately-owned and government trading organisations), a small number of companies have a dominant share of the market.

Table 4.5: Market concentration in waste and recycling services industries (excluding local government)[9]

Number of companies	Market share (cumulative %) 2001	2007
Top 5	42	54
Top 10	56	66
Top 50	73	82
Top 200	91	93

According to *The Blue Book*, 54% of the waste and recycling services market is dominated by less than 0.5% of all companies offering services in the sector. The data suggest that the trend towards greater concentration of market share in a few companies is continuing.[10]

While concentration of market share can lead to reduced competition, the greater scale at which larger industry players operate can deliver

‡ The report focuses on business involved in resource recovery and recycling, and includes such major companies as ALCOA and Visy. It includes companies that may not be classified as waste management and recycling services, such as those manufacturing construction products from recycled materials. It excludes some companies involved in waste management, such as those working specifically in the areas of landfill waste disposal.

§ ABS surveys of waste and recycling focus on providers of recycling and waste collection, treatment and disposal services (including some government business enterprises, but not local government entities). The ABS does not provide an independent sectoral or industry profile for recycling as a discrete industry sector.

¶ This report covers collection, transport, treatment, processing and disposal of waste. It also covers collection, transport, treatment of sale of recyclables. Re-processing and re-manufacturing of recyclables are not included, nor are downstream uses of recycled products (such as the application of recovered organics in agriculture). Government entities are excluded, but some government trading organisations are included in the IBIS categorisation of waste disposal services.

** Both of which may have added financial value.

financial, economic and environmental benefit.†† Compared to smaller entities (such as local governments), larger entities are more able to gather the information necessary to make complex waste management and recycling technology and infrastructure choices.[11] This is especially relevant for decisions about capital intensive and complex technologies—such as Alternative Waste Treatment (AWT) facilities—for recovering organics and other recyclables from mixed municipal waste that would otherwise have gone to landfill.

Structure of the waste and recycling services industry and markets

The provision of waste and recycling services varies according to the type, nature and volume of waste. While some organisations provide services across more than one of the MSW, C&I and C&D waste streams, many specialise in one or two of those streams. Other organisations will focus on particular materials within the three streams, such as those processing recovered concrete, or collecting waste office paper. Hazardous wastes may be handled by general service providers (such as a landfill owner with a hazardous waste area on a landfill site), or by specialist firms with particular technology and expertise (such as with the handling of mercury-containing wastes).

Government regulatory frameworks and policies (including licensing) may impact on what waste services are to be provided, how and where, including for the treatment of hazardous wastes (see **Chapter 4.4**). Also, the value of the waste or material, the amount generated, and its concentration in areas or collections, will have a bearing on the structure and composition of the service industries involved. Service provision in regional and remote locations may differ from metropolitan areas. This is discussed in **Chapter 4.6**.

†† More concentrated market share may lessen competition and have adverse impacts on prices charged for the delivery of services, particularly in areas where there are few providers. However safeguards against anti-competitive behaviour exist in the *Trade Practices Act 1974*.

Collection

For MSW in larger population centres, typically a service provider is contracted by local governments (individually or in groups) or state government, to provide kerbside collection of landfill waste, recyclable products and sometimes a separate green waste collection. Local governments themselves may be the service provider.

This segment is dominated by large private and public enterprises, providing collection, treatment, recycling and landfilling services. Small businesses also provide services direct to households.

C&I collection of hazardous wastes is the responsibility of specialist services. Collection arrangements for general landfill waste and recyclables from C&I sites depend on volume and location. A supermarket will have different collection arrangements from those of a small retailer in a large shopping centre.

Many of the large providers for MSW also provide services to C&I clients—though it is less likely that a single collection service provider will offer recovery and landfill options to both clients. This is due to the fragmented nature of the C&I market, which provides fewer large and integrated service contracts than local governments can let in MSW. Profit margins are very tight in C&I collection, with the viability of some collectors being based on their capacity to charge customers for the volume of the bins collected (whether full or not) and pay at landfill only for the actual mass of waste disposed.

C&D collection differs yet again. Some C&D wastes from small-scale demolition or construction work (such as residential homes) may be disposed of via small to medium size skip bins. Some of this waste is also dropped off directly at landfill. Larger demolition jobs are likely to be serviced either directly by a C&D waste processor, or indirectly via a waste collection services provider.

In some cases, the builder must arrange for waste collection, but at other times this is the responsibility of the client. Construction wastes separated at the source can be shipped directly to re-processing facilities rather than via transfer station or landfill sites, as long as they are not contaminated with materials such as asbestos.

The type and content of construction contracts will have a significant bearing on how wastes and resources are managed, separated and collected from building sites.

Treatment and disposal

Treatment and disposal of MSW occurs in a variety of ways, often depending on whether there are AWT facilities in a particular area. If there is no AWT, the collection truck takes a compacted load direct to landfill at or near the tip face. Some newer large landfills use an offsite staging area to dump wastes from the trucks, before separate vehicles such as front-end loaders move it to the tip face.

If there is an AWT facility or similar in the MSW collection area, it will receive the landfill waste before it goes to the tip face. Generally speaking, AWTs require large amounts of capital and specialist expertise for setup and operation. As a result, they are usually not established by small-to-medium enterprises (SMEs), but more commonly by major companies such as SITA or Veolia, or by governments (including government businesses, councils, and groups of councils), sometimes in joint venture arrangements.

There is a range of AWT types, but generally these plants involve a staging area where waste is tipped. Waste is fed by conveyor through a variety of processes to separate the different material types within the wastes—especially those that can be recycled profitably and at reasonable quality, such as some plastics and metals—and to remove products like car batteries that may contaminate a recovered organics product such as compost. If the AWT provides composting services, the shredded organic fraction will be put into one or more digesting and composting processes. Biogas may be collected and used to generate energy. The finished recovered organic products can be on sold and the remaining residual waste sent to landfill.

C&I treatment and disposal involves a diverse range of practices due to the different composition of commercial and industrial wastes. Industrial wastes often contain more specialised materials and are more likely to contain hazardous substances than commercial waste. As a result, industrial wastes are likely to be treated and disposed of by providers which have specialist expertise.

Many commercial wastes, such as those from offices, public buildings, retail, sporting facilities and supermarkets, are treated and disposed of in much the same way as MSW. Service providers take the landfill waste direct to a landfill site (occasionally using a transfer station), and recycling service providers take mixed recyclables to a Materials Recovery Facility (MRF) or similar site. The recyclables are then separated and processed much as for MSW. A few AWT facilities process C&I waste in order to extract recyclable materials. These facilities face a number of difficulties including the fragmentation of the C&I stream (which limits continual access to significant volumes of recyclables) and the differences in the materials composition of C&I waste compared with MSW.

C&D treatment and disposal depends on whether materials have been separated, or are contaminated. Asbestos and other hazardous materials aside, much C&D waste (especially clean fill from site works) can be classed as inert waste. As this can be placed in inert landfills, which are cheaper to operate and have lower gate prices, significant volumes of construction and demolition waste are disposed of in landfill, including as daily cover. There may be some processing of those wastes prior to the tip face, such as to reduce their volume, recover easily recyclable materials of value (such as steel), or remove hazardous material (such as chemical drums, fuel or copper chrome arsenic (CCA) treated timber).

Resource recovery

The financial return on recycling mixed wastes depends on the quality of the materials in the waste stream, levels of contaminants, ease of processing, the amount of material and whether there is a reliable or constant flow of it, and the price for recovered materials in end markets. International prices for materials have a strong influence on the economics of recycling, particularly for firms dealing with metals, plastics, paper and cardboard. The price of oil also directly affects the market for materials such as plastics (affecting whether it is cheaper to make new plastic instead of recycle), rubber from tyres (an alternate source of energy) and used oils.

Local and national prices for virgin materials, along with barriers to the use of recycled materials, affect demand for materials such as recycled concrete, fill, asphalt, glass and bricks. In addition, while there may be demand for recycled materials, supply to the recycler may be limited by the price of landfill or the institutional arrangements for collection.

Although there is a trend towards consolidation, there are still numbers of SMEs operating, particularly for handling small-scale flows of particular materials, or servicing particular components of specific streams (such as the office building market in C&I). Levels of technology and requirements for human capital differ across recycling and recovery, though there is a trend towards more sophistication and expense as recovery extends into complex manufactured goods and hazardous materials.

Different business models exist for waste recovery. Some providers, especially those working with the MSW stream, create the capacity to separate, recover, and possibly process a wide range of materials (metals, glass, plastics, paper and cardboard). Some recovery businesses focus on a single material type out of a particular stream (such as paper from commercial buildings). Others may process several related materials derived from multiple streams (for example, windrow composting of recovered green waste and garden organics coming out of MSW, C&I and C&D wastes).

Many of the same facilities and processes can be used for recyclable materials extracted from MSW and C&I streams. Major organisations such as Visy have facilities that can process materials such as plastics or paper and cardboard into new products or into source materials for other producers.

Recovery and recycling of C&D materials varies depending on the material involved, their volumes, and the intended re-use. Some C&D materials, such as steel beams, partitions, bricks and some structural timbers, can be recovered for re-use with minimal re-processing, if they have not been damaged too much in the recovery process. Other approaches take C&D materials and crush, grind, re-smelt or otherwise re-process the materials into new products, such as converting concrete or brick into road base.

The diversity of C&D materials and re-processing options makes for a variety of business models. These are generally capital-intensive, even if focused on local volumes of a limited range of materials. C&D recycling is rarely the domain of small businesses. Some sectors, such as scrap metal recycling, retain a range of company sizes in markets, while others, such as concrete recycling and re-manufacture, tend to concentrate with small numbers of large firms, often operating in multiple markets.

It is also important to note that some large organisations have business models stretching further upstream or downstream from the collection, treatment/disposal and resource recovery points. For example, a company such as Visy is involved in each of those three stages, but is also a re-manufacturer of recycled content packaging.

Expanding markets for recovered resources

There is considerable scope for increased use of waste as a resource and further developing markets for a range of secondary materials in Australia subject to the removal of certain market barriers. An industry survey carried out by Access Economics identified two main impediments to securing growth and higher employment in the resource recovery sector: falling commodity prices, and an uncertain regulatory environment.[12]

International conditions

Markets for most recovered materials are subject to international conditions relating to commodity demand and pricing. Up until the 2008 Global Financial Crisis, there had been strong demand for materials like metals, plastics, paper and cardboard—particularly from growing economies like China.[13] However, between October 2008 and February 2009, scrap metal prices fell by 75%[14] and the Sims Group (the world's largest scrap metal recycler) stopped buying and withdrew services in regional areas. Demand and prices for plastics also fell and re-processing in China declined significantly.[15]

The fall in commodity prices resulted in lower volume demand in Asia, and subsequent financial hardship for operators reliant on export markets. This resulted in contracts being revised and some recyclable materials stockpiled or sent to landfills.[16]

In its *Waste Technology and Innovation Study*, GHD noted that the lack of re-manufacturing infrastructure in the recycling industry has made it more attractive for companies to export recovered recyclables instead of performing value-adding operations in Australia.[17]

Additionally, recent recovery in the global prices, particularly for cardboard and plastics, means that many recyclable materials will continue to be exported.

Local opportunities

Some recyclables have strong potential for re-use in expanded local markets. Recovered demolition and construction materials such as crushed concrete, bricks and glass can be re-used in road construction, with the majority of these materials able to be re-used locally. In Victoria for example, using C&D waste allowed Melbourne's Western Link road to save an estimated $4 million by sorting and diverting 15 000m^3 of waste concrete, rock, asphalt, steel and timber from landfill.

Organic waste also presents good opportunities for recovery and re-use, subject to further development of local markets for recycled organic products that meet efficacy and quality standards. A Market Development Plan has been prepared by Compost Australia to underpin this process.[18]

Regulatory barriers

Existing regulatory and policy settings can act as an impediment to recovery of waste resources and establishing secondary markets for waste.

An example is the differences between jurisdictions in the way waste is defined, classified and regulated (discussed further in **Chapter 4.4**) which can place additional costs on business and impact on their ability to operate across boundaries, whether local, state or international.

This could be addressed through improved national co-ordination. For example, a consistent waste classification system would provide more certainty about how wastes and recovered resources are handled, used, transported and disposed.

A further impediment identified by the Productivity Commission is the lack of information and assurance relating to the quantity of supply and quality of the end product, which may discourage consumers, industry and government purchasers from buying recycled or recovered materials (even where they perform better than virgin materials).[19]

The use of national specifications, guidelines and standards for products that re-use recovered materials would provide assurance that end products are of a consistent, recognised standard to facilitate market certainty and development. The development of engineering specifications for use of recycled materials in road construction is one example.

Skills and employment in waste management and recycling

In general, recycling and resource recovery processes are both labour- and capital-intensive, while landfill management is capital-intensive but requires few people compared with recycling. The skills profile for resource recovery is quite diverse. At least one AWT facility provides jobs from entry-level unskilled manual labour (such as sorting) through to complex engineering skills requirements (such as aspects of anaerobic digestion and renewable energy production).

The key employment risk for recycling relates to attraction and retention of skilled and experienced plant operators. This segment of the recycling workforce is employable elsewhere, often for better wages or conditions, and the consequences of vacancies or less-skilled substitution can be severe for plants.

The skills mix of landfill employment is somewhat narrower at both ends, with entry-level positions likely to involve machine operation and permanent onsite staff often reaching a ceiling at middle management level, while there may be some trained environmental or engineering specialists for very large landfills. The skills mix of periodic service provision to landfill sites (such as installation and servicing of landfill gas capture systems) may include some higher level skills such as specialist engineers.

A study by Access Economics comparing the direct and indirect employment generated by landfill disposal of waste with that generated by recycling, shows that estimated direct full time equivalent (FTE) employment per 10 000 tonnes of waste is 9.2 for recycling and 2.8 for landfill disposal. On a national level, this corresponds to an estimated direct labour force of 22 243 FTE jobs in recycling activities and 6 695 FTE jobs in landfill operations, a total of 28 930 FTE jobs across Australia.[20]

The Access Economics study uses an industry multiplier of 1.84 to estimate an indirect labour force of 18 864 jobs in recycling and 5 564 in landfill, a total of 24 288 FTE jobs across Australia. Direct and indirect jobs created in the waste industry are estimated at 53 246. The predominant job types are truck and forklift drivers, recycling and rubbish collectors, earth moving plant operators, factory process workers, and general and production managers.

Costs and benefits of waste and recycling across the economy

The actual and potential costs and benefits of environmentally sound waste management and recycling accrue across the entire economy and are not confined to the waste sector.

Businesses, including those in manufacturing and the supply chain, can introduce systems that create value from potential waste streams, achieve cost savings, minimise their environmental impact and derive benefits which flow on beyond their boundaries to other sectors and to the community. For example, a company that manufactures food products can manage many of its own wastes, including through onsite treatment, with only limited use of external waste management services for the residual solid wastes that cannot be kept on site.

One such example of onsite waste and recycling comes from the McCain Foods Ballarat plant in Victoria. This plant processes meat, vegetables and breads, manufacturing products including frozen pizza. In the mid 1980s McCains built their first 11ML lagoon for anaerobic decomposition of food wastewater, with another $3 million 28ML lagoon added in 1996. In 2008 the company invested a further $200 000 to increase their biogas re-use efficiency from 50% to 80%, and is now planning further investment and action to lift its biogas use efficiency to 95% by converting around 30% of the 3 000 tonnes of food waste currently going to landfill each year. More efficiency with biogas from their food wastes can reduce demand for natural gas in their plant, saving costs and greenhouse emissions. There are other benefits, as the anaerobic fermentation process reduces the strength (level of contamination) of the wastewater by 90% before it goes to the municipal sewage treatment plant, leading to further savings in cost and environmental impact.[21]

Another example is from the Harvest FreshCuts plant at Wacol in Queensland. This plant processes about 3 000 tonnes of raw produce into 9 million bags of salad and vegetable products each year for major supermarkets retailers and independent food outlets. Working with the Australian Industry Group and the Queensland Environmental Protection Agency, an eco-efficiency assessment was conducted for the Wacol plant. The assessment identified a range of opportunities to reduce waste and costs, including reductions in energy, water, sanitising agents, packaging wastes and wastewater. Replacing cardboard boxes with re-usable plastic crates for the supply of products to retailers could save $110 000 a year. Recycling polystyrene boxes rather than disposal to landfill offers further savings. In the 15 months since the assessment was undertaken, over $80 000 in actual savings have been realised, as well as significant reductions in environmental impact.[22]

It should be noted that while costs and benefits may accrue to manufacturers from improved waste management (including recycling), costs and benefits are also associated with recycling, recovery and re-use activities. Comprehensive cost-benefit analysis (taking into account non-market costs and benefits) provides one tool for determining the overall net community benefit from the waste management options being considered.

Economic benefit of improved materials efficiency

International and domestic experience and research support the argument that better materials efficiency and waste performance can produce economic benefit. For example, taking cooperative and collaborative approaches to regional-scale re-use of production process by-products that would have gone to landfill can produce economic and environmental benefits. In the UK the National Industrial Symbiosis Program involves 8 000 participant companies and has diverted more than 2.2 million tonnes of business waste from landfill, created 490 new jobs, reduced carbon emissions by 2.1 million tonnes, generated £104 million in new sales for members and saved them £81 million.[23]

Another example of the economic benefit of strategic co-ordination in waste and recycling is the Waste and Resources Action Programme (WRAP) in the UK. This voluntary, cooperative partnership arrangement between governments and industry has a focus on capacity building, infrastructure provision, education and awareness raising, and market development. Over the period of the first business plans for the programme (2000–2007), WRAP achieved:

- 5.8 million extra tonnes processed by the recycling industry every year
- £182 million of new investment in the recycling sector from commercial sources
- £1.3 billion annual turnover in the recycling industry—doubled since 2000.[24]

In Australia, the Kwinana industrial area near Perth supports diverse and non-competing processing industries, including alumina, nickel, oil refineries, chemical factories, power plants, cement manufacturing and fertiliser plants. These industries collaborate in areas of mutual interest and benefit, such as safety and the environment.

The interdependency among these industries and their physical proximity allows trading of by-products for re-use and co-operative energy efficiency ventures. This provides environmental and economic benefits beyond what is achieved by widely dispersed industries. Over the past three decades, Kwinana industries have established 32 by-product re-use projects and 15 shared utility projects[25] which have achieved

- water savings of 8 200 gl/year
- energy savings of 3 750 tj/year
- waste reductions of 421 600 tonnes/year
- gas emission reductions of more than 134 000 metric tonnes per year, and
- carbon dioxide emission reductions equivalent to removing 73 000 cars from the road.[26]

Conclusion

Resource recovery and recycling can generate employment, productivity and other economic benefit across the Australian economy, with this benefit in many cases outweighing the costs of recycling. Some of this economic benefit may arise directly from the growing waste and recycling services sector, while other benefits may come from companies and organisations involved in waste and recycling but not classified as waste businesses.

Australia could derive a net economic benefit from better national co-ordination of arrangements for waste and recycling across the economy. This benefit will come from more efficient and effective markets, enhanced materials efficiency, streamlined government regulation, reduced business costs and new employment in waste and recycling.

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CHAPTER 4.4
POLICY AND REGULATION

This chapter outlines the current policy and regulatory framework for managing waste and resource recovery in Australia. It describes key policy and regulatory measures used by the state and territory governments to manage waste, and provides a brief overview of national policy and governance arrangements for waste, as well as regional and local policy and regulatory initiatives.

Under the Australian constitution, waste management is the primary responsibility of the states and territories which regulate and manage waste in accordance with their respective legislation, policies, plans and programs. The Australian Government has responsibility for national legislation, strategies and policy frameworks for waste, including measures that give effect to obligations under international agreements.

Local governments have responsibility for waste management within their local areas as laid down by the regulatory framework of each state or territory. Some local governments have developed their own strategies and regulations on waste management, and programs to implement local sustainability and education outcomes.

Managing waste is not just the province of governments. The diversity of materials, products, services and processes that generate waste mean that relevant industries, business, communities, households and individuals are involved in waste management and resource recovery. Activities undertaken by business and the community are explored further in **Chapters 4.2** and **4.3**.

Policy and regulatory environment–states and territories

State and territory governments have primary responsibility for regulating and administering waste, including planning for waste management and waste avoidance, minimisation and re-use, licensing and regulation of waste transport, storage, treatment, resource recovery and disposal, and managing the environmental impacts of waste management activities.

Policies and legislation

All states and territories have policies (or strategies) and legislation for waste management, and specific agencies or departments to administer these arrangements (see **Table 4.6**).

Waste and resource recovery are extensively regulated to manage the environmental risks and impacts associated with the generation of waste and landfill disposal, and to address inherent challenges such as the inadequate amount of data and information about waste activity.

Early waste legislation in Australia focused on the public health aspects of waste disposal, and protecting the environment from harm, rather than minimising waste itself or fostering re-use and recycling. Since the 1970s, legislation and regulation have gradually come to emphasise waste avoidance, minimisation, and ways of encouraging resource recovery, using a risk-based approach to manage safety and environmental concerns. This change has been in line with a shift in attitudes and expectations across the nation as well as in the international community. Australia became signatory to a number of international conventions and embraced new approaches to the management of waste. Jurisdictions began to adopt elements of the waste hierarchy in their waste policies. The waste hierarchy (also known as the 'waste management hierarchy'), first enunciated by the European Union in 1975,[1] is a guide for prioritising waste management practices, consisting of avoidance, minimisation and resource recovery, with waste avoidance as the highest preference, followed by minimisation, re-use, recycling and re-processing, and finally disposal.

Some states make explicit reference to the waste hierarchy in their policies. For example, in Victoria, legislation and policy refers to management of waste in accordance with the hierarchy, with avoidance being the most preferred option and disposal being the least.[2] In South Australia, the waste hierarchy is one of the guiding principles of its waste legislation.[3] Other state policies and

Table 4.6: State and territory waste management agencies, legislation and strategies[4]

State/ territory	Relevant Agencies	Legislation	Strategy
NSW	Department of Environment, Climate Change and Water	*Protection of the Environment Operations Act 1997 (amended in 2008)* *Protection of the Environment Operations (Waste) Regulation 2005* *Waste Avoidance and Resource Recovery Act 2001*	*Waste Avoidance and Resource Recovery Strategy* (WARR) 2007
Vic	Environment Protection Authority (EPA); Sustainability Victoria	*Environment Protection Act 1970* *Environment Protection (Distribution of Landfill Levy) Regulations 2002* *Sustainability Victoria Act 2006* *Environment Protection (Industrial Waste Resource) Regulations 2009*	*Towards Zero Waste Strategy 2005*
Qld	Department of Environment and Resource Management (DERM)	*Environmental Protection Act 1994* *Environmental Protection Regulation 2008* *Environmental Protection (Waste Management) Policy 2000* *Environmental Protection (Waste Management) Regulation 2000*	*Let's Not Waste our Future—Queensland Waste Strategy (draft)*
WA	Department of Environment and Conservation; Waste Authority	*Environmental Protection Act 1986* *Waste Avoidance and Resource Recovery Act 2007* *Waste Avoidance and Resource Recovery Levy Act 2007* *Waste Avoidance and Resource Recovery Regulations 2008* *Environmental Protection (Controlled Waste) Regulations 2001* *Environmental Protection (Rural Landfill) Regulations 2002*	Draft Waste Strategy (currently under public consultation)
SA	Environmental Protection Authority (EPA); Zero Waste South Australia	*Environment Protection Act 1993* *Zero Waste SA Act 2004* *Plastic Shopping Bags (Waste Avoidance) Act 2008* *Environment Protection Regulations 2009* Environment Protection (Waste to Resources) Policy 2010	*Waste Strategy 2005–2010*
Tas	Department of Primary Industries, Parks, Water and the Environment; Environment Protection Authority (EPA)	*Environmental Management and Pollution Control Act 1994* *Environmental Management and Pollution Control (Waste Management) Regulations 2000*	The Tasmanian *Waste and Resource Recovery Management Strategy* (2009)
ACT	Department of the Environment, Climate Change, Energy and Water (regulatory & monitoring)	*Environment Protection Act 1997* *Waste Minimisation Act 2001*	*'No Waste by 2010 Strategy'* Waste Management Strategy 1996
NT	Department of Natural Resources, Environment, the Arts and Sport (NRETAS).	*Waste Management and Pollution Control Act 2007* *Waste Management and Pollution Control (Administration) Regulation 2001*	2007 *Re-thinking Waste Disposal Behaviour and Resource Efficiency* Interim Action Plan

strategies do not articulate a preference for one element of the hierarchy over another.

Since 2007 most states have released discussion papers and other documents on the future of waste minimisation and resource recovery. Recent updates to policies promote resource recovery and avoidance as part of the overall strategy, and as a means of contributing to broader environmental and economic sustainability goals.

The NSW 2007 waste strategy, for example, makes explicit reference to the contribution of waste reduction and recycling to key environmental objectives such as water conservation and reduced climate change impacts. This was underpinned by research into the benefits of recycling which provided evidence about how diversion and recovery of waste (from household and kerbside recycling) contributes to greenhouse gas reduction, water and energy savings, and conserving non-renewable virgin resources.[5]

In Victoria, the *Towards Zero Waste Strategy* is part of a policy package which includes the *Victorian Greenhouse Strategy* and *Our Water Our Future*, designed to deliver the state's environmental sustainability goals. Victorian research on life cycle assessment of waste and resource recovery options (including energy from waste)[6], and ongoing data collection such as the annual survey of recycling industries,[7] will inform implementation of its Waste Strategy.

South Australia's waste strategy is aligned with *South Australia's Strategic Plan* and helps to meet its sustainability targets (which relate to reducing waste to landfill and greenhouse emission reduction) as well as economic targets for jobs growth and investment in infrastructure.[8] Queensland's waste strategy discussion paper in 2007 proposed an integrated approach to waste management linked to sustainability measures in *Smart Queensland: Smart State Strategy 2005–2015* and the *South East Queensland Regional Plan 2005–2026*.[9]

The draft waste strategy for WA incorporated sustainability in the values and principles and objectives of the draft policy. Tasmania's draft *Waste and Resource Management Strategy* is also based on principles of sustainability.

Implementation of policies

States have adopted a variety of management measures and mechanisms to put their strategies into effect. An overview of some of the key measures is at **Table 4.7**.

Other measures include waste classifications, levies, licensing of specified waste management activities, tracking of regulated wastes, financial mechanisms/incentive programs to support market and infrastructure development, education and behavioural change initiatives, and product stewardship approaches.

Table 4.7: State and territory waste management and resource recovery measures[10]
(✓ = yes, ✗ = no)

State/ territory	Waste strategy	Waste & recycling targets	Household hazardous waste collection	Product stewardship (including EPR schemes)*	Landfill levy	Landfill ban
NSW	✓	✓	✓	Legislation allows for EPR but no schemes in place	✓	✗
Vic	✓	✓	✓	✗	✓	Automotive batteries, whole tyres and some other wastes
Qld	New strategy under development	✗	✗	✗	✗	Limits on number of tyres allowed in new landfills
WA	✓	✓	✓	✗	✓	✗
SA	✓	✓	✓	Beverage containers	✓	Considering a ban on a range of materials to landfill
Tas	Under development	Considering waste reduction goals and targets	✗	✗	✗	Whole tyres and untreated clinical waste. From 30/6/09, controlled wastes unless landfill is approved to accept such material
ACT	✓	✓	✗	✗	✓	Computers
NT	To be updated	✗	✗	Beverage containers (under development)	✗	✗

* All jurisdictions except the Northern Territory and the Australian Government have product stewardship legislation in place to give effect to the National Packaging Covenant.

Use of targets

Most states encourage waste diversion from landfill and greater recycling and resource recovery by setting targets in waste strategies. **Figure 4.3** shows how waste targets vary in both time frames and scope. Their scope includes broad aspirational goals like 'zero waste' in the ACT, to more specific targets such as to reduce the amount of waste going to landfill (NSW and SA); to reduce or contain the growth in solid waste generation (NSW and Vic); and to increase the rate of recycling and resource recovery (ACT, SA and Vic). Tasmania is in the process of considering waste reduction targets.

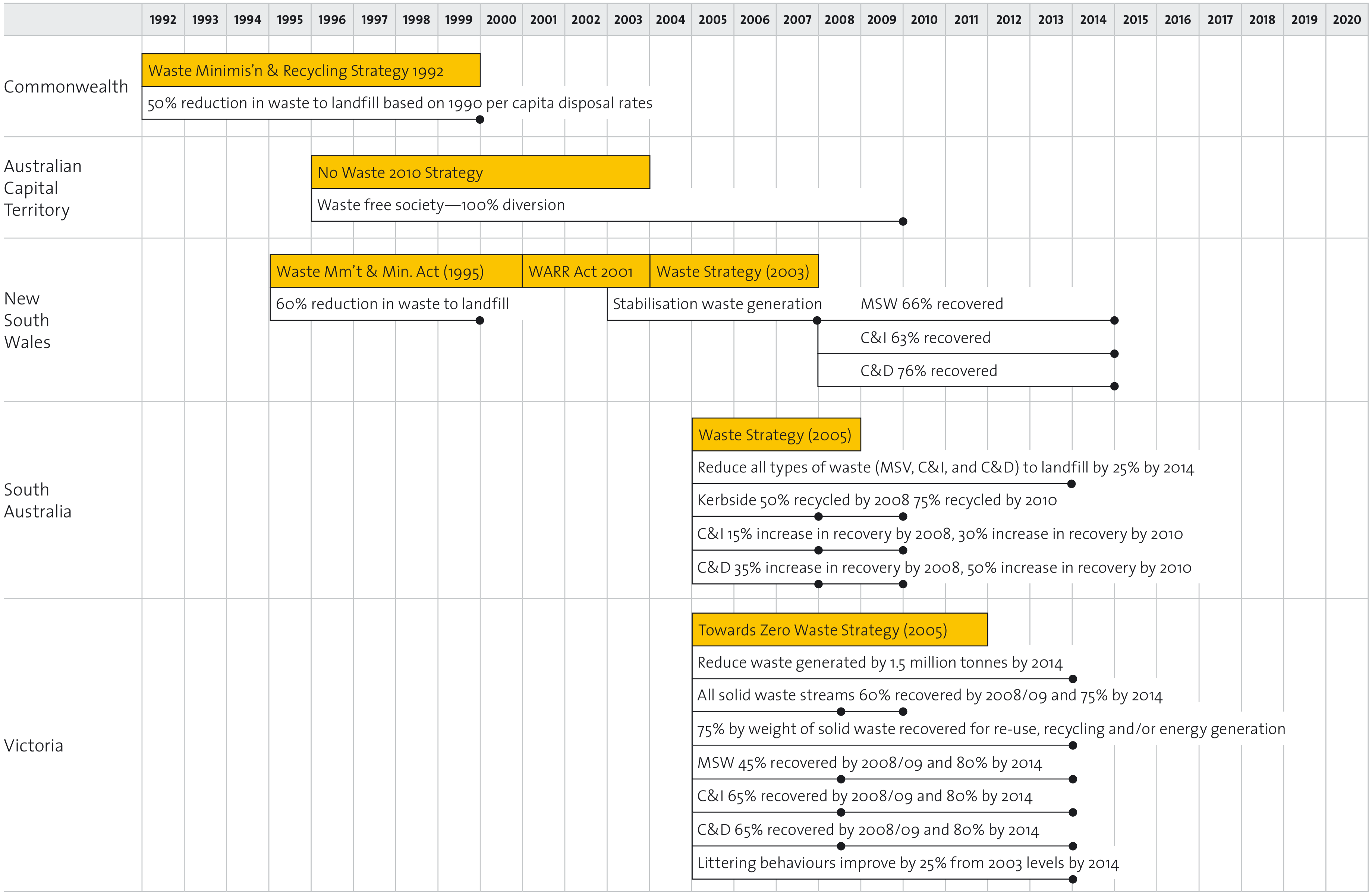
States use different mixes of regulatory, policy, educative and economic instruments to help them meet their targets and policy objectives, and have introduced reporting to track progress against them. The following examples demonstrate some of these approaches.

Reporting approaches

NSW produces a report every two years to track progress towards the recycling targets and other result areas in the *NSW Waste Avoidance and Resource Recovery Strategy*. NSW is halfway towards its 2014 recycling targets with growing recycling rates for all sectors and regions. A summary for the period 2002–03 to 2006–07 is provided in **Table 4.8**.

The Victorian Government's *Towards Zero Waste* strategy sets out four statewide targets for waste reduction, resource recovery and littering, as well as specific targets and actions for Victoria's municipal and business sectors to deliver more sustainable use of resources by 2014. An assessment of Victoria's progress towards these targets is prepared annually. A summary for 2007–08 is provided in **Table 4.9**.

Figure 4.3: Australian Resource Recovery and Waste Targets 1992 to 2020



Note: The above is based on formally approved targets. Other jurisdictions (e.g. Western Australia) may be in the process of finalising targets.

Note that:

- 61% of Victoria's solid waste was recycled in 2007–08, compared with 62% for 2006–07
- Victoria's commercial and industrial (C&I) and construction and demolition (C&D) sectors exceeded their 2007–08 resource recovery targets by 5% and 3% respectively
- Victoria's municipal sector fell 2% short of the 2007–08 resource recovery target of 42%, and
- meeting the target of a 1.5 million tonne reduction in total waste, compared to 'business as usual', remains a significant challenge, especially in light of Victoria's projected population growth.

Queensland has produced a waste and recycling *Report Card* with a summary of waste generation, resource recovery and waste disposal to June 2008, and five year trends for reported solid wastes. Detailed analysis of the data is provided in the

Table 4.8: Summary of progress towards NSW Targets, by waste stream and region[11]

		2000 baseline†	2002–03	2004–05	2006–07	2014 recycling target
NSW	MSW		30%	33%	38%	66%
	C&I		34%	38%	44%	63%
	C&D		64%	62%	67%	76%
	Overall		45%	46%	52%	
SMA‡	MSW	26%	33%	37%	42%	66%
	C&I	28%	34%	35%	42%	63%
	C&D	65%	68%	66%	70%	76%
	Overall	38%	48%	49%	54%	
ERA§	MSW		28%	33%	41%	66%
	C&I		45%	53%	48%	63%
	C&D		67%	65%	72%	76%
	Overall		47%	50%	56%	

† Baseline recycling rates were only available for the SMA in 2000 these data were used to establish the strategy targets.

‡ Sydney Metropolitan Area.

§ Extended Regulated Area (Hunter, Central Coast, Illawarra).

Table 4.9: Summary of 2007–08 progress on Zero Waste (Victoria)[12]

2014 target	2007–2008	
	Projected result¶	Actual result
1.5 million tonne reduction in solid waste generated (reported as total solid waste generated)	9.88 million tonnes generated	10.29 million tonnes generated
75% by weight of solid waste recovered for re-use, recycling and/or energy generation	58%	61%
Sectoral recovery rates achieved: • Municipal solid waste (65%) • Commercial and industrial waste (80%) • Construction and demolition waste (80%)	 42% 64% 64%	 40% 69% 67%
A 25% improvement in littering behaviours from 2003 levels	10%	7.7%**

¶ Figures generated through modelling and reported in previous years have been updated using a new baseline, resulting in a recalculation of projections.

** Actual result is from the 2007 *Victorian Litter Report*; the next results are due in late 2009.

periodical report, *State of Waste and Recycling in Queensland 2008*. While Queensland does not currently have waste targets, these reports are used to inform policy development and meet environmental reporting obligations.[13]

Grant and incentive programs

Since 2004, Zero Waste SA has implemented a number of grant and financial incentive programs to assist key players, including resource recovery and recycling industries, local councils and regional waste infrastructure providers, to achieve the waste targets in *South Australia's Waste Strategy 2005–2010*.[14] The programs have assisted with new infrastructure for the recycling industry to improve recovery and processing (including industrial equipment for sorting and to reduce contamination), and to pilot a food waste collection service with local government.

A 2007 review of the effectiveness of SA Zero Waste programs showed that at an early stage of delivery and data collection, the programs were making an important contribution towards the SA policy target of a 25% reduction in solid waste to landfill by 2014.[15] A significant overall diversion rate of 27.8% occurred in 2006, with 17.9% of waste diverted over 2005 and 2006 by projects funded under the SA Zero Waste grant and incentive programs.

The Waste Authority of Western Australia has several grant schemes which support its strategic waste objectives. Priority areas for funding include projects that promote recycling of green waste and construction and demolition waste.[16] For example, funding has been provided for the 'Vale Smart Builders Program', a co-ordinated resource recovery system to increase recycling and re-use of residual building materials at the Vale residential estate in the Swan Valley. The program aims to reduce the amount of material used in housing construction that goes to landfill as waste, and participants include Perth's biggest builders, key material suppliers, recycling companies and industry groups.

Prioritising actions

Some state and territories have developed methods for prioritising policies and action on waste. These priorities are used to identify key materials or products for increased re-use and recycling activity, waste reduction, and product stewardship schemes.

An example is Victoria's *Towards Zero Waste Strategy* which sets priorities across industry sectors, regions, materials and products, which are then reflected in the strategy.[17] Priority (geographic) areas are those with the greatest need and potential to achieve improvements in solid waste recovery to 2015 (based on both waste generation levels and landfill capacity). Priority industry sectors are major generators of waste, particularly priority materials. Priority materials were selected taking into consideration the following criteria:

- quantities of disposed waste and future levels
- adequacy of current recycling systems
- environmental impacts of disposal (toxicity)
- costs to community and industry of managing discarded products
- opportunities for improved management.

The same criteria were applied to identify priority products with additional considerations around shared responsibility across the product life cycle.

In NSW, an Extended Producer Responsibility (EPR) Priority Statement is produced annually, to identify 'wastes of concern' for industry action. An Expert Reference Group provides advice about the implementation of the Statement. The current Statement nominates 17 waste products and also gives notice of the wastes recommended for regulatory action in the coming year.[18]

Western Australia's waste strategy (in draft at the time this report was compiled) identified ten priority waste materials for product stewardship schemes based on an assessment of environmental risk and the potential for improving recovery rates.[19]

Waste classification systems

Classification is defined as "the assignment ... to groups within a system of categories distinguished by structure, origin, etc".[20] Definitions and classifications of waste are central to the system of waste management and resource recovery in Australia.

Waste classification systems play a vital role in ensuring that specific waste streams are appropriately managed to protect human health and the environment. They are directly linked to whether something is considered to be a waste, a hazardous waste or a resource, to the way waste is regulated and to mechanisms for reporting waste management activities. They also affect how hazardous and other wastes are managed, moved and tracked, internationally and between Australian jurisdictions. This is discussed further in **Chapter 3.3**.

Classifying a product, by-product or material as a waste, even if it was never intended to be waste, can impose a range of requirements on businesses that are generally more onerous than those applied to virgin material, even if there is no essential difference in risk profile of the item in terms of health and the environment. If a material is classified as a waste, or if facilities which use waste products as alternatives to raw materials are classified as waste facilities, attitudes towards their use are affected. Conversely, some processes for certifying that a product is safe for re-use, such as the prescription of risk-based standards, is necessary for protection of the community and the environment

The Cement Industry Federation submission to the 2009 National Waste Policy consultation paper uses fly-ash as an example of a by-product that faces different classifications in different states. In some states it is identified as a controlled/hazardous waste not fit for re-use. By contrast, in other states the same material is considered fit for re-use and is regularly incorporated into construction material. In the states where it is not allowed to be used for construction, there is a concern that the material may still be used without correct handling, resulting in a lower quality product and affecting the market for fly-ash in other jurisdictions. The industry proposes that if a waste is subsequently used for another purpose then it requires a classification that reflects its role as a co-product or by-product to which typical manufacturing standards apply.[21]

State and territory approaches to classification

Each state and territory approaches waste classification differently. Some jurisdictions may use one set of classifications for regulating resource recovery and landfill disposal, but may use a different set of classifications for data collection and reporting, such as by using volume and types of waste to landfill as variables. For example in NSW, classification for the purposes of reporting waste data is distinct from the classification system designed for appropriate management and disposal of the waste. The latter is a risk-based system that classifies waste for disposal according to appropriate treatment and handling to minimise potential risk or harm to the environment and human health. Classification for reporting waste data in NSW is a practical approach that recognises the data provider's capacity to identify material at the time of reporting. Reported waste is classified under three broad categories of municipal (MSW), commercial and industrial (C&I), and construction and demolition (C&D), which are in line with most other states and territories across Australia.

Differences in terminology of waste classifications can make it difficult to compare data between the jurisdictions and present comprehensive national information. While the overall definition of what constitutes a waste is similar in each jurisdiction, the specific waste classifications vary both in descriptive name and actual waste type. In particular, 'hazardous waste' is referred to as: regulated waste (Qld), controlled waste (Tas), and prescribed industrial waste (Vic). A summary of the current waste classification system applied in each state and territory is at **Appendix C**.

At a national level, inconsistent classifications and definitions can increase complexity, place additional costs on business, and affect their ability to operate across boundaries, whether local, state or international. These issues have been raised by the waste industry in submissions to the 2006 Productivity Commission Inquiry into Waste, the 2008 Senate Inquiry into Australia's Waste Streams and the 2009 National Waste Policy consultation paper.[22] For example, in its submission to the National Waste Policy consultation paper, Transpacific Industries identified inconsistent waste classification between states as one of the barriers to cost-effective and environmentally beneficial waste management practice.[23]

Different approaches to defining, classifying and regulating wastes can also have unintended consequences, namely materials may be transported to areas which have less rigorous disposal and treatment requirements, increased market power for operators of facilities subject to less demanding licensing conditions, and increased risk to the environment and human health—such as where people undergoing medical care at home are unclear about the appropriate disposal of clinical waste. Submissions to the National Waste Policy consultation paper from the biohazard waste industry provided examples about the effect of different approaches to pharmaceutical wastes. A waste management company can treat a specific type of waste with a treatment technology in one jurisdiction, but in another jurisdiction is not allowed to treat the same waste with an identical treatment technology.[24]

Several states are simplifying their classification systems. The benefits of this are shown by Victoria's overhaul of its prescribed waste regulations to align with risk and encourage appropriate recycling of waste resources. The state expects to achieve administrative savings of $6 million annually and $830 million over 10 years.[25] A review of guidelines for waste classification has been completed in NSW and another is underway in South Australia.[26]

Levies

The regulation of types of wastes allowed to landfill varies both within and across jurisdictions. Some states (NSW, Vic, WA, SA and ACT) apply waste levies to material disposed to landfill (see **Table 4.10**). These are applied on

Table 4.10: Levies by jurisdiction[27]

Jurisdiction	Levy (per tonne)	Forecast levy increase	Application of levy funds
NSW	Sydney metro area (SMA): $58.80 Extended regulated area (ERA): $52.40 Regional regulated area (RRA): $10.00	The SMA will increase by $10 per tonne until 2015–16. The ERA will increase by $11.50 until 2012–13 then increase by $10 per tonne until 2015–16. The RRA will increase by $10 per tonne until 2015–16. (Levy increases are adjusted annually for changes in CPI).	Central revenue
Vic	Rural: $7 (MSW) & $13 (industrial) Metro: $9 (MSW) & $15 (industrial) PIW cat B: $250 PIW cat C: $70 Asbestos: $30	No increases forecast	Levies fund activities of EPA, Sustainability Victoria and Regional Waste Management Groups, and contribute to the Sustainability Fund.
Qld	None (proposed as part of the draft waste strategy)	NA	NA
WA	Putrescible waste: $7 Inert waste: $3/m^3	Proposed increase 1 Jan 2010: 300% ($28)	Some funds are directed to waste reduction initiatives
SA	Metro: $23.40 Non-metro: $11.70	No increases forecast	45% EPA, 5% Environment Protection Fund and 50% Zero Waste SA
Tas	None	NA	NA
ACT	Household: $64.15 C&I: $113.85 Specific items: charged according to a schedule of fees	No increases forecast	Funds are directed to waste reduction initiatives
NT	None	NA	NA

a dollar-per-tonne basis; costs vary within and between jurisdictions, and can apply to a range of different materials.

Local residents also pay for waste disposal (kerbside collection) through rates paid to the local council. Waste levies increase the cost of disposal for all materials going to landfill, including waste materials generated by recycling processes. Levies can also encourage the investment in resource recovery infrastructure and take into account the environmental externalities not otherwise costed.

Planning and development approval systems

Planning for and development of new waste management infrastructure (or expansion of existing facilities) is subject to the planning legislation operating in each state and territory. This legislation establishes a hierarchy of planning instruments and the assessment and approval process and decision-making responsibilities for development. Planning instruments that apply to waste infrastructure may include state level policies or provisions, regional plans and provisions, and local planning schemes. Local schemes may control the location and development of waste facilities through zoning and other siting and amenity-related controls. Local schemes can also give effect to relevant plans like regional waste management plans.

The location and size of a proposed waste management facility can determine the assessment and approval regime that applies. For example in NSW, resource recovery and waste management facilities that are located in particular areas and/or exceed specified thresholds (volume handled and capital value) fall under State Environmental Planning Policy (SEPP) (Major Development 2005).[28] This SEPP covers major projects of regional or state significance which require an approval from the Minister for Planning. In South Australia, development applications for the purpose of the reception, storage, treatment or disposal of waste may be either determined by the Development Assessment Commission (a state-based planning authority) or, at the Planning Minister's discretion, assessed as Major Developments. Applications for waste management facilities are also required to be referred to the EPA which has the power to direct, within a specified time period, conditions to be included in the licence.

Most states have implemented reforms to allow for development approvals to be integrated with environmental licensing processes (required under environmental protection legislation).

However, the full suite of regulatory requirements that might apply to a new or proposed expansion of a waste management facility may not be discovered until after a development application has been lodged, which may lead to project delays and additional costs. Submissions during the National Waste Policy consultation process noted that divergent regulatory arrangements impact on the capacity of businesses to determine what development permits, licences or approvals are required from governments to allow them to operate.[29] Stakeholders also noted that the development approval for a site, and licence conditions could prevent waste synergies between companies where a site licence prohibits the receipt or processing of wastes from other locations.[30]

Victoria initiated a review of Waste Transfer and Recycling Facility Provisions in Planning Schemes, through an Advisory Committee appointed under the *Planning and Environment Act 1987*.[31] The review is being undertaken in response to three identified needs:

- to promote recycling and refuse transfer and management with appropriate environmental and amenity safeguards
- to ensure planning scheme definitions for waste transfer and recycling are adequate to cope with the transition to new technologies and high levels of waste recovery and re-use
- to ensure that recent issues raised in Panel Reports, Victorian Civil and Administrative Tribunal (VCAT) Decisions, and issues raised by local government and the community relating to waste transfer and recycling facilities and their definitions and land use controls are addressed.

The Advisory Committee is reviewing the land use definitions, zoning controls and other related provisions in planning schemes that apply to waste transfer stations and materials recycling facilities, and will make recommendations as appropriate to the Minister for Planning.[32]

Strategic planning

Planning instruments at state, regional and local levels can be used to identify future locations and requirements for waste management infrastructure and facilities based on population, development and recycling trends.

Strategic planning measures can include identifying infrastructure corridors or precincts or hubs, as well as the need for buffers between land uses, specific industry zones and policy provisions to encourage resource recovery. For example in South Australia, the 30 Year Plan for Greater Adelaide has a target to identify land for development of waste infrastructure in designated growth areas.[33] The new South East Queensland (SEQ) Regional Plan 2009–2031 contains regional principles and policies relating to waste that promote resource recovery and address provision of waste infrastructure and facilities. This includes a policy to provide for location of adequate sites for future resource recovery facilities across the region, including, where appropriate, creation of resource recovery precincts. State agencies are required to give effect to these policies in their own planning, and local governments must adopt policies and amend local planning schemes to align with the regional plan.[34]

These long-term planning measures can both safeguard existing infrastructure and address community concerns about the impact of new waste facilities on residential amenity and the surrounding environment. This avoids the potential for future conflicts between new waste management facilities and urban development and protracted delays to projects.

Strategic planning instruments also need to take account of potential risks after the closure of waste facilities, as illustrated by the impact of methane gas from the Cranbourne landfill in Victoria in the case study below.

Submissions received during the National Waste Policy consultation process raised issues about both consideration and siting of waste management and recycling operations as part of strategic urban planning, which flagged them as matters for which better national co-ordination could deliver benefits. Submissions from the waste management industry identified the need for longer-term planning for waste management facilities in each major city, noting that state planning frameworks generally do not provide certainty about where critical recycling infrastructure can go.[††] Industry submissions raised the problems caused by lengthy and expensive approvals processes, delays in investment, and abandonment of projects.[35]

†† Some states have measures for long-term planning for waste infrastructure in regional growth areas, refer to earlier examples about SA's 30 year plan and SEQ regional plan

Case study: Methane emissions from Cranbourne landfill, Victoria[36]

A landfill at Stevensons Road, Cranbourne, operated between June 1996 and June 2005 for the disposal of municipal waste from the municipalities of Casey and Frankston. In 2008, unsafe levels of methane gas coming from the landfill were detected in local homes and underground services. Methane is a particular concern because it is flammable and explosive at concentrations of between 5% and 15% of the volume of air.

The City of Casey owns the closed landfill, and is implementing a range of works to address the gas migration. These include construction of a cement and clay underground barrier to prevent migration of gases through the soil and installation of more gas extraction wells. In 2008–09 the City of Casey committed approximately $21 million towards these measures and in the long term, the total cost of rehabilitating the landfill is expected to exceed $100 million.[37]

These actions are expected to reduce the risks associated with methane emissions over time. However, emissions of methane were recently detected above the upper limit for explosiveness in Brookland Green housing estate, up to 600 metres from the landfill.

Other submissions regarded regional-scale planning of resource recovery and waste management as critical to ensuring that the community's expectations for recycling and reasonably-priced waste management do not impinge on the enjoyment of their properties and open spaces.[38] Cross-border agreements that enable recovery of larger volumes of post-consumer waste, better management of hazardous wastes and more consistent regulatory options were noted as areas for collaboration in the future.[39]

National legislation, policies and governance for waste

Context

Australia is party to a number of international conventions and agreements relevant to waste that have been reflected in national legislation, strategies and policy frameworks. An overview of the key agreements is provided in **Chapter 1.2** of this report.

National legislation

The Australian Government has enacted the following legislation to give effect to its international obligations:

- the export of hazardous waste from Australia is subject to the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Cth)
- industrial and agricultural and veterinary chemicals are subject to the *Industrial Chemicals (Notification and Assessment) Act 1989* (Cth) and the *Agricultural and Veterinary Chemicals Act 1994* (Cth)
- marine waste and debris is covered through the *Environment Protection (Sea Dumping) Act 1981* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), and
- ozone depleting substances are covered by the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* (Cth).

The government has committed to reducing greenhouse emissions by at least 5% of 2000 levels by 2020. The proposed Carbon Pollution Reduction Scheme is expected to cover some waste management activities, particularly in relation to regulation of methane emissions from landfill.[40]

National governance and policy action on waste

Australian governments have a long history of collaboration on waste policy and actions (see **Chapter 4.1**). Collaboration occurs through the Council of Australian Governments (COAG),[41] (the peak intergovernmental forum in Australia) and the Environment Protection and Heritage Council (EPHC), established by COAG in 2002.

The National Strategy for Ecologically Sustainable Development (ESD Strategy) agreed by COAG in 1992 underpins the policies and programs implemented by governments to date. The strategy committed Australia to improving the efficiency with which resources are used, reducing the impact on the environment of waste disposal, and improving management of hazardous wastes, avoiding their generation and addressing clean-up issues.[42]

In 2002, the EPHC developed a national waste framework as the basis for collaborative action on issues of national priority including electrical products (televisions, computers and mobile phones), hazardous substances, tyres, degradable plastics, and packaging. In November 2008, the EPHC agreed to review the national waste framework to inform the development of the national waste policy.

The EPHC has a role in the implementation of a number of national COAG policy decisions and agreements relevant to waste management, including the agreement to establish a standard setting body under EPHC for chemicals in the environment, to assess mandatory environmental labelling and to develop a framework for monitoring the impact of chemicals in the environment.

National Waste Policy: Less Waste, More Resources

The *National Waste Policy* announced by EPHC in November 2009,[43] builds on the 1992 ESD Strategy and provides the framework for implementing Australia's international obligations on waste and relevant COAG agreements. The policy sets directions for resource recovery and waste management to 2020 and aims to reduce the amount of waste for disposal and manage waste as a resource to deliver economic, environmental and social benefits.

The policy sets directions in six key areas and identifies 16 priority strategies that would benefit from a national or co-ordinated approach. The six key areas are:

1. **Taking responsibility**—Shared responsibility for reducing the environmental, health and safety footprint of products and materials across the manufacture-supply-consumption chain and at end-of-life.
2. **Improving the market**—Efficient and effective Australian markets operate for waste and recovered resources, with local technology and innovation being sought after internationally.
3. **Pursuing sustainability**—Less waste and improved use of waste to achieve broader environmental, social and economic benefits.
4. **Reducing hazard and risk**—Reduction of potentially hazardous content of wastes with consistent, safe and accountable waste recovery, handling and disposal.
5. **Tailoring solutions**—Increased capacity in regional, remote and Indigenous communities to manage waste and recover and re-use resources.
6. **Providing the evidence**—Access by decision makers to meaningful, accurate and current national waste and resource recovery data and information to measure progress and educate and inform the behaviour and the choices of the community.

The National Waste Policy does not alter existing state and territory responsibilities for waste management. The policy builds on existing settings by providing a nationally agreed direction and focus to be implemented by individual jurisdictions through their legislation, policies and programs and by collective action by governments through the EPHC. Implementation plans for the policy are currently being developed.

National Environment Protection Measures (NEPMs)

The EPHC also incorporates the National Environment Protection Council (NEPC), a statutory body established under the *National Environment Protection Council Act 1994* (Cth),[44] and corresponding legislation in the states and territories.

Under this Act, the NEPC has initiated mandatory national regulation of relevance to waste through national environment protection measures (NEPMs).[45] Jurisdictions have enacted ‘mirror’ legislation to give NEPMs regulatory effect in each state and territory. NEPMs include:

- Movement of Controlled Waste between States and Territories NEPM
- Used Packaging Materials NEPM
- National Pollutant Inventory NEPM
- Assessment of Site Contamination NEPM
- Ambient Air Quality NEPM, and
- Air Toxics NEPM.

The key NEPMs relating to waste are the Movement of Controlled Waste between States and Territories NEPM and Used Packaging Materials (UPM) NEPM. The Movement of Controlled Waste NEPM controls the movement of hazardous waste in Australia, consistent with obligations under the Basel Convention and is discussed in **Chapter 3**.

The Used Packaging Materials NEPM (UPM NEPM) underpins the voluntary component of the National Packaging Covenant. The covenant is a co-regulatory package and has been agreed by industry and governments to introduce measures to reduce the environmental impacts of packaging materials.[46] Those who choose not to participate in the covenant are subject to the UPM NEPM. In November 2009 the EPHC supported, in principle, the strengthened Australian Packaging Covenant to replace the National Packaging Covenant due to expire in June 2010. The updated covenant has a greater focus on package design, workplace recycling, public recycling, and litter reduction projects. The extension of both the Covenant and the underpinning UPM NEPM beyond 2010 is under discussion.

Climate change policy

The Australian Government has committed to creating a low-pollution economy in which Australia's environment is protected. Underlying the Government's climate change policy are three pillars:

- *mitigation*—to reduce Australia's greenhouse gas emissions
- *adaptation*—to adapt to the climate change we cannot avoid
- *global solution*—to help shape a collective international response.[47]

Mitigation—The Australian Government has proposed the Carbon Pollution Reduction Scheme (CPRS) as the main driver to reduce greenhouse gas emissions. This is an emissions trading scheme which will use a 'cap and trade' mechanism. The cap is an upper limit on the country's carbon pollution to reduce it in future years. The ability to trade reduces the economic cost of meeting carbon pollution reduction targets. In January 2010, the Australian Government announced an unconditional greenhouse gas emissions target of 5% below 2000 levels by 2020 and conditional targets: by up to 15% or by up to 25% depending on the extent of future global agreement and action.[48]

The CPRS will apply to the waste sector, in particular to emissions from landfill. There are also opportunities for reducing greenhouse gas emissions in the future through increased recycling of some materials such as aluminium. Producing aluminium from virgin material involves a high energy cost compared with the energy costs of producing it from recycled content product.[49]

Adaptation—Because some greenhouse gases stay in the atmosphere for about 100 years after they are first emitted, some changes will be unavoidable due to past and inevitable future global emissions. The Australian Government is supporting a broad range of climate change science research activities to improve understanding of global and regional climate change and its potential impact on Australia's natural and managed systems.[50]

Global solution—In 2007, Australia ratified the Kyoto Protocol, an international and legally binding agreement that commits industrialised countries to reduce or limit their greenhouse gas emissions. Under the Kyoto Protocol, Australia is on target to slow growth of its carbon pollution emissions to 108% of 1990 levels in the first compliance period.

Through the United Nations climate change negotiations, the international community is working to develop a new long-term approach for global cooperation on climate change. Australia is committed to playing its full and fair part. The Australian Government has set targets to reduce emissions to 25% below the levels in 2000 by 2020, if there is a fair contribution from all emitters around the world to take strong action to reduce the risk of dangerous climate change by restraining atmospheric concentrations of greenhouse gases to 450 parts per million. If the international community is unable to reach agreement on a 450 parts per million target, the Australian Government still aims to reduce emissions in Australia by between 5 and 15% below 2000 levels by 2020.[51]

Renewable Energy Target

On 25 August 2009, national legislation was passed to deliver a national Renewable Energy Target of 20% renewable energy in Australia's electricity supply by 2020. This expands the previous Mandatory Renewable Energy Target (MRET) by over four times to 45 000 gigawatt-hours in 2020.[52] The MRET has been in place since 2000.

Eligible renewable energy generators can create tradable renewable energy certificates for each megawatt hour they generate. Under the new scheme, landfill gas generators are still eligible to create Renewable Energy Certificates. There will be a greater demand for certificates given the higher target and this is likely to increase uptake of landfill gas generation where this is feasible and economically viable relative to other eligible technologies. The target is a transition measure and will be maintained to 2025 then phased out progressively by 2030.

Policy and regulatory environment–regional and local

The role of local government depends on the regulatory framework of the state or territory it is located in, and can vary significantly. Public health legislation has traditionally underpinned waste-specific legislation, requiring local government to regulate municipal waste. Local governments also have planning responsibility for infrastructure needs for municipal and industrial waste facilities in their local areas and making provision for these in local planning schemes.

Local governments, of which there are 562[†] around Australia, play an important role in delivering household waste collection and recycling services, managing and operating landfills, providing education and awareness programs, and providing and maintaining litter infrastructure. They may also contribute to aggregated approaches to waste management through waste levy contributions and joint funding and operation of large scale infrastructure projects such as alternative waste treatment facilities.

Local governments often have compliance and enforcement roles in littering and the illegal disposal of waste. In some cases, they develop and deliver community-based initiatives such as clean up days, e-waste collections and composting trials. For example, Parramatta and Auburn City Councils in Sydney are designing a new waste exchange program in the Camellia and Silverwater industrial precincts with funding from the NSW Environmental Trust. New systems will be developed in the precincts, providing participating businesses with cost-effective opportunities to recover, re-use and recycle resources from waste streams of other businesses.[53]

Regional and local options for waste management are discussed further in **Chapter 4.6**.

† As of 3 March 2010. Source: Australian Local Government Association.

Conclusion

Since 1992, there has been a significant change in the pattern of waste management in Australia with growing diversion of waste from landfill and increased resource recovery. Community values and behaviour and attitudes to waste have also changed.

These trends are reflected in recent state and territory waste policies which focus on waste minimisation and re-use, and stronger alignment with related policies to achieve sustainability outcomes such as water and energy conservation and greenhouse gas reductions.

In the future, waste policies will need to address increased demand for recycling services and resource recovery infrastructure, as well as opportunities for new markets, products and technologies. The new National Waste Policy will assist this through co-ordinated action in a number of areas, including a National Product Stewardship framework and a national system of waste definitions and classifications.

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CHAPTER 4.5
TAKING RESPONSIBILITY FOR PRODUCTS AND MATERIALS

This chapter examines approaches to avoiding waste. It covers green design, sustainable materials management and product stewardship. It outlines international and national policy approaches to reducing the effects of manufactured goods on the environment and health and safety, through their design, manufacture, supply chain, consumption, and end-of-life disposal. The chapter gives examples of schemes and arrangements that governments, industry and the community have implemented to minimise those effects.

Waste avoidance–green design and sustainable materials management

Recycling programs have reduced the amount of waste that is sent to landfill, yet the amount of waste generated continues to rise. A focus on whole-of-life waste management will be increasingly necessary to manage these greater volumes. This approach, often referred to as 'sustainable production and consumption' is defined by the United Nations Commission on Sustainable Development as:

> The use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardise the needs of future generations.[1]

How products, systems and services are designed plays an important role in the avoidance of waste as well as in the efficiency and effectiveness of resource recovery, recycling and disposal. Research shows that 70–90% of a product's environmental and economic impacts are determined at the design stage.[2] From a design perspective, the waste associated with a product is influenced by:

- material efficiency—that is, the amount of material used to manufacture the product and the amount of waste generated during production
- the durability and serviceability of the product, which can delay disposal and reduce the number of times it needs to be replaced, and
- the ease with which the product can be re-used or recycled.

Material efficiency is largely driven by cost, although it has significant sustainability benefits. Reducing the amount of material used to manufacture a product generates environmental savings at every stage of the product life cycle. For example, less raw materials are needed, less waste is produced during the manufacturing process and there is less material to be managed or recovered at the end of its life.

The amount of waste generated by consumption is linked to changes in product durability and serviceability. Many products have a relatively short life span because they fail, go out of fashion or become obsolete. Most appliances and electronic products are no longer repaired when they fail because their price has fallen significantly in real terms,[3] and the cost of repair is often close to or higher than the cost of replacement.

The ease with which a product can be re-used or recycled often depends on its complexity. For example, electrical and electronic products and furniture are made from many different materials. The items need to be disassembled before the materials can be recovered—a process that can be labour intensive.

'Green design' (also known as eco-design) is the design and development of products that are intentionally created to be more durable and energy efficient, avoid the use of toxic materials, and are easily disassembled for recycling.[4] It has an increasing influence on product design today as a result of environmental regulation, product standards, corporate responsibility, extended producer responsibility schemes and green procurement practices.

Internationally, there are many policies to promote eco-design and to address the environmental impacts of products throughout their life cycle, including

- the European Commission's (EC) Integrated Product Policy (IPP), and its successor, the Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan

- the Sustainable Materials Management initiative of the Organisation for Economic Co-operation and Development (OECD), and
- the Framework Programmes on Sustainable Consumption and Production of the United Nations Environment Programme (UNEP).

European Commission's Integrated Product Policy

The IPP addresses all phases of a product's life cycle and focuses on taking action where it is most effective.[5] It encompasses policies that:

- require a certain standard of product performance (EU 2005 Eco-design Energy Efficiency Directive)
- ban certain substances in products (EU 2002 Regulation of Hazardous Substances Directive)
- require extended producer responsibility (EU 2002 Waste Electrical and Electronic Equipment Directive), or
- provide assurance to consumers that a certain level of environmental performance has been achieved (ecolabelling schemes such as Germany's Blue Angel Eco-mark).

In 2008, the EC developed the SCP/SIP Action Plan, with the objective of creating a

> virtuous cycle: improving the overall environmental performance of products throughout their life-cycle, promoting and stimulating the demand for better products and production technologies and helping consumers to make better choices.[6]

The EC has introduced a number of product-oriented directives.

The 2002 Directive on Waste Electrical and Electronic Equipment (WEEE)

This sets collection, recycling and recovery targets for all types of electrical goods. It imposes responsibility for the disposal of waste equipment on manufacturers. Manufacturers are required to establish collection infrastructure and either re-use/refurbish WEEE or dispose of it in an ecologically friendly manner.

The 2002 Regulation of Hazardous Substances (RoHS) Directive

This works in tandem with the WEEE Directive and bans the marketing of electrical and electronic products containing more than agreed levels of lead, cadmium, mercury, hexavalent chromium, and polybrominated biphenyl or polybrominated diphenyl ether flame retardants. Its objective is to reduce the risks to human health and the environment during manufacture, use, disposal and/or recycling of electrical and electronic equipment. The RoHS covers household appliances, IT and telecommunication equipment, consumer equipment, lighting equipment, electrical and electronic goods, toys, leisure and sports equipment, automatic dispensers, light bulbs and household lighting sources.

The 2005 Eco-design: Energy Using Products Directive

This establishes the framework for eco-design requirements by which products can receive a 'CE' marking. This label allows products/services to be placed in the EU market. It currently focuses on energy-using products and fosters market transformation/eco-innovation by targeting and cutting out lowest performers.

OECD Sustainable Materials Management

OECD countries have policies to prevent and reduce waste generation and treat the remaining waste in an environmentally sound manner, but waste generation continues to increase.[7] In 2005, the OECD began work on 'sustainable materials management', which aims to develop integrated material and waste policies to address environmental aspects of the whole life cycle of materials from cradle to grave. The OECD defines sustainable materials management as an approach which promotes the sustainable use of materials from the point of extraction through to material disposal. It involves reducing environmental impacts as well as taking into account economic efficiency and social considerations.[8]

UNEP Framework Programmes for Sustainable Consumption and Production

The 2002 World Summit on Sustainable Development endorsed the 3R policy approach ('Reduce, Re-use, Recycle') as a means of achieving sustainable consumption and production. UNEP developed a 10 year Framework Programme for Sustainable Consumption and Production, encompassing Sustainable Consumption, Cleaner Production and Life Cycle Initiatives.

In concert with the Framework Programme, Environment Ministers from the G8 countries (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom (UK), and the United States (US)) agreed to prioritise 3R policies and take action to improve resource productivity. They acknowledged the need for policies to further stimulate technological development and innovation, and to create markets for resource efficient products. They also recognised that governments alone cannot produce the necessary changes and that the contribution of all actors and sectors of society is crucial.[9]

Some countries have introduced overarching eco-design or sustainable materials management policies as part of their participation in OECD, UNEP or EU initiatives. The US has a Sustainable Materials Management Policy, Japan the 3Rs and Sound Material Cycle policies, and China the Circular Economy Policy. Economy-wide funding arrangements to bring forth new technological responses to achieve eco-design or sustainable materials management are also common. Examples include the Canadian Sustainable Technology Development Strategy, the US's Clean Energy Alliance and South Korea's Environmental Technology Business Incubator. **Chapter 1** has more details of international initiatives.

Australian approaches

Australia has taken a different approach to over-arching eco-design or sustainable materials management policies, and has a number of initiatives which span energy, water and waste programs. The OECD in its report *Eco-innovation in Australia* lists 52 programs.[10] Funding arrangements are specific to sectors, industries or programs.

Significant eco-design initiatives in Australia that relate to material or resource consumption and waste are:

- the Victorian Eco-Innovation Lab, a think tank that aims to build capacity and influence investment and social choices to expand the market for innovation;
- the National Packaging Covenant which supports innovative waste avoidance, materials management and resource recovery technologies, and assists in leveraging private investment. To date, the National Packaging Covenant has provided \$23 million to 60 projects with a total value of \$80 million. Recent projects include the establishment of a facility to recycle plastic bags and film, support for facilities to re-process glass fines for abrasives and road applications, and developing collection systems, re-processing facilities and markets for expanded polystyrene;
- the Victorian Government's Sustainability Fund, which supports projects fostering the environmentally sustainable use of resources and best practice in waste management to advance the social and economic development of Victoria. Examples of recent projects include mobile plastics shredders to recycle plastic waste in Northern Victoria, recycling of effluent from food producers, and developing a 'green community facilities' precinct in Queens Park which aims to reduce waste and greenhouse gas emissions;
- the Western Australian Government's Strategic Waste Initiatives Scheme, is supported by funds from the Western Australian Landfill Levy. The scheme aims to provide support and encouragement to business and industry, local government, community groups and individuals, in tackling priority waste streams. Recent projects include biodegradable alternatives and recycling opportunities for plantation agricultural polyethylene mulch film, polyethylene drip irrigation tape and crop netting, developing a recycled concrete road base performance specification for local government, and developing a small scale anaerobic digester suitable for processing food waste to produce biogas.

Product stewardship and extended producer responsibility

Product stewardship is an approach which acknowledges that all those involved in producing, manufacturing, selling, using and disposing of products have a shared responsibility to ensure the environmentally sound management of those products. Product stewardship schemes include take-back schemes, advanced disposal fees, deposit refund, a combined upstream tax/downstream subsidy, and standards.

Product stewardship schemes that place primary responsibility on the producer are called 'extended producer responsibility' (EPR) schemes and are based on the 'polluter pays' principle. Under this approach, manufacturers or producers bear the cost of managing the waste associated with their products.

The EU first introduced EPR directives for products in 1975. The most far-reaching of these are the 1994 Directive on Packaging and Packaging Waste and the 2002 WEEE. Since 1994, the OECD has published several reports on EPR including a *Guidance Manual for Governments 2001*, and an *Analytical Framework for Evaluating the Costs and Benefits of Extended Producer Responsibility Programmes 2005*.

According to the OECD, an EPR scheme is characterised by

- the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and
- the provision of incentives to producers to take into account environmental considerations when designing their products.[11]

Governments introduce product stewardship schemes for various reasons including limited space for landfill, lack of capacity to safely manage specific forms of waste at a municipal level (including products containing hazardous substances), in response to international regulations and agreements, increasing prices for oil and raw materials, availability of new recycling technologies, the scarcity of resources, and changing community values. Product stewardship and EPR schemes are widespread in Asia, Canada, the EU, and some parts of the US. **Table 4.11** sets out examples of schemes in these jurisdictions.

In Australia, a number of product stewardship and EPR schemes exist, including regulatory, co-regulatory and voluntary schemes. These have generally been developed on a product-by-product basis. **Table 4.12** provides examples of some of the Australian schemes.

Regulatory schemes

Under regulatory schemes, operational and governance arrangements are specified in legislation. Such schemes may apply a levy to a product to assist in its recycling or disposal.

The *Product Stewardship for Oil Program* is one example. Introduced in 2001 by the Australian Government, it provides incentives to increase the recycling of used oil. Under the *Product Stewardship (Oil) Act 2000*, a levy is placed on oil producers and importers of petroleum-based oils and their synthetic equivalents. This levy funds the collection and recycling system for waste oil, paying benefits to those who recycle it.

In South Australia a regulated container deposit scheme was introduced in 1977, and has proved to be successful in reducing litter and enhancing resource recovery for beverage containers. It allows people to retrieve their deposit for each beverage container they return to a recycling depot. The state government has recently increased the deposit amount on beverage containers from 5 to 10 cents to encourage more recycling of beverage containers.[12]

In 2005 the Australian Government introduced regulations under the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989*, to control the acquisition, disposal and handling of refrigerant gases. The regulations affect the refrigeration and air conditioning industry, and persons who handle these substances are required to hold a Refrigerant Handling Licence. Companies or persons who deal in and dispose of these substances are required to hold a Refrigerant Trading Authorisation. The regulations are administered by an industry board, the Australian Refrigeration Council (ARC).[13]

Table 4.11: Examples of product stewardship and EPR schemes in Europe, North America and Asia

Product/item	Countries and scheme governance
Waste electrical and electronic equipment	**EU:** Directive 2002/96/EC on waste electrical and electronic equipment **Holland:** *WEEE Decree of July 2004* **USA:** *Minnesota Electronics Recycling Act 2007* **China:** Management Regulation on the Recycling and Treatment of Disposal Appliances and Electronic Products **Taiwan:** *Waste Disposal Act 1988* **Japan:** *Law for the promotion for the effective utilisation of resources 2003*
Batteries	**EU:** Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators **Belgium:** Belgian Battery Take-back Scheme (BEBAT) **USA:** Waste Diversion Ontario Battery Scheme **South Korea:** *Product Recycling System 2003* **Taiwan:** *Waste Disposal Act 1988*
Mercury containing products	**EU:** Directive 2002/95/EC Reduction of Hazardous Substances **USA:** Lamp and other Mercury-containing Products Programs **South Korea:** *Product Recycling System 2003*
Packaging	**EU:** Directive 94/62/EC on packaging and packaging waste **France:** *Household packaging decree* **Germany:** *Closed-Loop Substance and Waste Management Act 1994* (includes the German Packaging Ordinance) **Switzerland:** *Beverage Container Ordinances of 1990 and 2000* **UK:** *Producer Responsibility Obligations (Packaging Waste) Regulations* **Japan:** Containers and packaging recycling law **Taiwan:** *Waste Disposal Act 1988*
General consumer products (e.g. whitegoods, lubricants, tyres)	**EU:** Directive 2005/64/EC on approval of motor vehicles with regard to their re-sale, recycling and recovery **EU:** Council Directive 75/439/EEC on disposal of waste oils **Holland:** *Management of White and Brown Goods Decree 1998* **Canada:** *Ontario's Waste Diversion Act 2002, British Columbia's Waste Recycling Regulation 2004* **South Korea:** *Product Recycling System 2003* **Japan:** *Home Appliance Recycling Law 2001, Law for Promotion of Effective Utilisation of Resources*

Table 4.12: Examples of product stewardship and EPR schemes in Australia

Regulatory	Oil	*Product Stewardship (Oil) Act 2000* imposes a levy to fund recycling
	Beverage containers	*Beverage Container Act 1975* (South Australia)—legislation for deposit and refund on beverage containers
	Refrigerant gases	*Ozone and Synthetic Greenhouse Gas Management Act 1989* undertaken by Refrigerant Reclaim Australia—in place since 1998 and regulated in 2000
Co-regulatory	Packaging materials	Used Packaging National Environment Protection Measure (NEPM) under *National Environment Protection Council Act 1994* with regulation under separate legislation in each State. Introduced in 1999, underpins the National Packaging Covenant, a joint industry-government scheme
Voluntary	Chemical and pesticide drums and contents	drumMUSTER and ChemClear—Industry led schemes under Industry-Commonwealth Agreement in 1998 subject to re-assessment and authorisation by ACCC every 4 years
	Mobile phones	MobileMuster—voluntary industry scheme commenced 1999
	Cartridges	Planet Ark—voluntary industry scheme commenced 2003
	Mattresses	Dreamsafe (Vic) and WSN (NSW)—local company-based fee for service to remove and recycle used mattresses
	Computers	Byteback—free take back trial in Victoria, jointly funded by Victorian Government, leading computer manufacturers and peak industry association. It commenced in 2005.

Co-regulatory schemes

Co-regulatory schemes include voluntary industry-run initiatives which are supported by government regulation. The industry component (which is negotiated with government) provides the industry with the flexibility to construct the most efficient and effective arrangements for recovery of targeted products. The regulatory component targets those not willing to participate (known as free-riders) and ensures that participants in the industry component are not unfairly disadvantaged compared with the free-riders in the market place. Scheme participants determine the operational arrangements and meet running costs.

The National Packaging Covenant is an example of such an arrangement and has been in operation since 1999. The Covenant aims to ensure that all involved in the packaging chain play their part in reducing packaging waste, and is underpinned by the Used Packaging National Environment Protection Measure (NEPM) under the *National Environment Protection Council Act 1994*. The Covenant is the voluntary component of the co-regulatory arrangement.

Voluntary schemes

Voluntary schemes are those set up by industry and/or non-government organisations for the collection and recycling of a specific waste product. These may be limited to a single organisation or extend across the industry.

Newsprint recycling

Newspaper publishers first committed to using recycled newsprint in their manufacturing processes under a voluntary Industry Waste Reduction Agreement in 1991. The goal of the agreement was to reduce newspaper waste going to landfill. The Publishers' National Environment Bureau (PNEB) runs the scheme on behalf of the industry.

As a result there has been an increase in the newsprint recycling rate from an estimated 28% in 1991, to 53% in 1995 and 74% in 2005.[14] Paper containing 40% recycled fibre was found to be of superior quality to virgin newsprint, with a smoother printing surface and reduced thickness. This in turn resulted in improved paper roll yields and reduced waste by 7%, with flow-on environmental benefits in handling and road transport. Similarly, recycling old newspapers uses less energy than the mechanical pulping of wood for newspaper.

PNEB prepares five-year Sustainability Plans which detail the industry's environmental targets and improvements. The 2006–2010 plan was endorsed in 2005 by the Environment Protection and Heritage Council, which noted that this was the most successful example of voluntary recycling in Australia.[15] The 2006–2010 Plan aims to add new recycling targets and improve energy and water conservation across the industry.[16]

Cartridges for Planet Ark

In 2003, Planet Ark, Close the Loop® and participating manufacturers set up the innovative 'Cartridges 4 Planet Ark' program, under which cartridges are collected and returned for re-manufacturing and recycling, therefore reducing disposal to landfill. A number of producers (including Brother, Canon, Epson, HP, Konica Minolta and Lexmark), recyclers (Close the Loop®) and collection outlets (including Australia Post, Office Works, Dick Smith, Tandy and Harvey Norman) share responsibility for the product at end-of-life.[17]

Fuji Xerox

Fuji Xerox has a long-standing commitment to accept responsibility for its photocopying and printing products throughout their life cycles. It accepts all packaging, products, parts and toner cartridges returned by its customers for re-manufacturing and recycling. It also incorporates policies for re-manufacturing and recycling into its product design process.[18] Fuji Xerox claims that its product stewardship scheme results in the recovery of more than 99% of the resources embodied in the equipment it takes back for recycling.[19]

MobileMuster

MobileMuster is the recycling program of the Australian Mobile Telecommunications Association (AMTA), the peak body representing Australia's mobile telecommunications industry. It is the only electronic product recycling program led by the whole of industry in the world. It is funded voluntarily by its members, including handset manufacturers, battery distributors and mobile phone network service providers. These organisations pay an advance recycling levy, raising 42 cents for every handset they import into Australia.[20]

MobileMuster was initiated by AMTA in 1999 to collect and recycle mobile phone handsets, batteries and accessories from a network of over 3200 mobile phone retailers, local councils, government agencies and business drop-off points across Australia. The recycling service is free to consumers, schools, businesses, local councils and government agencies. AMTA reports annually on the program. The 2007–08 report noted that 97 tonnes of mobile phone components were collected for the year, up 24% on the previous year. The number of handsets and batteries collected also increased by 31%, to 755 200. Disposal of handsets to landfill has decreased.[21]

drumMUSTER and ChemClear

drumMUSTER and ChemClear are two chemical collection, recycling and disposal programs run by Agsafe Limited (a non-profit organisation). The programs were developed by the National Farmers Federation, the Australian Local Government Association and a number of peak industry associations through the Industry Waste Reduction Scheme. The programs include some 72 manufacturers of agricultural and veterinary chemicals. Participating manufacturers pay a four cent per litre or kilogram levy to Agsafe to run the programs, which is passed on through the distribution chain until it becomes part of the final purchase price of the agricultural or veterinary chemical.

drumMUSTER collects clean chemical containers for re-use or recycling. Some containers are sent to landfill if no other alternative exists. As at October 2009, more than 14 million containers have been collected from over 700 sites, representing over 18 000 tonnes of recyclable material saved from landfill.[22]

ChemClear collects unwanted agricultural and veterinary chemicals in rural areas for safe disposal through a website and a free call booking system. Chemicals produced by participating companies are collected free of charge, while those produced by non-participating manufacturers incur a collection fee. Collections occur when quantities of chemicals reach a threshold for a particular region.[23]

FluoroCycle

FluoroCycle is a voluntary scheme expected to commence early in 2010. It aims to increase the recycling of mercury-containing lamps and decrease the volume of them going to landfill. The initial focus of the scheme is on the commercial and public lighting sectors, which account for approximately 90 percent of lighting waste. The scheme will give public recognition to businesses and organisations that become signatories and meet relevant conditions. For example, generators of waste mercury-containing lamps will be required to recycle their lamps to become signatories. Signatory status will also be awarded to promoters of the scheme, such as business partners or association members. The scheme will include an outreach strategy, providing information and advice to potential signatories to increase participation.

National arrangements

Product stewardship and extended producer responsibility has been a key policy of the Environment Protection and Heritage Council (EPHC) and its predecessor, the Australian and New Zealand Environment and Conservation Council. To date, the main option for introducing national product stewardship schemes has been the development of NEPMs for particular waste products or materials.

NEPMs are broad framework-setting statutory instruments developed and implemented under the *National Environment Protection Council Act 1994* to provide for the protection or management of particular aspects of the environment. A Used Packaging NEPM was introduced in 1999 to underpin the industry-led National Packaging Covenant.

At its November 2009 meeting, EPHC agreed to a landmark product stewardship framework and announced that televisions and computers would be the first products to be covered by this legislative framework. The tyre industry is also developing a scheme to increase recycling in Australia of used tyres.[24]

State-based approaches

South Australia was the first Australian jurisdiction to introduce a regulated product stewardship scheme with its *Beverage Container Act 1975*. The original purposes of the legislation were to reduce litter and solid waste and to conserve resources.

The NSW *Waste Avoidance and Resource Recovery Act 2001* provides for the development and implementation of product stewardship schemes. It requires the Director-General of the Department of Environment, Water and Climate Change "to publish an annual priority statement on EPR schemes that the Director-General proposes to recommend for implementation."[25] In the last annual statement, the Department retained its focus on 17 'wastes of concern' noted in previous statements and gave notice that the following products "could require regulations relating to producer responsibility schemes to be initiated in NSW in the coming 12 months". These products are lightweight plastic bags, tyres, TVs and computers.[26]

In Western Australia, the *Waste Avoidance and Resource Recovery Act 2007* includes provisions relating to both product stewardship and EPR schemes. The guiding principle for the application of EPR in Western Australia is that "the Government would not intervene where industries are effectively reducing priority wastes, but would act decisively where they are not".[27] Like the legislation in NSW, this Act requires the WA Department of Environment and Conservation to release an annual priority statement, outlining 'areas where the development of EPR schemes is considered necessary to reduce problem wastes'.

Tailoring overseas schemes to Australian conditions

Internationally, product stewardship has been applied broadly to a range of products and stakeholders. The focus in recent times has been predominantly on EPR schemes. Two reports, 'Product Stewardship Schemes in Asia'[28] and 'Product Stewardship in North America and Europe'[29], concluded that there is no single approach that could be simply copied and introduced into Australia for any given product or material. Each approach needs to be evaluated objectively to understand its policy drivers and its evolution over time, and to consider its applicability to Australian conditions.

Factors that drive policy in countries such as Japan, Taiwan, South Korea and China may differ from those relevant to Australia. In Asian countries, limits on landfill, lack of capacity to manage waste at a municipal level, and scarcity and cost of inputs for manufacturing, have led to the development of EPR schemes.[30] In Europe, limited landfill capacity results in high costs. These issues are less important in Australia, where landfill is not constrained by physical availability and is relatively inexpensive.[31]

However, Australia can apply general lessons from international product stewardship schemes, including the need to

- effectively design financial incentives
- provide incentives (and possibly obligations) across the various participants in the supply chain
- consider impacts on competition, and
- ensure appropriate participation of manufacturers, account for free-riders and include a resource and innovation focus.[32]

Views of Australian stakeholders on product stewardship

Within Australia there is general support amongst stakeholders for product stewardship approaches. Submissions to the 2006 Productivity Commission *Inquiry into Waste Generation and Resource Efficiency*,[33] generally expressed support for the expansion of EPR schemes if they are backed by quality research about issues associated with disposal of the product and benefits of avoiding disposal. However, submissions also noted that this approach would not be suitable or necessary for all products. The models most commonly discussed as successful examples of EPR and product stewardship schemes were container deposit as implemented in South Australia, and the National Packaging Covenant. It should be noted that support for these schemes is not unanimous with one criticism being that it is difficult to measure the outcomes of the schemes.[34]

Respondents to the 2008 Senate Inquiry into the *Management of Australia's waste streams*[35] were polarised about the benefits of a container deposit scheme. Individuals and environmental groups appear to strongly support the scheme, while manufacturing and other industry groups were either not supportive or recommended further study. Government related entities generally supported the notion of the scheme where benefits could be proven.[36]

The majority of submissions to the National Waste Policy supported development of an EPR/ product stewardship framework as a means of effectively managing problematic waste streams (e.g. e-waste and hazardous waste). Strong views were expressed that EPR schemes would not be appropriate for all waste products and that analysis detailing net benefits must inform which products are included. Submissions noted that programs should be monitored and supervised by government, be accompanied by measures to address free-riders and ensure equity between remote and urban areas. Further, the framework should not be overly prescriptive to allow schemes to be tailored for different products.[37]

Conclusion

Waste avoidance approaches such as green design, sustainable materials management and product stewardship, assign responsibility for the avoidance or management of waste to those who design, manufacture and use products.

These approaches are usually supported by government regulation or by industry initiatives that involve co-regulation. Voluntary action plays an increasingly important role, particularly in waste avoidance and recyclables collection initiatives.

Product stewardship and extended producer responsibility schemes have been widely adopted overseas as an approach to address lack of landfill space, manage hazardous components in end-of-life products, apply new recycling technologies, reduce costs for local municipalities and reflect community values about safe management of end-of life products.

A new national legislative framework for product stewardship in Australia will provide for regulatory, co-regulatory and voluntary approaches, enabling business to take responsibility for the nature and amount of end-of-of life waste and/or products. Televisions and computers will be the first products to be covered by the proposed legislation.

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CHAPTER 4.6
REGIONAL AND REMOTE AREAS

For the one-third of Australians who live outside the major metropolitan areas in regional, remote and Indigenous communities,[1] local government is generally responsible for their waste management. Of the 143 submissions made in response to the consultation paper, *A National Waste Policy: Managing Waste to 2020*, 20% were from local governments or their representative organisations. Common concerns related to landfill management, access to re-use and recycling facilities, the need for small-scale solutions to local waste management issues, and the quality of waste management in Indigenous communities. Councils noted that the waste they manage is similar in nature, complexity and hazard to that in urban areas.

Information in this chapter draws on the views expressed by local government in their submissions to the consultation paper, unless an alternative source is referenced. Landfill data has been drawn from the results of the Waste Management Association of Australia's (WMAA) National Landfill Survey 2007–08.[*]

Landfill management

Australia's major waste streams have historically been dealt with relatively close to their source and in most localities the primary means of waste disposal is landfill. Most regional centres have significant landfill capacity within 20 to 30 kilometres of their urban boundaries.[2] The relatively low cost of landfill, compared to the cost of transporting materials to recycling facilities, makes landfill the economical option. The location of some landfills in regional areas is shown in maps in **Chapter 2** of this Report.[†] Further information is provided in **Chapter 3.1**.

Most small-to-medium landfills are found in regional and remote areas and accept up to 100,000 tonnes of waste per year. Many of these landfills may not be suitable for retrofitting to enable gas capture due to their size, scale, topography and location.[3] In addition, they may not have liners and leachate management to reduce their impact on air, water and soil quality. **Figure 4.4** shows a range of environmental indicators for small-to-medium landfills.

In submissions to the consultation paper, councils expressed concern that they do not have the resources or skills to meet new and increasingly sophisticated requirements for managing landfills. For example, any new requirements for managing greenhouse gas emissions will impose costs that councils believe they are not equipped to meet.[4]

Regional councils viewed their small ratepayer base as a significant limitation to their ability to fund the range of waste management services commonly considered desirable, such as kerbside recycling collection, managed landfills and diversion of recyclables from landfill. Some councils, particularly in coastal areas, must also fund waste management from a small ratepayer base for high populations of transient visitors.[5]

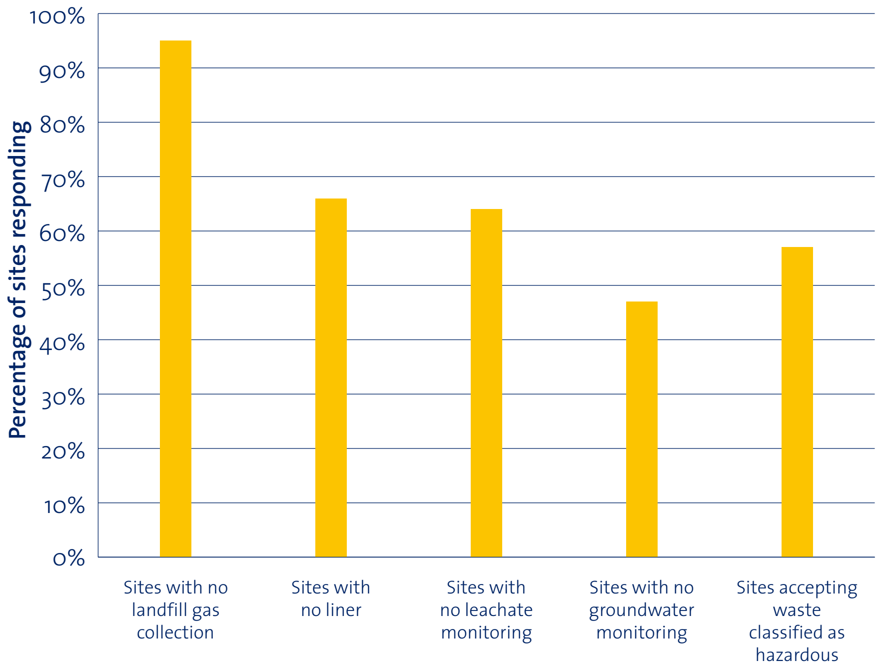
Some locations present particular challenges for councils. For example, Kangaroo Island in South Australia has around 4000 residents. The regional council has traditionally operated several small landfills on the Island that did not meet contemporary standards. After a detailed review and community consultation, the council decided that waste would no longer be landfilled on the Island. It introduced measures to assist residents with recycling and negotiated a special sea freight rate to take residual waste to the mainland.

Consolidating waste disposal at larger capacity regional landfills with management features such as lining, leachate control and gas capture, is often suggested as a solution to the difficulty of managing small landfills with fewer environmental controls. The WMAA Landfill Survey showed that landfills with capacity over 100 000 tonnes were highly likely to have these features.[6] However, in some instances, centralising facilities meets local resistance, as ratepayers have to travel further to

* It should be noted that the WMAA survey contains aggregated results from 324 landfill operators out of 665 sites surveyed. As some operators manage more than one site, the survey results cover 65% of surveyed landfill sites.

† Data on the location of all landfills, including those that have closed, are not available.

Figure 4.4: Environmental indicators of small to medium landfills (<100 000 tonnes)[7]



Source: The Waste Management Association of Australia's National Landfill Survey 2007–08

the landfill and possibly pay for disposal, and there is also a concern about the associated likelihood of illegal dumping.[8]

The opportunity for regional collaboration on waste facilities is discussed later in this chapter.

Access to recycling and re-use

A fundamental factor in regional areas is a lack of local recycling facilities and markets for recovered materials. Recycling facilities are generally clustered around capital cities or major regional centres. Although kerbside collection of recyclables is available in many regional areas, the facilities for recycling the collected materials are not usually close by.[‡]

The South East Resource Recovery Regional Organisation of Councils (SERRROC), representing 12 councils in south-eastern NSW, noted that councils are vulnerable to 'the cost versus recycling paradox'—that is, the costs of collecting and then transporting materials to a major centre where they are either broken down or transformed can be much greater than simply disposing to landfill.[9] The City of Darebin estimated it would cost about $1000 per tonne to recycle televisions, compared with landfill costs of $45 per tonne.[10]

Councils considered that recycling might be feasible with proper accounting of 'externalities', product stewardship schemes, reduction of transport costs through high-volume contracts, use of rail and regional transfer centres.[11] Submissions also identified the need for funding for local governments, particularly in remote areas, to off-set some of the costs associated with transporting e-waste to recyclers.[12]

A common view was that a national framework for extended producer responsibility applied to particular products or product features (such as packaging) would assist regional areas by reducing the amount of materials that go to landfill, and by making it economic for certain products or materials to be collected and removed to appropriate facilities.[13]

Local government areas with dispersed or low populations cannot access the volume of materials that make collection of recyclables commercially

‡ The maps in Chapter 2 of this Report illustrate types and clustering of collection services and management facilities.

viable, since transport costs outweigh the resource value of the materials.[14] Similarly, it is not viable to establish certain types of recycling facilities locally unless there is a guaranteed volume of throughput.[15]

A 2002 survey of local governments, waste generators, designers, building product manufacturers, recyclers and waste collectors undertaken by the Queensland Environmental Protection Agency (EPA) found a lack of markets for most construction and demolition (C&D) waste in regional areas, except for the traditional higher-value materials such as ferrous and non-ferrous metals and quality timber. The survey found that a major factor in the absence of recycling facilities or services is cost, particularly for transport.[16] That report also recommended publishing a Construction and Demolition Recycling Directory, listing recycling outlets for C&D waste products on a regional basis.[17] A similar proposal for a database of recycling facilities was also raised by local government.[18]

Approaches to regional waste management

Aggregation

Some local governments have established regional waste groups, usually in high population areas, to manage waste efficiently, share the costs of capital investment, achieve economies of scale in service delivery and share information. For example, in NSW, eight voluntary regional waste management groups encompass 95 councils and cover 90% of rural and regional NSW under the umbrella of 'Renew NSW'. Each group develops regional waste management and resource recovery plans to provide direction for ongoing management of waste services, identify partnership opportunities, and serve as a resource in each region. Renew NSW is supported by the NSW Department of Environment, Climate Change and Water.[19]

In its submission to the consultation paper, SERRROC supported regional waste groups noting:

> ...waste issues in regional and rural Australia can be more effectively managed through regional organisations such as SERRROC, because it enables member councils to approach and address waste stream management issues from a wider perspective than individual councils, gains access to region-wide contracts and gives member councils more clout in commercial negotiations. This situation is operating successfully in NSW but there is always a need for more assistance to make the management of the whole waste stream considerably more sustainable.[20]

In Victoria, there are 12 Regional Waste Management Groups covering rural Victoria, and a single Metropolitan Waste Management Group for Melbourne. These groups are established under state legislation and are responsible for the preparation of regional waste plans to implement statewide policies, strategies and programs. The groups work in partnership with member councils to assist implementation of the waste plan at the local level, and also play a key role in waste education and fostering best practice in waste management within the region. Waste Management Groups are funded by Victoria's landfill levy.[21]

Aggregation of waste facilities through regional cooperation gives councils the opportunity to provide more services than just landfill. This case study from Queensland illustrates multiple benefits of a cooperative approach.

Case study—regional collaboration on waste[22]

A regional partnership was formed between the Central Queensland Local Government Association and four councils in Central Queensland—Central Highlands, Gladstone, Isaac and Rockhampton regional councils. The councils cover a combined area of 147 500 square kilometres and a combined population of 211 000.

The partnership is working to award contracts in a range of important waste services, including domestic and commercial waste collection, recyclables processing, bulk haulage, landfill operations and liquid waste disposal. This voluntary regional approach is the first of its kind in Queensland.

The partnership is expected to

- deliver significant cost savings over the life of the contracts through economies of scale
- attract more interest from tenderers
- sustain new recycling services and enable the provision of kerbside recycling collection for the first time in areas such as Emerald, Capella, Springsure, Duaringa and Blackwater
- enable implementation and maintenance of consistent and best practice waste management services across the region, including in areas previously thought to be difficult or too costly to service
- result in higher rates of recycling
- remove the need to transport recyclables by road to Brisbane through construction of a regional materials recovery facility in Rockhampton, which itself will stimulate the local economy and increase employment opportunities
- drive innovation in disposal technologies, waste-to-resource and waste-to-energy options, green waste contracts and waste education initiatives, and
- inform future regional collaboration processes in Queensland.

Regional aggregation and the Trade Practices Act

It is possible to consolidate individual local government waste management contracts by regional aggregation, but such initiatives must not trigger the anti-competitive behaviour provisions in Section 45 of the *Trade Practices Act 1974* (TPA). The TPA allows for the authorisation[§] of initiatives such as tendering and contracting for waste management services. In the view of the Australian Competition and Consumer Commission (ACCC), the public benefit of the proposed activity must outweigh its costs.

Exemption applications must be examined by the ACCC, whose 'Guide to Authorisation' can be seen at the ACCC website.[23] Application fees range from $1000 to $7500. This authorisation process is a public safeguard to ensure that proposed contractual arrangements promote public benefit.

On 6 November 2009, the ACCC authorised the application of four Sydney councils to jointly tender and contract for the provision of all municipal putrescible waste transfer, processing and disposal services in their respective local government areas (*Hurstville City Council & Ors*).[24,25] Authorisation was granted for a period of 20 years, on the basis that the public benefits outweighed any costs. The application was made on 4 August 2009, and in this case, interim authorisation was granted after three weeks, on 26 August 2009. The interim authorisation allowed the councils to conduct joint tendering processes up to the point of, but not including, entering into contracts while the ACCC examined its full submission. This typifies the time frame for such authorisations to be granted.

§ Authorisation is a process under which the Australian Competition and Consumer Commission (ACCC), in response to an application, can grant immunity on public benefit grounds against action under the competition provisions of the *Trade Practices Act 1974*.

Scaleable technology

Small scale technologies may provide effective options for managing specific local or regional waste streams, in particular C&D waste and organics. However, there are many factors influencing decisions to establish such facilities. Barriers to the uptake of new technology are discussed in **Chapter 4.7** of this report.

The 2002 Queensland EPA survey of C&D waste identified various opportunities suitable for local implementation. For example, waste timber materials in regional areas could be shredded for use in the rehabilitation of current and former landfill sites. The cost of shredding was estimated to be in the range of $7 to $10 per processed cubic metre. Mobile concrete crushing plants could be used to crush small stockpiles of concrete rubble for a cost of approximately $12 to $16 per tonne (crushing and screening), plus mobilisation costs. The survey suggested that it could be possible for a group of local governments to stockpile materials and have a mobile concrete recycler crush the stockpiles on a six-monthly or yearly basis.[26]

The following case study illustrates the possibility of regional and local use of C&D waste stream material.

Case study—recycled crushed concrete as road base[27]

By recycling concrete, enough material can be provided to construct hundreds of kilometres of high-performance roads annually, eliminating the need to further deplete natural resources including millions of tonnes of virgin rock. A report commissioned by Australia's largest construction and demolition recycler, the Alex Fraser Group, has found that recycled crushed concrete (RCC) offers superior performance compared with its virgin counterpart, is cheaper, and is more environmentally friendly.

Some key benefits of RCC are:

- it has a carbon footprint 65% less than equivalent products from quarries;
- it is a softer concrete material which requires less energy to crush than virgin rock;
- it is 20–25% less dense than crushed rock so fewer trucks are required for delivery;
- since cost is calculated on a weight basis, it is cheaper than crushed rock;
- it can offer better performance in wet weather;
- reliability of supply and convenience of locations;
- cheaper disposal of waste concrete (Alex Fraser Group does not charge disposal fees for RCC delivered in Victoria, and charges a nominal amount in Queensland).

Many contractors use RCC as their first preference for materials on the basis of price. Anecdotal evidence indicates that it is quicker and easier to lay and to compact. It is thought that improved compaction is due to RCC being made up of smoother and rounder particles, with a better distribution and larger percentage of fines and binder particles in the mix.

Standard specifications

In Victoria, VicRoads has supported the use of RCC since 1993 and has developed standard specifications for class 2 and 4 pavement sub-base from RCC. Beyond meeting the VicRoads specifications, some companies also provide a guarantee that their products comply with ISO 9000. Most producers of RCC manufacture products to comply with Australian and VicRoads Standards.

Performance

Comparative tests on two sections of an industrial road in Victoria were conducted by the Australian Road Research Board using a falling deflectometer test. One section of the road was laid in 2002 using RCC and was compared with another section laid 18 years before using virgin crushed rock. The life expectancy of the RCC section was shown to be about 440 years compared to five years for the virgin crushed rock section. The strength of the RCC was calculated as 3500MPa, almost 13 times greater than the 270MPa result for the virgin crushed rock. This was despite the virgin crushed rock layer being thicker than the RCC (400mm:270mm) and being covered with more asphalt (50mm:30–40mm).

Various methods of dealing with organic waste are suitable for small scale installation, including composting systems and waste-to-energy technologies. The following case studies illustrate the value of introducing scaleable and fit-for-purpose AWTs into small communities.

Case study—HotRot

An organic recycling project on trial at The Australian National University (ANU) is reducing the environmental and economic costs of sending organic waste to landfill.

The HotRot unit is operated by ANUgreen, the University's environmental management program. The unit converts organic waste to composted material, a process that takes between 15 and 20 days. The material is then static-cured at lower temperatures for one month, using microbes that are able to function at cooler temperatures.

In 2008, 195 tonnes of food waste from on-campus food outlets and residences were diverted to the in-vessel composting unit. Feedstock for the HotRot is collected daily throughout the ANU campus and includes meat, dairy products, citrus, oil, bones, liquids, coffee grounds, paper (such as serviettes and paper towels), sugar sachets, tea bags, animal bedding and green waste. University staff and students have been educated about what can be composted and how the facility works, which helps to minimise contamination levels in the facility.

Initial benefits of this organic waste treatment trial are:

- diversion of up to a third of ANU's general waste away from landfill;
- a net operational cost saving of $15 000–20 000 per year (when compared with landfill);
- reduced production of greenhouse gases (methane) of almost 600 t CO_2-e;
- production of an 'A grade' nutrient-rich compost that is used across the ANU grounds;
- demonstration of the implementation of new technology (first in Australia);
- no production of toxic leachate;
- reduced emissions from transportation of waste, as it is processed locally;
- reduced stress on waste infrastructure.

If the trial confirms these environmental and financial benefits, the ANU hopes to extend the project to reclaim up to 90% of all food waste on campus, processing up to 500 tonnes a year from a community of around 17 000 people.[28]

Figure 4.5: The ANU HotRot organic recycling trial.

1. Bins ready to be emptied into the HotRot unit

2. Bin being loaded for emptying

3. Feedstock emptying into the HotRot

4. Composting in progress

5. Compost exiting the HotRot

6. Removal of compost to stockpiles

Photos courtesy of ANU, photographed by Dragi Markovic (DEWHA).

Case study—vertical composting unit

On Lord Howe Island, the installation in 2000 of a bio-waste treatment process known as a vertical composting unit (VCU) revolutionised waste management in this World Heritage site and replaced the shipping of organic waste from the Island.

The VCU is able to process all the Island's organic waste including meat, dairy products, food scraps, green waste, cardboard, paper, and sewage sludge.

This was the first application of the technology in an isolated community. The VCU is processing between 0.8 and 1.2 tonnes a day. This produces between 0.5 and 0.75 tonnes of compost, which local residents are using on their gardens. A three-bin sorting system was also introduced for recyclables, compostables and garbage items.[29]

Figure 4.6: The vertical composting unit on Lord Howe Island.

Photo courtesy of the Lord Howe Island Board.

Waste management issues in remote and Indigenous communities

The following discussion focuses on remote Indigenous communities, but the matters covered are also relevant to other remote communities.

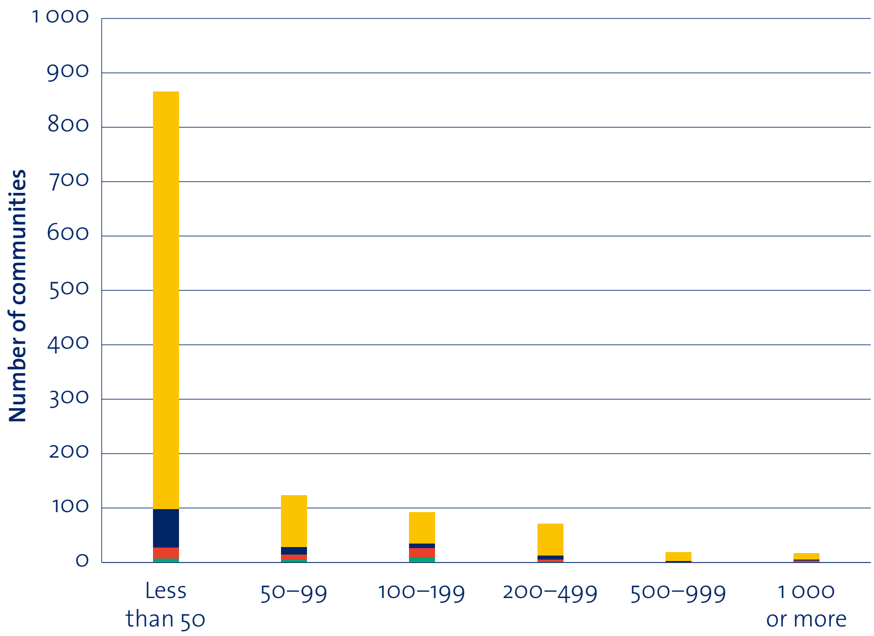
The 2006 Australian Bureau of Statistics (ABS) report *Housing and Infrastructure in Aboriginal and Torres Strait Islander Communities*[31] identified 1187 discrete Indigenous communities, classified them as non-remote,[32] remote and very remote, and gave a further categorisation according to population. As illustrated in **Figure 4.7**, of these discrete Indigenous communities, 1008 (85%) were very remote, 767 (76%) of which had populations of fewer than 50.

In relation to rubbish collection, the ABS report provided aggregated data covering 366 discrete Indigenous communities. The data do not include small communities administered by larger communities. Organised rubbish collection existed in 337 of the communities in 2006 compared with 363 reported in 2001, with the decrease in collection services occurring in the very remote communities.[33]

While more than 90% of communities had an organised rubbish collection, this does not indicate the quality or appropriateness of the service or facility. Proper siting and management of landfill facilities in remote communities are particularly important to avoid health, safety, amenity and other environmental impacts that can occur—for example, where landfill is sited close to groundwater bores that provide drinking water.[34]

In remote communities, waste management may be difficult and intermittent. The availability of suitable disposal facilities for certain materials, in particular hazardous waste, can be limited.

Figure 4.7: Remoteness of discrete Indigenous communities, by population, 2006[35]



	Less than 50	50–99	100–199	200–499	500–999	1 000 or more
Very remote	767	95	58	59	17	12
Remote	71	14	8	7	2	2
Outer regional	20	9	16	4	0	3
Inner regional	5	5	8	1	0	0
Major cities	2	0	2	0	0	0

Population sizes

Table 4.13 sets out the type of rubbish disposal in Indigenous communities according to the 2006 ABS survey. It is evident that waste management infrastructure in the surveyed communities is varied and that a significant proportion of rubbish disposal is not of an acceptable standard—for example unfenced tips and burning of waste.

Table 4.13: Types of rubbish disposal in discrete Indigenous communities by State and Territory and population, 2006.[36]

Reported usual population	Fenced community tip	Unfenced community tip	Rubbish tip outside community land	Burnt	Other type of rubbish disposal	No organised rubbish disposal[(a)]	Total[(b)]
New South Wales							
Less than 50	1	-	6	-	-	2	18
50 or more	2	1	7	-	1	2	39
All communities	**3**	**1**	**13**	**-**	**1**	**4**	**57**
Victoria/Tasmania							
Less than 50	-	-	-	-	-	-	-
50 or more	-	-	1	1	1	-	3
All communities	**-**	**-**	**1**	**1**	**1**	**-**	**3**
Queensland							
Less than 50	5	28	22	18	5	-	85
50 or more	17	9	9	-	-	-	39
All communities	**22**	**37**	**31**	**18**	**5**	**-**	**124**
South Australia							
Less than 50	15	19	14	1	-	-	63
50 or more	14	3	9	-	-	2	28
All communities	**29**	**22**	**23**	**1**	**-**	**2**	**91**
Western Australia							
Less than 50	19	117	29	8	-	3	189
50 or more	29	21	10	-	-	7	82
All communities	**48**	**138**	**39**	**8**	**-**	**10**	**271**
Northern Territory							
Less than 50	28	304	75	9	24	2	510
50 or more	26	69	31	-	2	11	131
All communities	**54**	**373**	**106**	**9**	**26**	**13**	**641**
Total							
Less than 50	68	468	146	36	29	7	865
50 or more	88	103	67	1	4	22	322
All communities	**156**	**571**	**213**	**37**	**33**	**29**	**1187**

(a) Data not collected in 'administered' communities with a population of less than 50.

(b) Total includes 'not stated'.

The following case studies from the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands of South Australia and Warraber Island in the Torres Strait, illustrate some of the waste management challenges for remote communities. Detailed waste management plans for pilot projects have been prepared for these communities taking account of local conditions. The outcomes of these pilots may be useful for other remote communities.

Case study—Warraber Island pilot project

Warraber Island was selected as the host community for a pilot project to demonstrate best-practice principles in waste management appropriate to the Torres Strait Island communities.[37] Funding for the $600 000 pilot project was provided by the Australian Government's Product Stewardship for Oil Program ($200 000), the Torres Strait Regional Authority ($200 000), the Queensland Department of Environment and Resource Management ($150 000), the National Packaging Covenant ($27 500), and the Australian Food and Grocery Council ($20 000).

Warraber Island is a low-lying coral island in the Torres Strait with an area of 37.6 hectares and a population of 281 people in 2008.[38] The Island's small area means that landfill options are severely limited, and are further constrained by extreme tides and a high water table. In addition, there are challenges in managing the export of waste materials to the mainland to meet quarantine requirements.

A detailed waste audit was undertaken in 2008. It revealed that each person on Warraber Island generated more than 500kg of waste annually. Of the total 130 tonnes of waste generated on the island each year, organic material (including paper, cardboard, food and garden waste) accounts for almost 65%. Recyclable containers represent 7%. Approximately 26% of the waste stream cannot be recovered or recycled.

The audit noted that the greatest diversion from landfill could be achieved by recovering the organic materials. In response, a sophisticated composting system is being introduced to speed up decomposition of organic materials while producing minimal odour. The system will be used to create high-grade compost which will be used on public spaces and by community members in home gardens.

A new waste management program will involve the community separating its waste into a number of streams for further management. This includes composting of organic wastes, shredding of cardboard for composting, baling of recyclables, and provision of infrastructure for waste oil. Households are being provided with different bins for waste types. Special equipment for shredding and baling will need to be purchased and maintained.

While it is intended that the full project plan will be implemented, the cost of recycling may need to be subsidised in the short term until funding arrangements are settled with the Torres Strait Island Regional Council (TSIRC) and communities. The highest risks identified for the project are a possibly low level of community engagement in the process and level of training for those employed in the new waste services.[39]

The TSIRC has already introduced a number of initiatives relating to contractor waste, householder gas bottles and purchasing of vehicles ('one on, one off') to reduce waste on the Island. Fuel is now sent to the Island in bulk rather than in small drums. The major barge operator delivering materials to the island is changing its packaging practices to reduce the amount of shrink wrap used within shipping containers by up to 50%.

Case study—APY Lands regional waste management

The Anangu Pitjantjatjara Yankunytjatjara (APY) Lands cover an area of 102 650 square kilometres in the north-west corner of South Australia. The population is around 2300, spread across 13 main communities.

The *Regional Waste Management Priorities and Implementation Plan* for the APY Lands was funded by the South Australian government to develop a strategic approach in order to reduce waste, increase resource recovery and improve landfill management. The plan aims to address the environmental and health impacts of current practices and to allow for the introduction of sustainable waste management practices across the region.

The interim report for the plan[40] notes that during the past decade, there has been no substantial capital investment in waste infrastructure. As a result, waste practices are sub-standard and there is no overall co-ordination between communities. Much infrastructure, including the collection vehicles and trailers for the APY Lands, is not operational or is in poor condition as maintenance is minimal. Many bins need replacement or repair.

Many of the landfills at the larger communities are full or almost full. Some communities urgently require new landfill sites. Many landfills are unfenced, giving access to vermin and dogs, and allowing debris to be scattered. There are instances of landfills adjacent to natural water courses or above groundwater bores that provide the water supply for communities. Typically, when new waste is delivered to landfills, it is set alight and burnt in an effort to deter feral and domestic animals and birds. Although this extends the life of the landfill, burning of large volumes of plastic results in smoke and the release of toxic contaminants into the atmosphere, contrary to the requirements of the EPA South Australia and is harmful to residents.

Barriers to improved waste management in the region include

- limited funding
- remoteness including distance to markets for recovered resources
- limited accessibility and difficult transport logistics
- limited access to skills for operating and maintaining infrastructure
- poor equipment and limited availability of parts
- hot climate
- low level of community commitment to waste management initiatives.

The interim report identifies the basic level of waste service that should be provided to each community. It recommends local collection and disposal. Local management can provide opportunities for local employment and minimise the need to transport waste long distances on poor roads. This approach also seeks to address the lack of co-ordination and service delivery for waste across the region.

The report identifies options to increase separation of materials for re-use and recycling and proposes that all landfills within APY lands be licensed to improve management practices. It also provides an inventory of works required at each site to comply with EPA requirements.

A series of trials in new waste management techniques is proposed before finalisation of the plan. This will allow for evaluation of 'fit-for-purpose' and compliant approaches to waste management for the APY Lands.

The Warraber Island and APY Lands projects identified common challenges and highlighted some differences. Warraber Island has significant landfill constraints and opportunities to divert organic waste are being pursued. The APY Lands have challenges in landfill design and management and no effective regional co-ordination or delivery of services.

Both projects identified a number of types of waste that are difficult to dispose of, and ultimately should be transported to recycling or treatment facilities. These included cooking oil, used motor oil, fluorescent lights and tubes, used lead-acid batteries, paints, tyres, end-of-life motor vehicles, scrap metals, rainwater tanks, septic tanks, e-waste, and chemical containers.[41] In many communities, these wastes are either landfilled or stockpiled.

The range and potential hazards of some of these wastes and the distance from specialised management and recovery facilities present significant challenges. It may be possible in some communities to set up central collection points. Materials could then be transferred to appropriate recycling facilities through regular pickups—for example by back-loading of delivery vehicles. Existing programs, such as drumMUSTER, ChemClear and for used oil recycling, may provide useful models.

The case studies demonstrate that solutions must be tailored to local and regional circumstances, taking account of geographic location, culture and regulatory frameworks. Provision of infrastructure and machinery should also be supported by employment, training and maintenance programs, as well as community education and engagement processes.

National action

The Council of Australian Governments' National Indigenous Reform Agreement (Closing the Gap) lists inadequate waste collection among the important contributors to the current unsatisfactory living conditions in many communities.[42] The National Partnership Agreement on Remote Indigenous Housing, signed in December 2008, sets performance indicators and benchmarks for Essential and Municipal Services, which includes waste disposal and the management of infrastructure and municipal services. The performance indicator is that Indigenous communities will have "normalised service level standards and delivery arrangements", that is, "reflect a standard of service delivered to non Indigenous people in communities of similar size and location". The benchmark is for all communities to have rubbish disposal by 2018.[43]

The Commonwealth Department of Families, Housing, Community Services and Indigenous Affairs is to conduct an audit of Municipal and Essential Services in 70 remote Indigenous communities as part of the National Partnership Agreement on Remote Indigenous Housing. The audit results will inform a report to the Council of Australian Governments on clearer roles and responsibilities and funding with respect to municipal and essential services delivery. The scope of the audit will include the capture of data and information on waste disposal.

Conclusion

Waste disposal and recycling in regional and remote communities are often costly and difficult to implement due to the small populations involved and the large distances to the nearest facilities. Often local landfill is a cheaper alternative to transporting materials for recycling. In many cases, existing landfills are not managed according to contemporary standards, and may pose risks to both human health and the environment. These risks need to be considered when costing alternatives and developing solutions.

In remote and Indigenous communities there is a need for tailored solutions, guided by local circumstances to allow these communities to manage their waste and participate in re-use and recycling schemes effectively.

Small-scale facilities, particularly in the organics, waste-to-energy and C&D materials recycling sectors, may prove viable at a regional level and provide environmental and community benefits. The cost of establishing such facilities and of transporting materials to consolidated regional facilities may need to be addressed at a state and federal level, as many small local government areas do not have sufficient resources for such undertakings.

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CHAPTER 4.7 INFRASTRUCTURE AND TECHNOLOGY–CURRENT AND FUTURE

This chapter describes the infrastructure available in Australia for the receipt, handling, processing and disposal of waste. It examines emerging demands on that infrastructure and future needs for expanded capacity, including factors that influence decisions about waste and recycling infrastructure. The chapter does not cover transport and collection of waste.

Facilities and infrastructure

Waste management and resource recovery infrastructure encompasses a wide range of facilities. From wheelie bins, skips and trucks to transfer stations, recycling facilities, manufacturing sites and landfills, all play a critical part in effective waste management.

There are 880 licences in Australia for the receipt, handling and disposal of waste, according to publicly available records. These licences cover local government and private providers and apply to about 653 actual facilities, as shown in **Table 4.14**.

Table 4.14: Number of licensed waste facilities, Australia, 2009

Type of facility	No.
Landfills	411
Transfer Stations	151
Materials Recovery Facilities (MRFs)	31
Compost	27
Hazardous	8
Storage	8
C&D	3
Liquid	10
Tyres	3
Other	1
Total	**653**

There is currently no co-ordinated national information about waste management facilities, especially about their actual capacity.

Types of infrastructure, and their capacity

1. Landfill sites

There are three main types of landfill site:

- putrescibles sites accept household and other wastes containing organic materials such as food and garden organics;*
- inert sites accept material that is not biologically active: this is mainly construction and demolition waste;
- hazardous sites accept material that is classified by authorities as requiring a higher level of management due to the risks to human health and the environment.

Almost half of all the waste generated in Australia is sent to landfill. Landfill is likely to remain an important component of Australia's waste management infrastructure, given the fact that, as discussed in **Chapter 2.1**, generation of waste in Australia increased by 31% between 2002–03 and 2006–07. Even if there is a significant increase in recycling, there will still be a need to dispose of residual materials from resource recovery and alternative waste treatment facilities.

A 2009 study by Hyder Consulting modelled the likely depletion of existing physical landfill capacity at 16 major population centres in Australia.[1] The researchers collected data on landfill capacity and subtracted, year by year, the projected quantity of material sent to landfill in several population centres: Adelaide, ACT, Brisbane, Cairns, Darwin, Geelong, Gold Coast, Hobart, Launceston, Melbourne, Newcastle, Perth, Sydney, Toowoomba, Townsville and Wollongong.

Two scenarios were modelled:

- high waste generation and low resource recovery, resulting in **rapid depletion** of landfill capacity, and
- low waste generation and high resource recovery, resulting in **slow depletion** of landfill capacity.

* In some urban centres, putrescible and inert wastes are disposed at the same site, or putrescible landfills may receive some inert material even when there are discrete local inert landfills.

Figure 4.9 shows the number of population centres out of the 16 that expect to exhaust current approved physical landfill capacity over the period 2010–2020. In this figure, the category 'all capacity' refers to total physical capacity should inert capacity be exhausted and all waste be deposited in putrescible landfill sites.

The modelling confirmed that most of the population centres have sufficient approved physical landfill capacity to last many years, and those with only a few years of approved physical capacity have plans to expand that capacity. No evidence was found of an immediate critical shortage of physical landfill capacity at any of the major population centres. The analysis highlights the potential for waste reduction and recycling to extend the lifespan of existing landfill capacity by many years. The study found that future landfill capacity was constrained most strongly by social, environmental and political factors rather than limitations on physical capacity.

The trends outlined in **Chapter 2.1** for growth rates in waste generation indicate that in the long term there is likely to be a need for new landfill capacity.

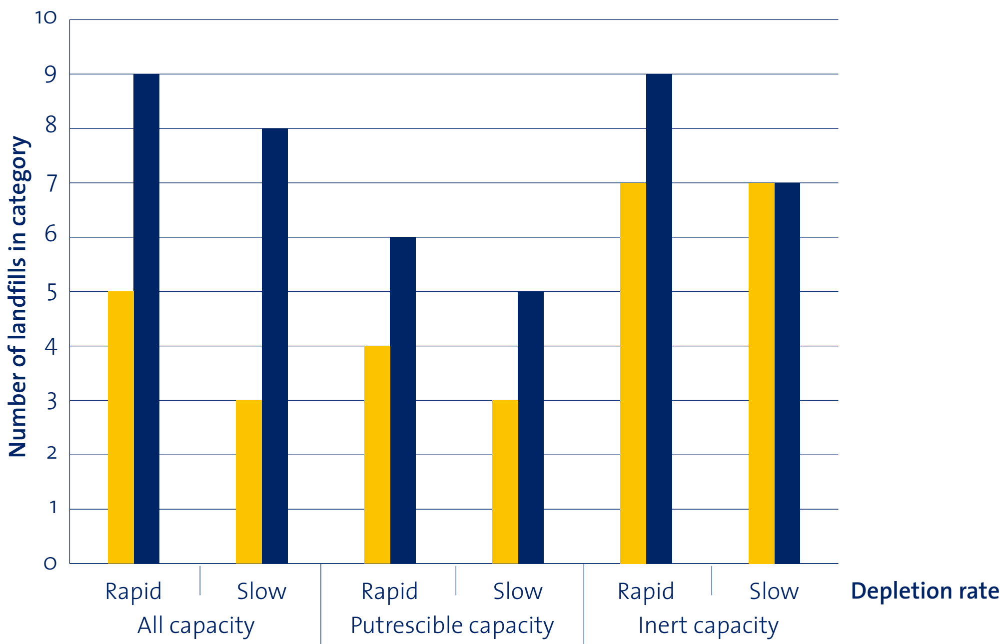
Constraints on landfill

Key constraints on future landfill capacity identified in the Hyder study are:

Distance: As landfills close, they are usually replaced by sites further away from the waste source. This can increase the environmental impact of transport. For example, the sites that currently service Cairns are expected to run out of capacity by 2010. As Cairns composts its waste using a 'Bedminster' system,† it does not need a true putrescible site. Residues from the Bedminster operation are expected to be transferred to the Mareeba landfill some 65 km from Cairns.

† A facility where the organic component of waste is turned into compost.

Figure 4.9: Number of population centres out of 16 that are likely to require approval of additional landfill space between 2010 and 2020[2]



	All capacity – Rapid	All capacity – Slow	Putrescible capacity – Rapid	Putrescible capacity – Slow	Inert capacity – Rapid	Inert capacity – Slow
No. of population centres needing to extend 'approved capacity' between 2010 and 2015	5	3	4	3	7	7
No. of population centres needing to extend 'approved capacity' between 2010 and 2020	9	8	6	5	9	7

Regulatory requirements: In recent years, the application of minimum environmental standards for lining, leachate management and groundwater monitoring have made smaller operations unviable. The Hyder Consulting report noted that the most important environmental constraint was probably buffer requirements imposed by regulators to protect sensitive land uses nearby, such as for housing. Buffer distances of 200m to 500m are common. In addition, landfilling below the average groundwater level is not allowed in some jurisdictions because the permeation of water promotes degradation and leachate loss to the environment. No further landfill development is expected in Melbourne's east and south-east, for example, because the depth from surface to groundwater is only a few metres. Perth's Swan coastal plain is another region that faces challenges in siting landfills because of its combination of sandy soils and high quality, high level groundwater.[3]

Community objections: These form a significant and increasing constraint on supply, particularly where communities are asked to accept waste from other areas. For example, in the mid-1990s, 15 000 people attended a community meeting in Werribee, Victoria, in relation to a proposal for a hazardous waste landfill. The proposal did not proceed and a subsequent decade-long search for an alternative site culminated in a proposed facility near Mildura, which also attracted strong opposition from local residents, and did not proceed.

The effect of local opposition is that waste tends to remain within localities that are accustomed to it. Extending a landfill is politically easier than establishing a new one, and founding a landfill in an area with existing sites is generally easier than one in a new area. In addition, closed landfills often provide safe locations for waste transfer stations or other waste infrastructure.[4]

2. Resource recovery facilities

In 2009 a study by GHD found that recycling of solid waste from all three streams requires infrastructure to support:

- collection and transport
- resource recovery—material recovery facilities, sorting facilities, drop-off centres, transfer stations
- re-processing—beneficiating (sorting and removal of contaminants), pre-processing, composting, dismantling, granulating etc., and
- manufacturing—transformation of materials into new materials or products; recycled paper mills, recycled plastics sites, used steel and aluminium smelting etc.[5]

The first two categories are not essential in the limited circumstances where materials can go straight from source to a re-processor or manufacturing facility.

Australia has well-developed infrastructure for the collection, transport and re-processing of recyclables in metropolitan areas. Records show that 182 facilities nationally are totally or partially dedicated to resource recovery—112 in metropolitan centres and 70 in regional or rural areas.[‡]

Re-processing in Australia includes glass beneficiation, plastics washing and granulation, composting, alternative waste treatment for organics, e-waste dismantling, crushing of construction and demolition materials, and processing of used oil, tyres, and lead acid batteries. Infrastructure for the manufacture of recycled products in Australia includes paper recycling mills, ferrous and non-ferrous metals smelters, glass manufacturing, and plastic recycling and re-manufacturing facilities.

GHD noted that different technologies or innovations are needed for different locations, scales of waste generation, material flows, market conditions, institutional contexts and type of community. At the high-volume, high-cost end of the scale there are alternative waste treatment (AWT) plants which process mixed waste. These usually involve extracting recyclable material and treating organic waste separately. Systems which mechanically extract recyclables prior to treating the organic waste are referred to as Mechanical Biological Treatment systems (MBT). At the other end of the scale is home composting.

‡ Derived from state EPA records for licensed facilities.

3. Waste technology

The locations of waste facilities in each state and territory are shown in **Chapter 2** of this report.

The main current and emerging technologies in waste management and recycling include

- digestion (aerobic or anaerobic)
- bioreactor landfill
- mechanical biological treatment
- gasification
- in-vessel or tunnel composting, and
- pyrolysis.

There is a wide range of recycling and waste management technologies in place or being trialled to establish their viability under Australian conditions. Options vary according to waste stream and waste material. **Tables 4.15** and **4.16** show some of the options for different waste streams and material types.

Table 4.15: Technology types for waste streams[6]

	Technology type				
Stream	**Mechanical separation**	**Biological**	**Thermal**	**Chemical**	**Other**
MSW	Improved sorting techniques	Anaerobic and aerobic digestion, composting, biofuel production, bioreactor landfill	Pyrolysis, gasification, plasma arc, incineration, autoclaving, production of refuse-derived fuel (RDF)	Hydrolysis	Irradiation
C&I	Improved sorting techniques	Anaerobic and aerobic digestion, composting, biofuel production, bioreactor landfill	Pyrolysis, gasification, plasma arc, incineration, autoclaving, production of RDF	Hydrolysis	
C&D	Improved sorting techniques		Production of RDF		

Table 4.16: Technology types for waste materials[7]

Material	Technology type: Mechanical separation	Biological	Thermal	Chemical	Other
Kerbside recyclables	Optical sorting (laser sensing of different material types)				
Mixed plastics	Optical sorting (laser sensing of different plastic types)		Production of refuse-derived fuel (RDF), plasma arc gasification	Pyrolysis	
Timber		Biochar	Biochar		
Concrete	Improved sorting techniques				
Paper and cardboard	Improved sorting techniques and re-processing to same plastics	Anaerobic digestion, composting	Production of RDF	Pyrolysis	
Liquid paperboard	Improved separation of components	Anaerobic digestion, composting	Fuel production (RDF)	Pyrolysis	
Food organics	Dry processes (Trommels) and wet processes	Anaerobic digestion, composting			
Garden organics	Shredding and final screening	Composting	Biochar	Pyrolysis	
Glass	Optical sorting for improved recovery and re-use applications				
Rigid plastics	Re-processing into same or other plastic products	Conversion to polyhydroxyalkan-oates	Fuel production (RDF)	Depolymerisation to fuels	
Plastic films	Re-processing		Fuel production (RDF)	Depolymerisation to fuels	
Textiles	Re-processing into other cloth		Fuel production (RDF)	Tyre components	
Carpets	Re-processing into other carpets	Fertiliser			
Mixed recyclables	Near infrared and other identification and separation techniques				
Electronic waste	Automated disassembly and handling, re-processing of components		Pyrolysis	Extract metals by supercritical water oxidation process	Extract metals by electrokinetic process
Treated timber	X-Ray fluorescence and laser sorting	Bioremediation	Plasma arc, pyrolysis, combustion with other fuels	Extraction using bioxalate solution	New wood composites, electrodialytic remediation
Tyres	Crumbing, civil engineering uses		Fuel production (RDF), steam gasification, gas phase halogenation, pyrolysis	Devulcanisation, plasma, fuel production, continuous reductive distillation	Microwave, high pressure water
Fluorescent light bulbs and tubes	Batch crushing and separation, dense medium centrifugation		Thermal retort, thermal desorption		
Dry cell batteries	Handling and disassembly systems, super cooling and shredding			Neutralised electrolytes, hydrometallurgy	Magnetic separation
Wet cell batteries	Handling and disassembly systems, crushing and screening		Refining and smelting	Electrolytes filtering, paste desulphurisation, leaching	
Hazardous waste	Big Oversized Blender	Bioremediation, phytoremediation	Molten metal catalytic extraction, plasma arc	Molten metal catalytic extraction	
Building waste	Dry separation sorting				In-place recycling

4. Future infrastructure requirements

The generation of increasing quantities of waste brings with it a growing demand for new recycling and landfill infrastructure, and the need to set aside adequate time to plan for, fund and build such infrastructure.

In 2008 *The Blue Book* reported an analysis of future infrastructure needs based on jurisdictional waste diversion targets for solid recyclables and organics. Using 2004–05 figures, it estimated that at least 150 new recycling facilities will be required by 2015, at a cost of $2.574 billion. This figure was based on recovery and processing of an extra 16 million tonnes of waste, and domestic recycling of an extra 2 million tonnes of materials.[8] *The Blue Book* predicted that this level of development would generate significant growth in economic activity and at least 2000 direct and 4000 indirect new jobs.[9] Environment Victoria estimates that 2310 jobs could be created in Victoria if diversion and recycling rates could reach 80%.[10]

In 2009, Equilibrium OMG modelled waste and recycling infrastructure needs at 2020–21. This work used 2007 as a base year and took into account the need for infrastructure for transfer and consolidation, sorting, re-processing and beneficiation and organics processing across the MSW, C&I and C&D waste streams. It aligned the potential volumes of each material at 2020–21 (plus contamination and material lost during processing) with information on existing infrastructure type and capacity, to match likely volumes of material streams with the types and numbers of facilities likely to be needed in 2020–21.[§11]

Equilibrium OMG used waste generation figures which were based on Hyder Consulting work. Although these were lower than those used in *The Blue Book,* it is notable that the number of additional facilities needed to meet future recovery needs remains significant. (The 2009 modelling focussed on larger-scale infrastructure solutions, and did not address small-scale processing, mobile facilities, biodigesters for individual sites, or major changes in onsite residential organics management.)

The Equilibrium OMG projections provide a rough estimate of the infrastructure consequences of trends in population growth, waste generation, recycling and landfill disposal.

The modelling used the three scenarios developed by Hyder Consulting:[¶]

Scenario 1—population growth plus low additional waste generation (1% p.a.) and a 'business-as-usual' recovery rate of 51.5%

Scenario 2—population growth plus higher additional waste generation (3% p.a.) and a 'business-as-usual' recovery rate of 51.5%

Scenario 3—jurisdictions' existing strategies and targets for waste reduction and increased recovery are achieved for the period from the end of financial year 2006–07 to the end of FY 2020–21. It should be noted that the time frame of the assessment varies from existing jurisdictional strategic plans, as jurisdictional assessments are mostly in the 2014 or 2015 time frame.

Table 4.17 shows the tonnages of waste generated, recycled and disposed at the base year of 2006–07 and in 2020–21 under the three scenarios.

§ For further explanation of infrastructure capacity used in this modelling, see Appendix D.

¶ For a detailed explanation of the modelling methodology, see Appendix D.

Table 4.17: Waste generated, disposed and recycled (millions tonnes) under the 3 scenarios

	Generated	Recovered/ Recycled	Disposed
Base year (2006–2007, 51.5% recovery rate)	43.77	22.71	21.07
Scenario 1 (at end of FY 2020–21, low generation)	61.39	31.64	29.81
Scenario 2 (at end of FY 2020–21, high generation)	80.47	41.48	38.97
Scenario 3 (at end of FY 2020–21, jurisdiction targets met)	58.33	38.25	20.01

Table 4.18 shows a breakdown for each waste stream and material type under the three scenarios.[**]

The Equilibrium OMG modelling focuses on projecting resource recovery infrastructure needs in 2020–21. However, it also has implications for landfill infrastructure planning. For example, under the high generation scenario, the amount of material disposed to landfill will increase by between 17.85 and 38.92 million tonnes per year by 2020–21.[††] This exceeds the figure of around 30 million tonnes per year estimated as the limit of current and future approved landfill capacity.

** The material type quantities have been extrapolated from the materials composition of Australian wastes reported in Hyder Consulting's *Waste and Recycling in Australia*, 2009 and the *National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2009*.

†† Hyder Consulting, Australian Landfill capacities into the future, 27 August 2009 and Equilibrium OMG, analyses undertaken for the Department of Environment, Water Heritage and the Arts, 2009.

Table 4.18: Total amounts of various materials (millions tonnes) expected to be recovered at 2020 under the three scenarios

Material	Recovery (millions tonnes) Scenario 1: low generation	Scenario 2: high generation	Scenario 3: targets met	Comment
Organics	6.88	9.03	8.86	Investment and technological development, infrastructure and processing capacity are likely to increase in coming years. AWTs will recover an increasing amount of organic material in mixed waste to produce energy and compost. There may also be potential for other technologies such as pyrolysis, gasification, incineration, autoclaving and refuse-derived fuel (RDF).[12]
Paper	3.10	4.07	3.83	One new paper recycling facility is about to be commissioned and another is under feasibility planning. These would add a further 450 000–500 000 tonne recycling capacity. More paper and cardboard will also be recovered from mixed municipal waste through AWTs to produce energy and compost. There may also be potential for other recovery technologies such as RDF and pyrolysis.[13]
Wood	2.39	3.01	2.68	In addition to current processes to recycle timber, including re-use and grinding to produce mulch, there is potential to process timber into biochar, which helps to restore soil fertility and sequester carbon.[14] Treated timber is particularly challenging to recover but there are a number of technologies that could be used to produce energy or wood composites.[15]
Concrete	9.22	12.13	10.67	Recent infrastructure developments have focused on separation of concrete from mixed C&D waste streams to produce road base and other construction products. There is potential to expand markets for these materials through changes to standards and procurement practices that currently discriminate against recycled materials.
Metal (ferrous and non-ferrous)	3.10	4.07	3.71	Strong international markets exist and are likely to grow for used metals. While commodity price fluctuations will affect recovery rates, there is increasing investment in collection, sorting and beneficiation for export.
Plastic	1.53	2.02	1.89	Increasing amounts of recovered plastics will come from kerbside collections, C&I waste and AWTs. Infrastructure for plastic recycling and re-manufacture in Australia has declined in recent years, and the current commodity price of virgin polymers makes any new investment unlikely in the short term. Other technologies which could be used to recover plastics, particularly from mixed or contaminated waste streams, include RDF and depolymerisation to produce fuels. For example, an Australian company, Ozmotech, has developed a process to convert waste plastics into fuel: see <www.ozmotech.com.au>.
Glass	2.75	3.61	3.36	Significant capacity and potential markets exist for using waste glass. Recent infrastructure developments have focused on alternative uses other than glass bottle making, such as the use of crushed glass as road base.
Other	2.81	3.70	3.45	Other recovered materials include textiles, rubber, tyres, sludges, nappies and mixed materials. Present barriers to higher recovery rates are due to the relatively low volumes of each material type and the costs of sorting and beneficiating such materials in preparation for sale and re-processing. As volumes increase it is likely markets will seek to establish collection and recycling of a wider range of these materials. The market for tyres is developing, and some organised collection and export of textiles is beginning.

The projected national infrastructure needs for each scenario, according to OMG's analysis, are at **Table 4.19**.[‡‡] It should be noted that these figures represent an aggregated picture of infrastructure capacity, and do not reflect the options for establishment of smaller, more numerous facilities suited to regional needs.

The number of facilities listed in **Table 4.19** is higher for some materials, particularly organics. It is predicted that as the commitment to sorting waste in homes and businesses increases, and more material is diverted to specialised facilities, there will be a need for new infrastructure for organics. As infrastructure to handle the mixed waste collected at kerbsides will already exist in many areas, it will not expand to the same extent.

Victorian information suggests that for MSW waste, a 70–75% recovery rate for organics is needed to achieve a total MSW diversion, state-wide, of 65% by 2014. Current recovery of organics is 30%.[16]

The Victorian Government has allocated $10 million to the Victorian Advanced Resource Recovery Initiative (VARRI). VARRI's express purpose is to analyse the merits of systems and technologies, options for siting and the contracting and funding of new facilities. This work is additional to that being done through other existing waste strategies, agencies and authorities.

Use of recovered materials

The above tables show the number of facilities that will be needed to receive, sort and prepare materials for sale/re-processing/export. The modelling did not assess the potential markets for using the materials. As recovery rates increase, Australia is unlikely to have the capacity to use all collected materials within its own borders.

Taking plastics as an example, the Plastics and Chemicals Industries Association 2008 recycling survey reported local processing of 168 282 tonnes of plastics and export of unprocessed waste plastic of 92 827.[17] Of the amount processed locally, 21.2% or 35 675 tonnes are 'closed-loop' recycling, used internally within an organisation. Of the total processed in Australia, 61.3% (103 156 tonnes) is used in Australia and 17.5% (29 449 tonnes) are processed and then exported for use overseas, giving a total waste plastic export of 122 276 tonnes. The proportion of material exported is expected to increase in the future as a result of the closure of several facilities since 2007.

For paper, modelling suggests that there will be between 4.38 and 6.33 million tonnes of used paper, cardboard and other fibre in the annual waste stream by 2020–21, with between 3.10 and 4.07 million tonnes recovered for recycling. Australia currently has about 2 million tonnes of domestic paper recycling capacity. Amcor has proposed a new paper recycling mill in Botany in NSW, but it has also flagged the closure of the Fairfield mill in Victoria. On balance, this would result in only a slight net increase of about 50 000 tonnes in domestic recycling capacity.

The National Recycling Initiative identifies three paper recycling facilities as likely additions to the infrastructure landscape by 2015 (including the Amcor proposal noted above); one is at the 'concept' stage and the other two at 'feasibility'.

‡‡ Figures projected for each jurisdiction are shown in Appendix D.

Table 4.19: Additional infrastructure facility needs at 2020 under the 3 scenarios

Activity	Scenario 1 (low generation)	Scenario 2 (high generation)	Scenario 3 (jurisdiction targets met)
Mixed waste & Alternative Waste Treatment	20	45	47
Compost, consolidate, shred and mulch organics	49	103	98
C&D sorting and beneficiation	11	23	19
MRF (MSW and C&I)	20	43	42
Total	**100**	**214**	**206**

These facilities would add a total of 730 000 tonnes domestic processing capacity. If they were to proceed but no further paper recycling investments were made after 2015, Australia would have a domestic processing capacity of about 2.73 million tonnes with total recovery of 3.10 to 4.07 million tonnes, leaving 0.37 to 1.34 million tonnes of waste paper for export or other use.

Innovative re-use of materials in industrial processes in Australia

The Co-operative Research Centre for Sustainable Resource Processing (CSRP) based in Western Australia[18] pursues technological solutions for eliminating waste and emissions in the minerals cycle. Research projects focus on two Australian industrial regions, Kwinana in Western Australia, and Gladstone in Queensland.

The CSRP has undertaken foundation research on the re-use of by-products, water, and energy in the Kwinana industrial area, and future opportunities for innovation.[19] Activities in the Kwinana region show how industrial by-products currently going to waste can be re-used and converted into value-added products, thereby reducing the overall generation of wastes. (More detail about Kwinana is in **Chapter 4.3** of this report.) Research at the Centre for Cleaner Production at Curtin University focuses on the uptake of cleaner production, waste minimisation and industrial ecology.[20] The centre is a core contributor to the research of the CSRP at Kwinana and Gladstone and also conducts research into engineering tools and technologies for recycling of resources by industry.

Options beyond landfill: factors that influence new infrastructure provision and innovative technologies

As well as future waste generation trends, other factors can influence investment in waste and recycling infrastructure. They include government policy, the cost of borrowing money, and perceived and actual contractual risks. GHD found that the provision of new waste infrastructure and the uptake of recycling and waste management technologies is affected by

- the low cost of landfill compared with other options
- the requirement for more cooperation among councils[§§]
- distrust of new and unproven technologies
- concerns about the environmental effects of incineration
- a lack of scientifically sound product quality standards for outputs from waste technologies, which would ensure market acceptance and prevent harm, and
- reservations among likely investors and managers about making long-term commitments to technologies that may become unsuitable or outdated.[21]

Of these, the barrier most commonly cited is the low cost of landfill. In jurisdictions where landfill costs are higher, industry reports a greater preparedness to invest in innovations such as Alternative Waste Treatment facilities.

A study by GHD found that while councils often co-operate on a range of issues, and there are numerous regional council groups which usually work well, signing a joint processing contract worth at least $100m over 15 years requires a considerable commitment from councils to work together, and involves them surrendering a significant degree of control over a key service that they are used to providing independently.[22]

The study also revealed that councils find it challenging to embrace newer and complex technologies that are yet to be 'proven'. For instance, a waste-to-energy project in Wollongong did not proceed due to failure to resolve a variety of technical performance issues and meet state EPA stack emissions standards.[23]

Negative community reactions to waste disposal using incineration technology in Australia have also contributed to councils' disinclination to make the large investments necessary to establish new waste processing technologies. Opposition to 'oxidative' thermal (burn) technologies (which can produce gas emissions containing dioxins) has been a brake on

§§ Though this can lead to economies of scale.

willingness to explore safer technologies (such as pyrolysis) for processing of municipal wastes.[24]

The GHD report noted that even if councils are willing to implement AWT, there is a view that it might be prudent to wait for a better, cheaper technology that is 'just around the corner'. Continual publicity about new waste technologies in the environmental media creates an impression that any plant that is built today may be obsolete by the time it is commissioned, three to four years after tenders were first issued. GHD observed that:

> Despite AWT facilities becoming more common in Australia, there is still a high degree of scepticism about the claims made by many technology providers about the performance of AWT facilities generally … Local Councils are conservative and therefore wary of new technologies of any type.[25]

Many emerging technologies such as plasma arc, hydrolysis and irradiation for the processing of mixed waste are in still in the early development or in 'pilot plant' stages overseas. Some of these are still considered to be commercially risky on a large scale and their widespread adoption in Australia will probably be delayed until they are proven overseas by some years of continuous operation.

Decision-makers considering options for waste technology and innovation face the complex task of assessing their environmental, financial, social and technical performance, and integrating these assessments with stakeholders' preferences about how to achieve objectives in waste management and/or sustainability. The GHD report examined some of the different decision-making methodologies that can guide decision-makers in assessing innovation or technology options.

Population density

Population density can affect the provision of recycling and waste management infrastructure. **Figures 4.10** and **4.11** show variations in population density for Melbourne and Perth and the locations of waste and recycling infrastructure.

Where high population density and a dense built environment coincide, such as in the CBDs of major cities, material such as office waste paper may be produced in large volumes that are highly cost-effective and environmentally beneficial to collect and re-process. However, those densities can also make it difficult to supply some of the collection services, due to factors such as difficult truck access to narrow laneways.

Areas of lower population density are increasingly attractive locations for waste and recycling infrastructure. This includes multi-use facilities such as resource recovery parks, as well as landfill sites and transfer stations. Areas of lower population density are usually on the fringes of the cities that generate waste, or can be some distance away; additional transport is therefore required. Favourable zoning and reduced community opposition make it easier to establish waste and recycling facilities in areas of low population density but these areas can also be more expensive to service. There may be fewer competitors to provide waste management services, and a smaller rate base to pay for these more expensive services.[26] As a result, for services to continue, they may need to be either subsidised or scaled back to cover fewer types of materials. This can involve restricting municipal kerbside recycling collection to PET rather than a full range of recyclable plastics, or moving to limited drop-off centre options rather than kerbside collection from households or businesses.

Locating waste and recycling infrastructure on the edges of major population centres can be beneficial in providing employment and facilities to these regions, but urban encroachment such as new residential subdivisions can erode the separation zones between settlements and waste facilities, leading to objections to applications for planning approvals for additional operations such as a new landfill cell.

Figure 4.10: Population density and waste infrastructure for the Melbourne area

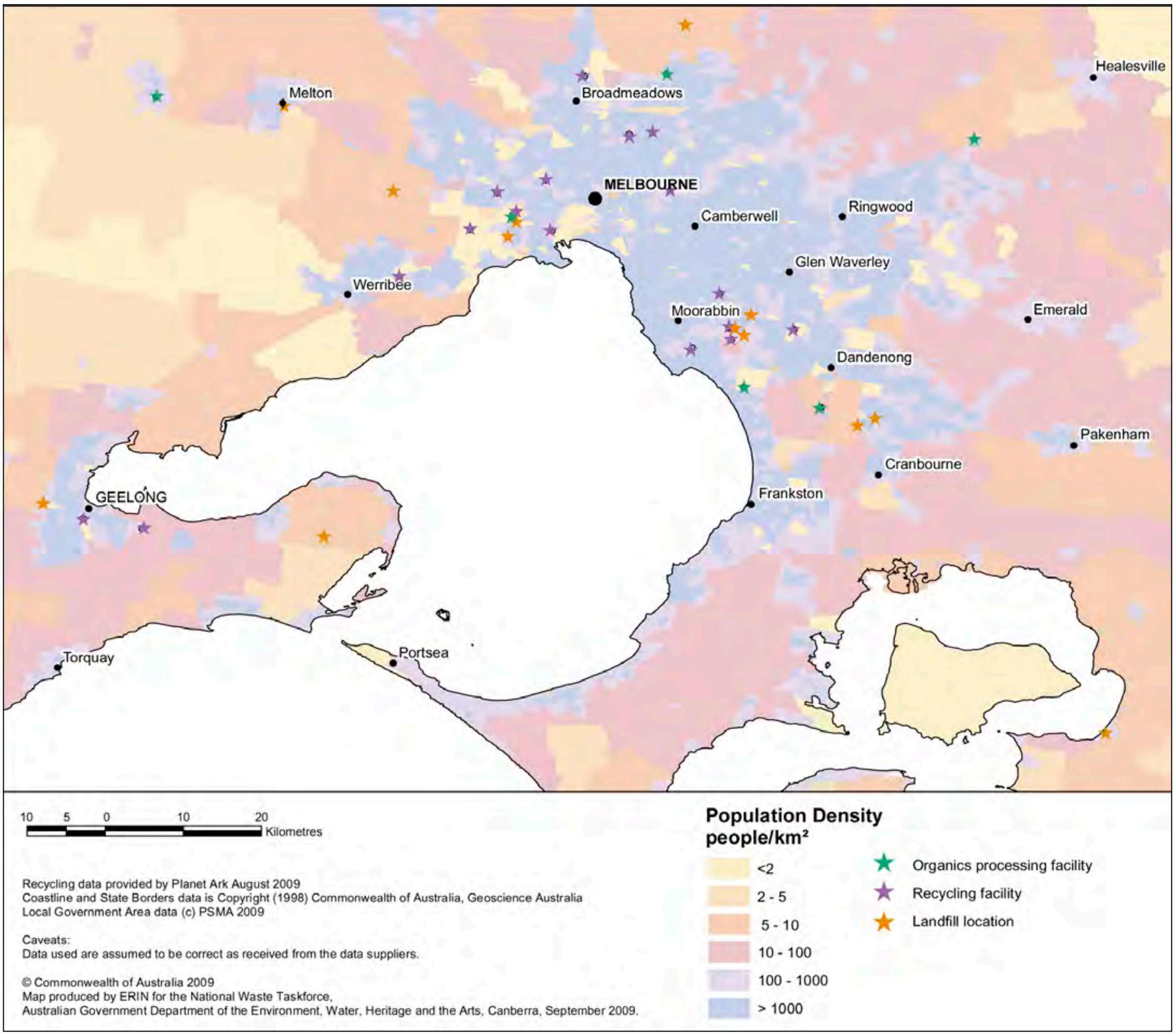
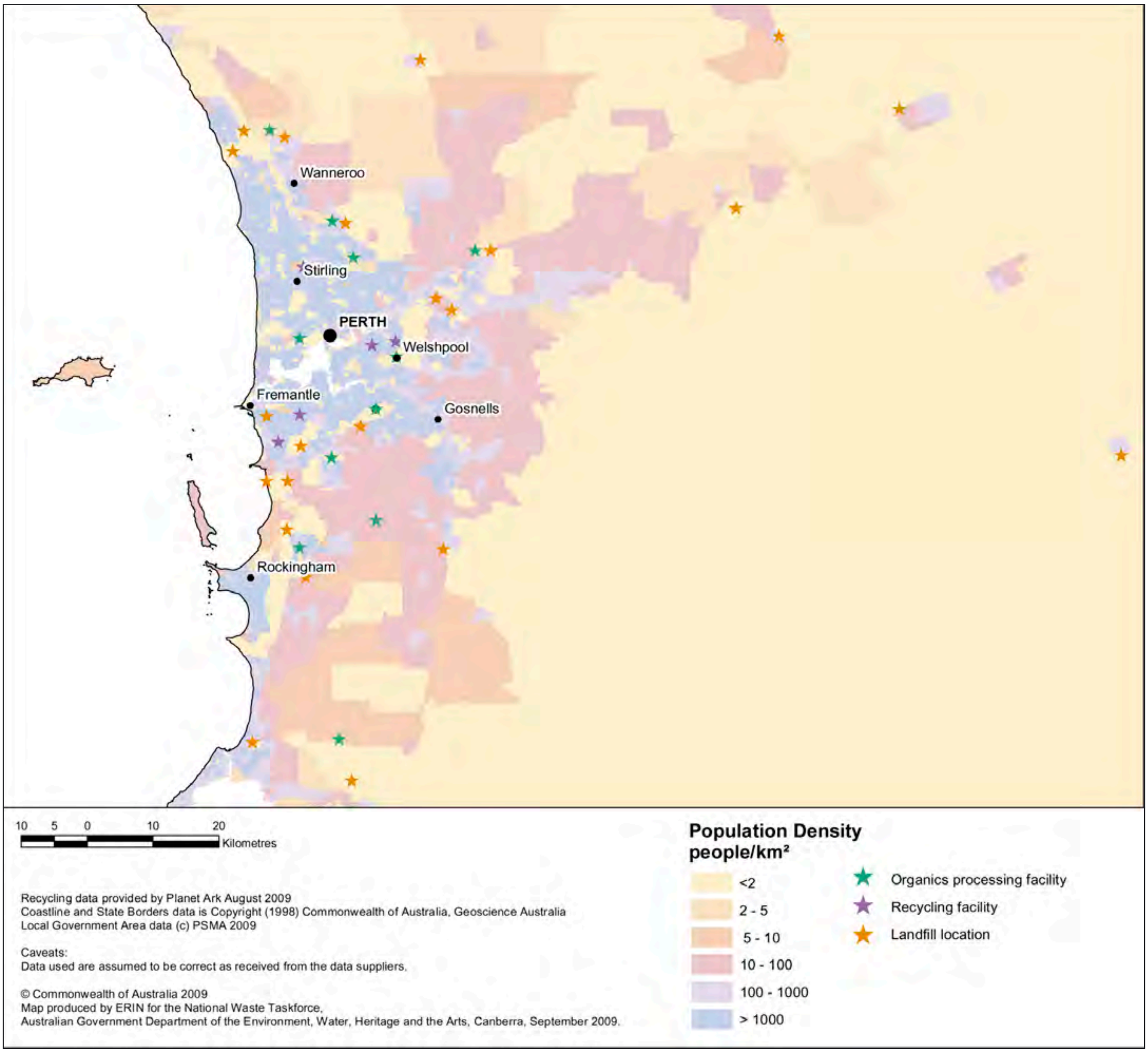


Figure 4.11: Population density and waste infrastructure for the Perth area



Conclusion

Most recent investment in waste infrastructure has been in facilities for resource recovery and processing, reflecting the increase in the types of material sent for processing and recycling. The technology supporting alternative waste technologies has been harnessed to treat and process recovered materials, and new processes have been trialled to gauge their viability.

Future growth in the volume of recyclables and the amount of waste diverted from landfill will require additional infrastructure to manage these materials. These trends have important implications for waste infrastructure planning. Additional landfill capacity may also be needed to handle increases in waste generation, as well as disposal of residual material from resource recovery and alternative waste treatment facilities.

Endnotes

1 Hyder Consulting, *Australian landfill capacities into the future, Final report*, Report to the Department of the Environment, Water, Heritage and the Arts, 2009.

2 Adapted from Ibid.

3 Ibid, p. 5.

4 Ibid, p. 5.

5 GHD, *Waste Technology and Innovation Study, Final Draft Report*, Report to the Department of the Environment, Water, Heritage and the Arts, 2009.

6 Ibid, p. 34.

7 Ibid, pp. 34–36.

8 WCS Market Intelligence, *The Blue Book: Australian Waste Industry 2007/2008*, WME, Sydney, 2008; Boomerang Alliance, *The National Recycling Initiative*, Sydney, 2008.

9 Ibid.

10 Environment Victoria, *The Green Jobs State: Seizing the Opportunities*, Melbourne, 2009.

11 Hyder Consulting, *Australian Landfill capacities into the future*, 2009; Equilibrium OMG, analyses undertaken for the Department of Environment, Water Heritage and the Arts, 2009.

12 GHD, *Waste Technology and Innovation Study, Final Draft Report*, Report to the Department of the Environment, Water, Heritage and the Arts, 2009, p. 34.

13 Ibid, p. 34.

14 Ibid, p. 66.

15 Ibid, p. 35.

16 Victorian Government and Sustainability Victoria, *Metropolitan Waste and Resource Recovery Strategic Plan*, Melbourne, 2009.

17 Hyder Consulting, *2008 National Plastics Recycling Survey (2007 calendar year)*, report prepared for PACIA, Melbourne, 2008.

18 <http://www.csrp.com.au/>

19 <http://www.csrp.com.au/projects/3b1.html>; <http://cleanerproduction.curtin.edu.au/research/ecology.cfm>

20 <http://cleanerproduction.curtin.edu.au/>

21 Adapted from GHD, *Waste Technology and Innovation Study, Final Draft Report*, Report to the Department of the Environment, Water, Heritage and the Arts, 2009, p. v.

22 Ibid, p. 96.

23 Ibid, p. 42.

24 Ibid, p. 61.

25 Ibid, p. 42.

26 REROC submission to National Waste Policy consultations, <http://www.environment.gov.au/wastepolicy/consultation/submissions/pubs/140-reroc.doc>

Chapter 5
Improving the data

Introduction

Accurate, consistent, transparent and timely data are necessary to support informed and timely decision-making by industry, government and the community, and to assist tracking progress in areas such as resource recovery. Currently, waste data are collected at all levels of government and by independent bodies. Jurisdictional waste data are collected to meet specific regulatory and policy requirements. While these data are fit-for-purpose within specific jurisdictions, they may not be consistent or comparable across jurisdictions and thus do not provide a comprehensive, robust data set at an aggregated national level. In addition, as discussed in **Chapter 4.4**, the range and number of waste classifications affect the accuracy and comparability of waste data across jurisdictions.

At least 217 separate waste and recycling data collection activities have been identified as taking place in Australia, with 144 of these recurring. Most of these (73%) are voluntary surveys or audits, with a further 23% compulsory.* A quarter of all requests for information are directed to local government. Of the requests for information, half come from government agencies, and a third come from regional authorities.

Some data are measured and collected formally, with external or internal assurance to assist with validation and data quality. Other data are produced by estimation, or may not have been subject to assurance procedures for reliability and certainty. There is a lack of comprehensive, consistent and empirically based data in the following areas:

* The remaining 6% is accounted for by a small group of minor categories.

Landfill data:

- the location, capacity and performance of every landfill in Australia;
- measurement methods (volume, weight);
- landfill gas capture performance, including over time;
- cost information on environmental and social externalities†.

Organics data:

- national generation of organic waste and the ratio of organics recycled to organics landfilled;
- national proportion of organics in the commercial and industrial (C&I) or construction and demolition (C&D) waste streams;
- the rate of decomposition and therefore methane production of different types of organics in landfill;
- the impacts of landfill infrastructure, design or management on rates of decomposition.

Hazardous waste:

- the amounts and types of hazardous wastes;
- hazardous waste treatment infrastructure;
- the generation of hazardous wastes by households;
- the types of hazardous wastes disposed to landfill (this information is required under the

† In waste and recycling, 'externalities' usually refers to costs borne by the environment or society and not included in the purchase price of the good or service. For example, the purchase price of items ending up in landfill and producing methane emissions released into the atmosphere may not include (internalise) the cost of managing those emissions and their impacts. Those additional costs are referred to as externalities.

- Basel Convention) and how hazardous materials perform in landfill;
- the impacts of hazardous wastes on air, water, land, ecosystems and human health.

Performance against the waste hierarchy:

- rates of waste avoidance, recovery and re-use;
- common definitions and measurement methodologies for recycling and alternative waste treatment.

Local government information:

- the costs to local government of providing recycling, resource recovery, waste collection and management, and litter collection services;
- national recycling capabilities.

To inform this report on the current nature of Australia's waste data systems, and the potential for a comprehensive national approach, Net Balance Management Group Pty Ltd (Net Balance) conducted a requirements study for a possible National Waste Data System. Much of the remainder of this chapter is drawn from its report *National Waste Data System Requirements Study: Final Report* (October 2009).

Current data systems

National and Australian Government systems

Waste management is primarily the responsibility of the states and local governments. The Australian Government works with the state and territory governments to provide appropriate national policy frameworks and guidance, and collaborates with the jurisdictions to develop necessary data to support these.

The Commonwealth has specific responsibilities, such as in hazardous waste, greenhouse gas reporting, and customs services. **Table 5.1** summarizes the data sets owned by Australian Government agencies, and shows if and how the quality of data sets is assured.

The Australian Bureau of Statistics (ABS) conducts several waste-related surveys, notably the *Electricity, Gas, Water and Waste Services* survey,[1] the *Waste Management Services* survey,[2] and the *Environmental Issues: People's Views and Practices* survey.[3] The surveys mainly measure the supply of and demand for waste services within the various sectors of the economy. It should be noted

Table 5.1: Data sets owned by Australian Government agencies*

Data set	Owner	Availability	Type of assurance
National Greenhouse and Energy Reporting System	Dept of Climate Change	To be established	External
National Pollutant Inventory	Dept of the Environment, Water, Heritage and the Arts	Public—on internet	External
Waste Management Services	Australian Bureau of Statistics (ABS)	Public reports	Internal
Import and export data	Australian Customs Service (ACS)	Some data publicly available from ABS; some data available for a fee from ACS or Dept Foreign Affairs and Trade	Unclear
NEPM Annual Report (controlled waste); Jurisdictional Reports on Implementation and Effectiveness of NEPMs	Environment Protection and Heritage Council (EPHC)	Public, through annual reports	External
Consumption and Recycling Data	National Packaging Covenant Council (NPCC)	Public, on NPCC website	External

* Based on Net Balance, *National Waste Data System Requirements Study: Final Report*, October 2009.

that waste services surveys may not include local government authorities.[4]

The surveys have collected data from households, government agencies and businesses that

- supply waste management services
- spend on waste services
- produce waste
- use waste services, and
- act to minimise the need for waste services (e.g. recycling and re-use).

State and territory systems

In most states and territories, waste management data systems primarily rest with the environmental regulator with some assistance from the waste authorities. The range and nature of data collected generally serves to meet legislative and reporting requirements, which differ between jurisdictions.

Table 5.2 gives an overview of the data sets owned by state and territory government agencies and **Table 5.3** presents a summary of the waste data collection systems in each jurisdiction.

Data collection—hazardous waste

Six jurisdictions (NSW, VIC, Qld, SA, WA, TAS and ACT) have waste tracking systems in place to record the movements of hazardous waste. NT currently gathers annual data from landfill operators and surveys.[‡]

Data collection—general disposal

The main method of data collection is the use of surveys and provision of monthly, quarterly or annual data from local government and landfill operators. Tasmania and the NT have no formal systems to collect this information.

Data collection—recycling

All jurisdictions, apart from NT, collect information via industry surveys and reports. Some industry associations collate national data on the recycling performance of their members in relation to a few materials such as plastics and paper. There are inconsistencies in how interstate and intrastate transfers of recyclables are recorded and accounted.

Data collection—stakeholders

Waste data are currently collected and reported by a range of stakeholders, including landfill operators, recyclers, local governments, industry associations and Environmental Protection Agencies or equivalent government agencies. Each stakeholder has its own data collection and reporting requirements to fulfil, and uses its own waste terminology and classifications. Furthermore, they cover different regional areas and industries. Waste data from rural and remote areas are limited, making it more difficult to determine the cost-effectiveness of potential solutions (such as if a rural or remote area has sufficient volumes of particular recyclable materials to support a collection service).

Databases

The various technologies used for tracking data, and the data support systems, are designed around the state or territory legislation, and thus the type and quality of data and databases vary between jurisdictions. Older legislation is geared more around accountability of volumes (including ensuring that risks of environmental harm and fraud were managed, by ensuring clarity about who was responsible for particular volumes of wastes). More recent legislation takes a cradle-to-grave approach (including trying to support understanding of opportunities present in flows of materials, not just who is responsible for managing particular volumes of wastes).

‡ The NT has a tracking system to record movements of hazardous wastes interstate (i.e., out of the NT). Holders of licences to transport listed wastes are also required to provide data on the amount of wastes handled annually, to facilitate the calculation of their annual fee. The NT does not currently gather annual data on hazardous wastes from landfill operators. Only one facility in the NT is currently approved to accept listed wastes, but it is anticipated that others will be approved in the near future.

Table 5.2: Data sets owned by state and territory government agencies

Data set	Owner	Availability	Type of assurance
New South Wales			
Controlled Waste System	Dept of Environment, Climate Change & Water	Internal use	External
Landfill Levy System	Dept of Environment, Climate Change & Water	Internal use	External
NSW Resource Recovery Industries Survey	Dept of Environment, Climate Change & Water	Public reports	Internal
Victoria			
Waste Cert System	Environment Protection Authority Victoria	Internal use	Internal
Landfill levy	Environment Protection Authority Victoria	Internal use	External
Recycling survey	Sustainability Victoria	Public reports	Internal
Annual Local Government Survey	Sustainability Victoria	Public reports	Internal
Sustainability Victoria waste model (waste quantities tracking system)	Sustainability Victoria	Internal use	Internal
Queensland			
Trackable Wastes System	Queensland Environment Protection Agency	Internal use	Internal
Waste generation, recycling and disposal survey	Dept of Environment & Resource Management	Public reports	Internal
Local government administration reports include waste data	Queensland EPA	Internal use (data incorporated into public report 'State of Waste in Queensland')	Internal
Western Australia			
Waste tracking—controlled wastes system	Dept of Environment & Conservation	Internal use	Internal
LG Annual Survey	Dept of Environment & Conservation	Public Summary report	Internal
Landfill Levy System	Dept of Environment & Conservation	Internal use	External
Re-processing & recycling survey	Dept of Environment & Conservation	Public reports	Internal
South Australia			
Waste Levy Database	Environment Protection Authority SA	Internal use for auditing and financial purposes	Internal
Waste Tracking System	Environment Protection Authority SA	Internal use	Internal
MSW & Compost (ZEUS)	ZEROWASTE	Quarterly report	Internal
Recycling Activity Survey	Zero Waste SA (confidential re-processor data retained by Hyder Consulting Pty Ltd)	Public report	Internal (Hyder)
Tasmania			
Annual waste disposal for municipal landfills	Dept of the Environment, Heritage and the Arts	Internal use	Internal
Australian Capital Territory			
Landfill data system	TAMS NOWaste	Internal use	Internal
Resource Recovery Survey	TAMS NOWaste	Internal use	Internal
Northern Territory			
Waste Handlers Annual Spreadsheet	Dept of Natural Resources, Environment, The Arts and Sport	Internal use	Internal
Listed Waste Tracking Spreadsheet	Dept of Natural Resources, Environment, the Arts and Sport	Internal use	Internal

Table 5.3: Jurisdictional waste data collection systems—hazardous, other, recycling

State/ territory	Waste data collection—hazardous waste§	Waste data collection—other waste disposal	Waste data collection—recycling
NSW	Waste tracking system uses Vic waste codes (hazardous waste).	Licensed waste facilities required to report monthly. Landfills not required to be licensed and servicing populations of < 1000 report annually.	Annual recycling industry survey; State Government collection data; Recycled organics industry reports
Vic	Waste tracking system for prescribed wastes.	Local government survey (Regional Waste Management Groups).	State government survey of recycling.
Qld	Waste tracking system for regulated wastes.	Data collection from landfill operators and local councils by state government.	Data collection from recycling facility operators and local council by state government.
WA	Waste tracking system for controlled waste.	Quarterly data collection mechanism applies to landfills receiving 80% of WA waste, for levy calculation purposes.	Currently through state government survey of recycling industry. A new collection system is being proposed under the draft waste strategy.
SA	Waste tracking for listed wastes.	Monthly landfill levy reports.	State government survey of recycling industry.
Tas	Waste tracking of controlled waste to be implemented under the current strategy.	Landfill operators report annually (Tasmanian Solid Waste Classification System).	Waste transfer stations—data collection included as part of operational contracts with local governments.
ACT	Manual waste tracking system for regulated wastes.	The NOWaste weighbridge transaction database.	Government survey of recycling industry.
NT	Annual reports from landfills licensed to dispose of or store listed waste. Listed waste handler annual returns.	Annual reports from major licensed landfills.	Not identified.

Source: Hyder Consulting, independent research undertaken for the Department of the Environment, Water, Heritage and the Arts (2009).

§ 'Hazardous waste' refers to regulated waste (Qld), listed wastes (SA), controlled waste (WA, Tas), and prescribed industrial waste (Vic).

Data for different waste streams

MSW data collected across most states are measured using data directly provided by a service provider (e.g. local governments, landfill operators). MSW data are most commonly collected on an annual reporting basis. However data capture rates are varied due to their spatial nature, and this is particularly evident in larger states.

C&I waste data are strong in some areas, particularly data relating to controlled/hazardous wastes. Significant data gaps exist in states, and are amplified due to confidentiality requirements. Most data captured are derived or estimated from survey data.

Most of the captured C&D waste data are derived or estimated from survey data. These data are not comprehensive and are likely to be indicative rather than accurate.

Net Balance analysed the current data collection and management performance of each state and territory, as shown in **Table 5.4**.

Some key points that can be drawn from **Table 5.4** are:

- most data across jurisdictions are derived rather than directly measured;
- MSW data are measured only in ACT, NSW, Vic, SA and WA;
- NT has no data for C&I and C&D, and its MSW data are estimated;
- there is varying quality of, and different collection methods for, data across and between jurisdictions for each waste stream.

Net Balance also provided an assessment of the reporting and quality of waste data for the three main waste categories, as shown in **Table 5.5**.

Table 5.4: State and territory data management ratings

State/ territory	MSW	C&I	C&D
NSW	Measured / Robust	Derived / Satisfactory	Derived / Satisfactory
Vic	Measured / Satisfactory	Measured / Satisfactory	Derived / Satisfactory
Qld	Derived / Satisfactory	Estimated / Satisfactory	Estimated / Satisfactory
WA	Measured / Satisfactory	Derived / Satisfactory	Derived / Satisfactory
SA	Measured / Satisfactory	Estimated / Satisfactory	Estimated / Satisfactory
Tas	Derived / Satisfactory	Derived / Questionable	Derived / Questionable
ACT	Measured / Robust	Derived / Satisfactory	Derived / Satisfactory
NT	Estimated / Satisfactory	-	-

Measured: data directly provided by a service provider, contractor or directly obtained from a monitoring device. For example, electricity invoices, contractor receipts, emissions monitoring equipment, incident reports, consultants reports, etc.

Derived: data obtained from calculations, mass balances, use of physical/chemical properties, use of coefficients and emission factors etc. (e.g. the conversion of cubic metres of waste into tonnes).

Estimated: usually where there is no other available method for obtaining the data. Such data may be pro-rated on previous results, use of precedents or historical data, or even a calculated guess.

Robust: evidence of a sound, mature and rigid reporting system, where room for error is negligible. Examples would include use of spreadsheets, databases and on-line reporting.

Satisfactory: some potential exists for error or loss of data. Examples would include manual but structured keeping of records, files and results.

Questionable: no logical or structured approach to data or record keeping. High potential for error and/or loss of data. Data may appear to differ from those initially reported.

Table 5.5: Quality of reporting Australian waste data, by stream

Principles	Municipal Solid Waste	Commercial and Industrial	Construction and Demolition
Transparency	Satisfactory	Questionable	Questionable
Comparability	Satisfactory	Questionable	Questionable
Accuracy	Satisfactory	Questionable	Questionable
Completeness	Questionable	Questionable	Questionable
Clarity	Satisfactory	Questionable	Questionable
Timeliness	Robust	Questionable	Questionable

Transparency: data documented and verifiable
Comparability: data are produced by same methodologies and can be compared across jurisdictions
Accuracy: uncertainty in data values must be minimised
Completeness: all sources within state boundaries identified and accounted for
Clarity: information is understandable and accessible
Timeliness: reporting is occurring on a regular schedule to enable informed decisions.

A similar assessment was made in relation to materials of data sets based on documentation drawn from the National Packaging Covenant, Hyder Consulting's 2008 report *Waste and Recycling in Australia* and other sources. **Table 5.6** provides an overall summary in relation to the 12 materials types.

Table 5.6: Quality of materials waste data, by type of waste

Waste type	Transparency	Comparability	Accuracy	Completeness	Clarity	Timeliness
Paper / cardboard	Robust	Robust	Robust	Questionable	Robust	Satisfactory
Glass	Satisfactory	Robust	Robust	Questionable	Questionable	Questionable
Plastics	Questionable	Robust	Robust	Satisfactory	Robust	Satisfactory
Steel Cans	Questionable	Robust	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Aluminium cans	Questionable	Robust	Satisfactory	Robust	Satisfactory	Satisfactory
E-waste	Satisfactory	Robust	Satisfactory	Robust	Robust	Satisfactory
Tyres	Satisfactory	Satisfactory	Satisfactory	Questionable	Satisfactory	Satisfactory
Batteries	Questionable	Questionable	Questionable	Questionable	Questionable	Questionable
Disposable nappies	Satisfactory	Satisfactory	Satisfactory	Questionable	Satisfactory	Satisfactory
Organics	Satisfactory	Satisfactory	Robust	Questionable	Robust	Satisfactory
Hazardous waste tracking system	Robust	Satisfactory	Robust	Satisfactory	Questionable	Robust
Hazardous waste generation	Questionable	Satisfactory	Questionable	Questionable	Questionable	Satisfactory

State and territory data systems

Most jurisdictions have made significant past and recent investments in the quality and usefulness of their waste and recycling data systems. Data improvements in recent years have been facilitated by factors such as the introduction of weighbridges, better staffing of landfills, contractual requirements for data collection, and waste levies.

Several issues were identified in the Net Balance report that affect the ability of states and territories to collect and manage accurate, consistent, transparent and timely data. These include:

- the use of estimated, rather than measured data
- the measurement of load volumes (cubic metres) instead of weight (tonnes), particularly in relation to green waste
- the voluntary nature of some reporting and the lack of associated deadlines/defined reporting periods and auditing
- voluntary basis of some surveys leading to lack of response and poor data
- the use of a mixture of electronic and paper based systems, leading to varied interpretation of data provided
- the reliability of the performance of online systems
- lack of comprehensive data capture systems in some jurisdictions
- lack of analysis (cross checking) of waste tracking records from industry
- poor linkage between waste tracking databases and licensing systems in some jurisdictions
- labour intensive, manual input/transfer of data from paper records which can result in human error
- lack of consistency in waste classification
- different organisations requiring data in different formats
- limitations in the data from some unstaffed rural and remote facilities
- confidentiality issues with operators, particularly for limited, spatial dependent surveys, and
- poor historical data, making trend analysis difficult.

Industry data systems

Some key waste databases maintained by industry groups are outlined in **Table 5.7**. The type of assurance was assessed by Net Balance.

Table 5.7: Data sets owned by industry groups

Dataset	Owner	Availability	Type of assurance
National Plastics Recycling Survey	Plastics and Chemicals Industry Association (PACIA) [Confidential data retained by Hyder]	Public—available from PACIA website	Internal (Hyder)
Annual National Processors Survey (Organics)	Waste Management Association of Australia (WMAA)	Public—available from WMAA website	Internal
MobileMuster	Australian Mobile Telecommunications Association	Website summary	Unclear
National Landfills Survey	Waste Management Association of Australia	Public—overview of results available on WMAA website; detailed results available to WMAA members	Internal
National Steel Can Recycling Survey	Australian Food and Grocery Council and National Packaging Covenant Council [Confidential data retained by Hyder]	Public—website	Internal (Hyder)

Cost of current data arrangements

Current data arrangements rely on voluntary disclosure, collection and collation of information. This can create significant cost for business and government, as well as often producing outputs fit only for single rather than multiple uses. In addition, there is duplication of effort across multiple inconsistent surveys, audits, consultancies/research projects and other data collection activities.

In its 2008 evaluation of waste data arrangements, WMAA estimated that the costs to their member organisations (including some local governments) of participation in the current fragmented and duplicative arrangements are almost $9 million per year. WMAA estimated that a more co-ordinated national approach could reduce the cost to $5.7 million per year, a saving of 35% to their member organisations. Costs to government of current waste data arrangements (excluding local government and opportunity costs), while not yet modelled in detail, are likely to be considerable.

WMAA research identified at least 217 separate waste and recycling data collection activities taking place in Australia, with 144 of these recurring. **Tables 5.8 to 5.10** set out the nature of the surveys, who is being asked for data, and by whom.

Table 5.8: Nature of survey

Nature	Percentage
Voluntary survey	52
Voluntary audit	21
Compulsory survey	21
Publicly available requests	4
Compulsory audit	2

Table 5.9: Who is being asked for data

Provider	Percentage
Local government	25
Waste disposal and resource recovery facilities	25
State government regulatory agencies	10
Businesses	10
Other (households, service providers, federal agencies)	30

Table 5.10: Who is asking for data

Requester	Percentage
Regional authorities	53
State government regulatory agencies	18
State government program agencies	15
Associations	12
Federal agencies	2

A national approach

The range, accuracy, comprehensiveness and currency of information available to government, business and the community are in need of improvement if Australia is to properly assess risks, create appropriate management strategies, plan for future infrastructure capacity, ensure that human and environmental health are protected, and meet Australia's international obligations.

In related fields such as energy and greenhouse data, actions consistent with Council of Australian Governments (COAG) principles of regulatory reform and red tape reduction have led to streamlined arrangements for how data are defined, collected, aggregated, disclosed and integrated with decision-making. Such streamlining has yet to occur with waste and recycling data, though any national reform of waste data arrangements would be about more than red tape reduction, as it would also assist in achieving better transparency of performance and timely decision-making about infrastructure needs. Several data system reform processes such as those under National Greenhouse and Energy Reporting System (NGERS), National Pollutant Inventory (NPI), ABS environment work and other Environment Protection and Heritage Council projects could inform the design and development of streamlined waste data arrangements.

In the light of the above findings, a national approach to data gathering and dissemination would provide the way forward to a comprehensive aggregation of data about waste generation, disposal to landfill and resource recovery. The 2009 National Waste Policy addressed this need by providing for the development of a system to facilitate access to integrated core data that are accurate, meaningful, up-to-date and available online. Benefits of such a system are:

- streamlining of all activities relating to waste data
- expenditure reduction through less red tape
- improved reporting to international bodies
- a reduced reporting burden on business
- a reliable information base to support regulatory reform
- a consistent, comprehensive data capture process
- accurate and reliable data to inform decisions, strategies and business
- consistent methods, classification and terminology for waste data
- common systems for collecting, storing, collating and accessing data
- clearer purposes for which data are collected, and
- support for state and federal legislation.

Conclusion

At least 217 separate waste and recycling data collection activities take place in Australia, with 144 of these recurring. Current waste and recycling data arrangements reflect large recent investments by state and territory governments, and have improved the extent, quality and utility of waste data in Australia. However, there are opportunities to improve the efficiency of current data collection, analysis and disclosure, especially where they rely on voluntary reporting and estimation rather than direct measurement. Collaboration among governments will be required to explore and develop future national reporting on waste and recycling, including the underlying data systems and arrangements.

Endnotes

1 Australian Bureau of Statistics, *Electricity, Gas, Water and Waste Services, Australia*, (various years), ABS Catalogue No. 8226.0.

2 Australian Bureau of Statistics, *Waste Management Services, Australia*, (various years), ABS Catalogue No. 8698.0.

3 Australian Bureau of Statistics, *Environmental Issues: People's Views and Practices*, (various years), ABS Catalogue No. 4602.0.

4 Australian Bureau of Statistics, *Waste Management Services, Australia, 2006–07*, ABS Catalogue No. 8698.0, Notes, p. 24.

Appendices

APPENDIX A
METHODOLOGY FOR ESTIMATING LANDFILL EMISSIONS OF METHANE

The National Waste Report provides estimates of landfill-related greenhouse gas production to 2020–21, in:

- **Chapter 2.1** (national)
- **Chapters 2.2 to 2.9** (covering individual states and territories)
- **Chapter 3.1** (landfills)

This Appendix explains the methodology used by the consulting firm MMA to create those estimates. The full details of the work are in MMA's report, 'Climate Change and the Resource Recovery and Waste Sectors' (2009).[1]

MMA uses a model called WASTENOT, which models flows of resources from their consumption to dispersal into either recycling activities or to landfill. The model estimates greenhouse emissions from all activities ranging from consumption to disposal or recycling. To be consistent with the sectoral definitions employed under the National Greenhouse Gas Inventory, the costs of mitigating emissions only apply to emissions from landfills.

Stages of the modelling process

Stage 1

Projections are made of the total waste generated for each of the three waste streams: municipal solid waste (MSW), commercial and industrial waste (C&I) and construction and demolition waste (C&D), based on external variables such as population and gross state product (GSP) forecasts. MSW is projected using a model of household expenditure and disposal patterns, where generation of waste increases as a function of population growth and income. C&I waste is projected as a function of GSP projections, using historical data to determine the relationship between waste generated and economic growth. C&D data are related to building approval data, which in turn are related to economic growth.

Stage 2

A programming formula determines the least-cost means of disposing of waste, subject to regulatory constraints and other incentives to divert waste. Waste can be diverted to landfills, material sorting and recycling facilities, or to alternative waste treatment facilities. In the MMA analysis, the focus is on organic material including food waste, paper and textiles, garden and green waste and wood waste. In this model, the amount going to landfill is affected by the cost of carbon on any landfill emissions faced by landfill operators (that is, on the proportion of landfills liable for payments under the Carbon Pollution Reduction Scheme (CPRS)). The amount of organic waste going to landfill is affected by the availability and cost of other options to treat the waste—options which avoid landfill emission costs.

Stage 3

Stage 3, which is undertaken in conjunction with Stage 2, involves determining the likely uptake of abatement options that can mitigate emissions at landfills which will be liable under a CPRS (or in response to other policy measures such as the Renewable Energy Target and NSW Greenhouse Gas Abatement Scheme). The options modelled include flaring, capturing the methane to treat and sell as pipeline quality gas, and capturing the methane to generate electricity. Emissions can also be avoided by diverting the waste to waste-to-energy facilities that use the organic material to create steam and electricity, as well as other potentially useful by-products such as biochar. The model determines the long-run marginal cost of each option of carbon abated per tonne, taking into account capital and operating costs of each option and deducting revenue from sale of useful products (electricity, Renewable Energy Certificates).

Stage 4

In this stage, emissions from landfills are calculated using the International Panel on Climate Change First Order Decay model. Degradable organic carbon stocks in landfill are estimated using historical waste data for Australia. The organic materials dumped at landfills for the projection are as determined in stages 1 to 3.

Sources of information used to populate the model include:

- Australian Bureau of Statistics (ABS) for historical data on Gross Domestic Product, GSP, population, household formation patterns, building approvals, production data (wood and paper), value-added data by industry sector, and household expenditure patterns.
- Hyder Consulting (2006)[2] and (2008)[3] reports to DEWHA on data on waste generated by product and waste stream. These were supplemented by state government agency data on landfill waste streams (e.g. Zero Waste SA[4] and Victorian Environment Protection Authority[5]).
- Australian Treasury[6] and ABS[7] projections of economic and population growth.
- MMA database of renewable energy projects for details of output and cost of currently operating landfills. MMA projections of electricity and REC prices.
- US EPA, IPCC Working group III and Delhotal (2006) (IEEP journal), for costs of carbon abatement options applicable to landfills and waste-to-energy facilities.
- Department of Climate Change[8] for details of carbon stocks and method for calculating emissions from landfills.
- ABS survey of waste management costs.
- Company sustainability reports and annual reports for data on output and waste generation.

Endnotes

1 McLennan Magasanik Associates Pty Ltd, *Climate change and the Resource Recovery and Waste Sectors*, Report to the Department of the Environment, Water, Heritage and the Arts, September 2009.

2 Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, February 2006.

3 Hyder Consulting, *Waste and Recycling in Australia*, Report to the Department of the Environment, Water, Heritage and the Arts, November 2008.

4 <http://www.zerowaste.sa.gov.au/Home.mvc>

5 <http://www.epa.vic.gov.au/>

6 <http://www.treasury.gov.au/>

7 <http://www.abs.gov.au/>

8 <http://www.climatechange.gov.au/>

APPENDIX B MUNICIPAL COLLECTION COVERAGE OF PLASTICS TYPES, BY LOCAL GOVERNMENT AREA (LGA)

Maps in the body of the report

The National Waste Report provides maps of what can be recycled and where, by local government area. The maps cover paper and cardboard, plastics (in general), glass, steel cans and batteries—materials for which data are available. These are only some of the key materials recycled in Australia.

This information appears in:

- **Chapter 2.1** (national)
- **Chapters 2.2 to 2.9** (covering individual states and territories).

Chapter 3.2 provides further information on plastics recycling, summarising the types of plastics used and potentially available for recycling—see **Table B1** below.

The maps in this appendix provide extra detail. They show municipal collection of different plastic types, by Local Government Area (LGA). The types of plastic they cover are rigid, food-grade plastics (resin codes 1–7), although some uncoded, rigid, food-grade plastic can also be recycled in areas such as the Australian Capital Territory. The maps illustrate the degrees of access that Australian residents have to plastics recycling.

The collection service arrangements covered are mostly kerbside municipal collection from households, but a few alternate collection arrangements, such as municipal drop-off centres, are also included.

The data used were voluntarily added by local councils to the database that supports Planet Ark's 'Recycling Near You' website. Planet Ark undertook some quality checking of the data, but its accuracy is primarily dependent on the quality of data entry by council officers.

The maps below show municipal collection coverage of plastics types, by LGA regions, for:

- NSW
- Sydney
- Inner Sydney
- Victoria
- Melbourne
- Queensland
- Brisbane
- Western Australia
- Perth
- South Australia
- Adelaide
- Tasmania
- Hobart
- Northern Territory

Note that there is no map for the ACT, as it is a single region for collecting recyclable plastics from the municipal waste streams, and covers all rigid, food-grade plastics, coded or uncoded, other than expanded polystyrene foam.

Plastics collection and recycling from the commercial and industrial and construction and demolition waste streams are not covered here, as data are not available.

Table B1: Plastics identification code*

Symbol	Chemical name	Selected applications
1 PET	Polyethylene Terephthalate **PET**	Carbonated soft drink and fruit juice bottles, pillow and sleeping bag filling, textile fibres.
2 HDPE	High Density Polyethylene **HDPE**	Shopping and freezer bags, milk bottles, bleach bottles, buckets, rigid agricultural pipe, milk crates.
3 V	Unplasticised Polyvinyl Chloride **UPVC**	Electrical conduit, plumbing pipes and fittings, blister packs, clear cordial and fruit juice bottles.
	Plasticised Polyvinyl Chloride **PPVC**	Garden hose, shoe soles, cable sheathing, blood bags and tubing, watch straps, rain wear.
4 LDPE	Low Density Polyethylene **LDPE** Linear: **LLDPE**	Garbage bags, squeeze bottles, black irrigation tube, stretch and shrink films, silage and mulch films, garbage bins.
5 PP	Polypropylene **PP**	Film, carpet fibre, appliance parts, crates, automotive applications, toys, pails, housewares / kitchenwares, bottles, caps and closures, furniture, plant pots.
6 PS	Polystyrene **PS**	Refrigerator bins & crispers, air conditioner, office accessories, coat hangers, medical disposables. Meat & poultry trays, yoghurt & dairy containers, vending cups.
	Expanded Polystyrene **EPS**	Drinking cups, meat trays, clamshells, panel insulation, produce boxes, protective packaging for fragile items.
7 OTHER	**OTHER:** Includes all other resins and multi materials (eg laminates). Eg acrylonitrile butadiene styrene (ABS), acrylic, nylon, polyurethane (PU), polycarbonates (PC) and phenolics.	Automotive, aircraft and boating, furniture, electrical and medical.

* This table was extracted from a document published by PACIA entitled 'Plastics Identification Code'; <www.pacia.org.au/DisplayFile.aspx?FileID=54>, accessed 19 January 2010.

The maps

Figure B1: NSW—municipal collection of plastics types, by LGA

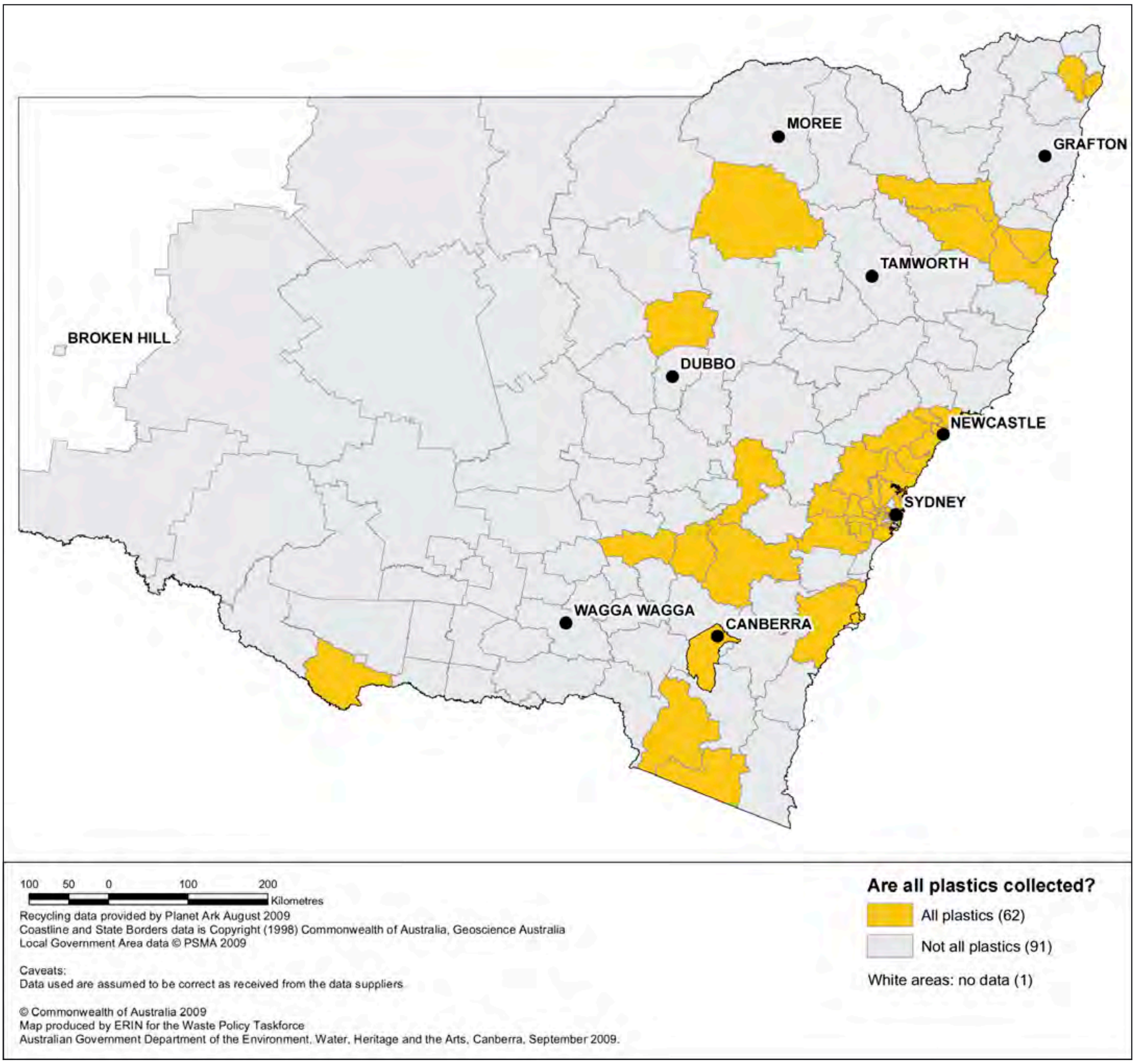


Figure B2: Sydney—municipal collection of plastics types, by LGA

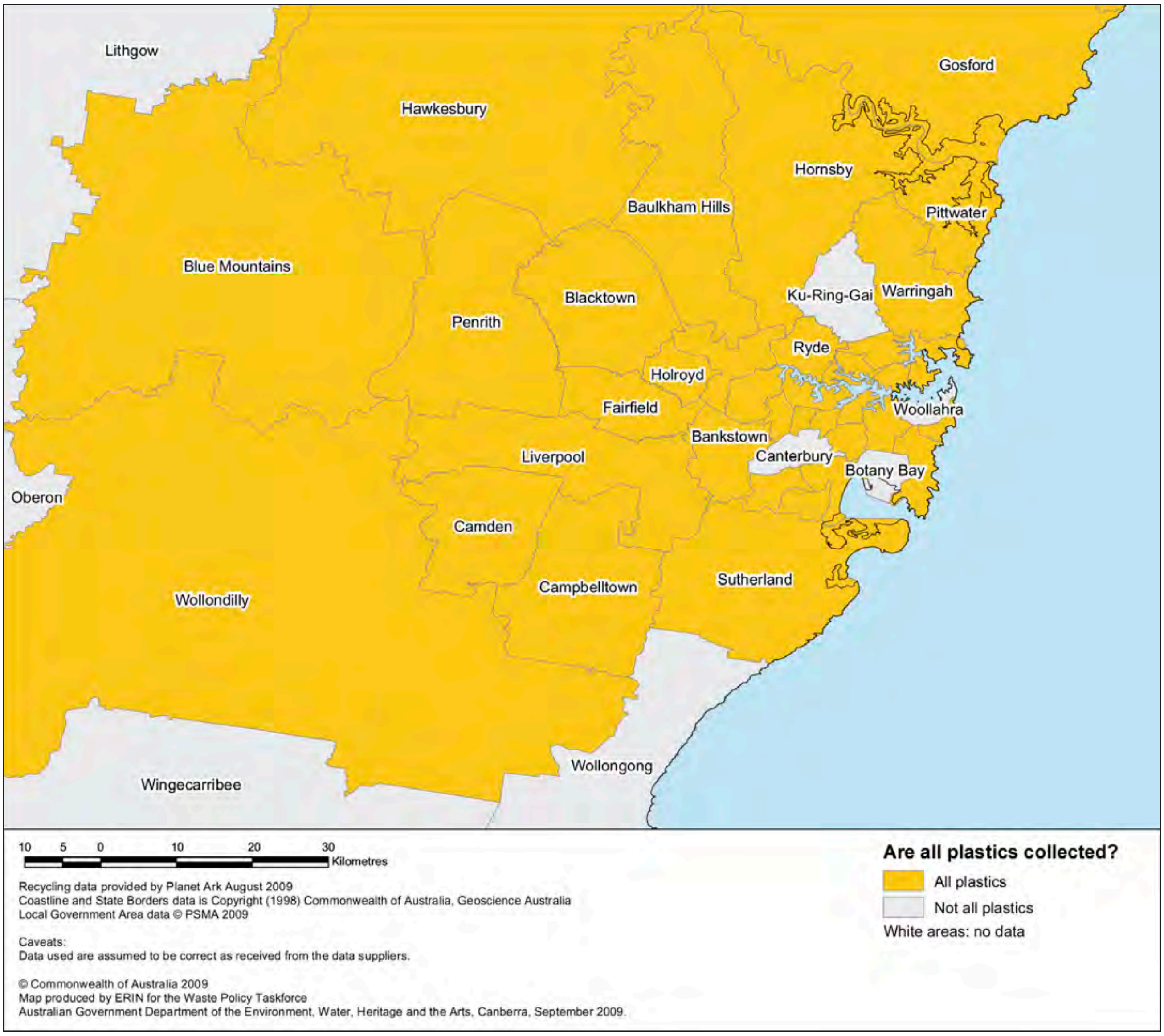


Figure B3: Inner Sydney—municipal collection of plastics types, by LGA

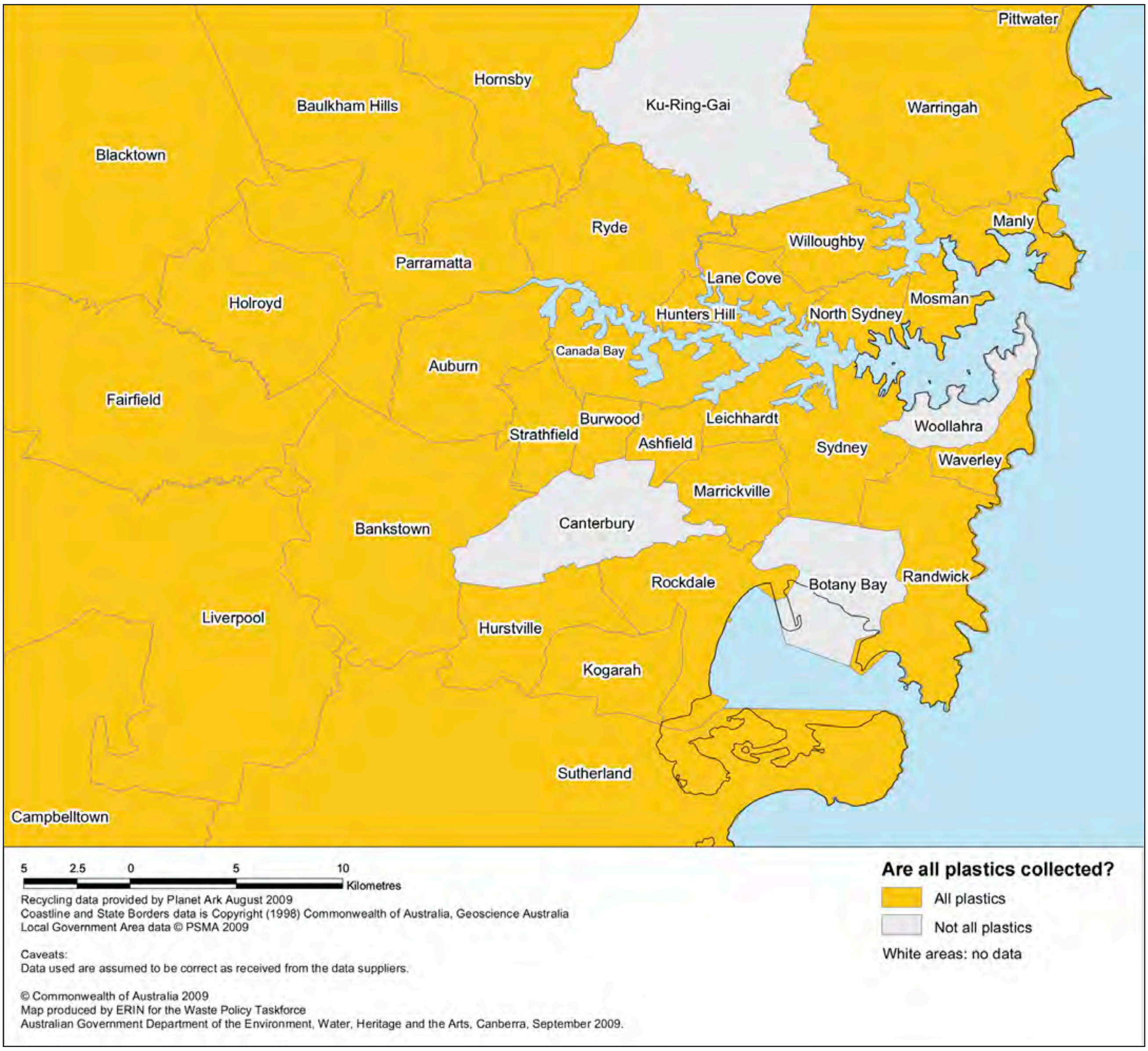


Figure B4: Victoria—municipal collection of plastics types, by LGA

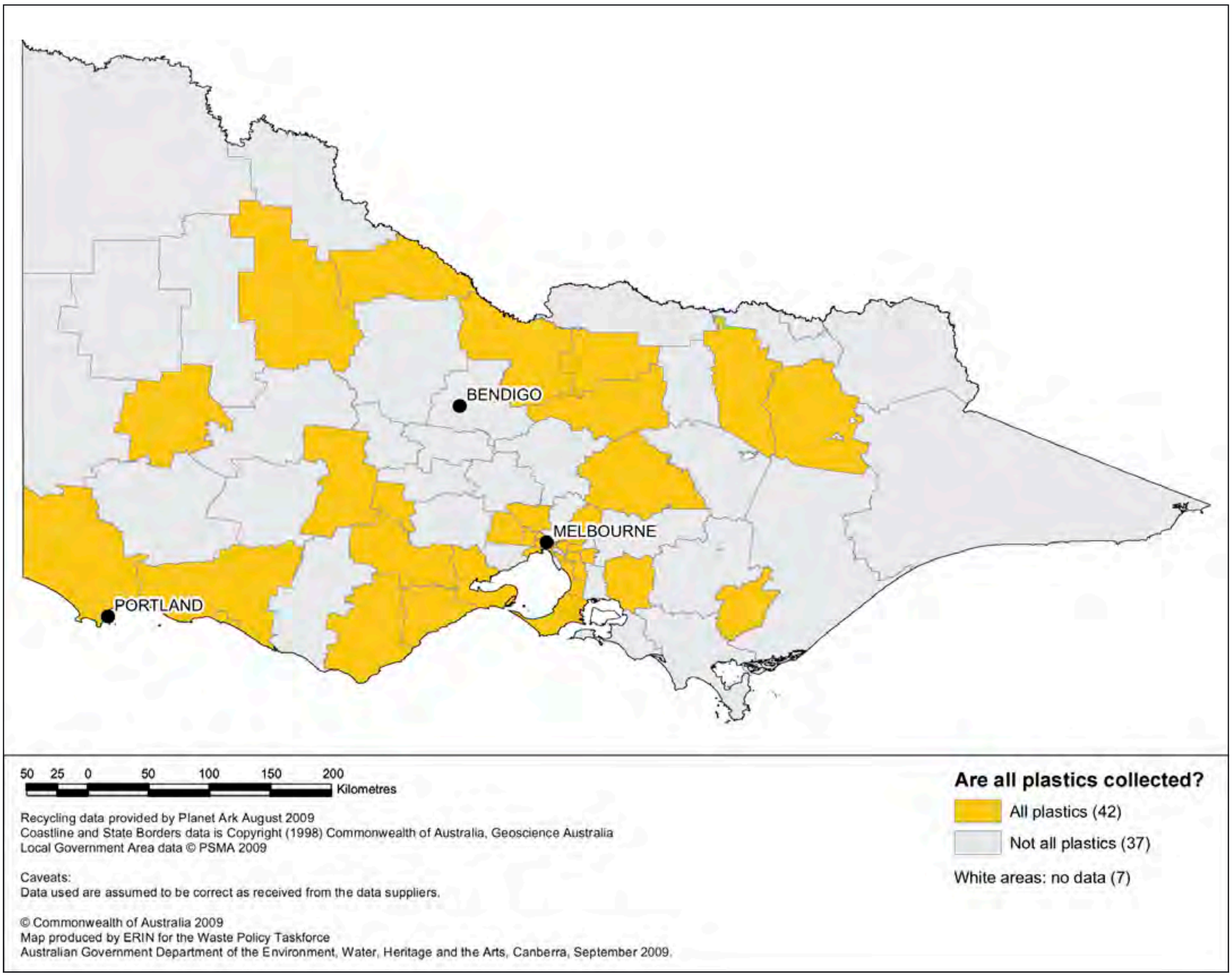
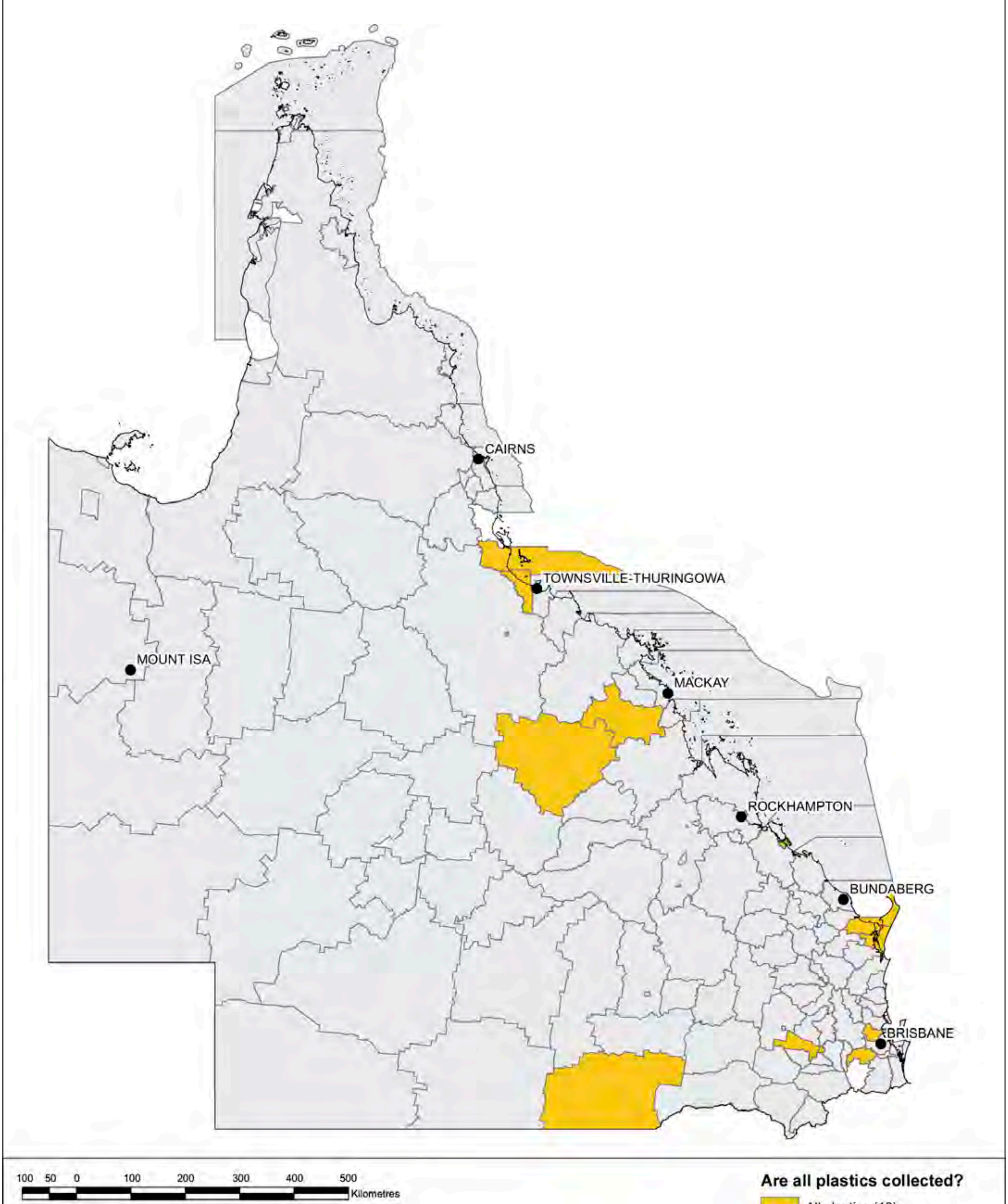


Figure B5: Melbourne—municipal collection of plastics types, by LGA

Figure B6: Queensland—municipal collection of plastics types, by LGA



Recycling data provided by Planet Ark August 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data © PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

Figure B7: Brisbane—municipal collection of plastics types, by LGA

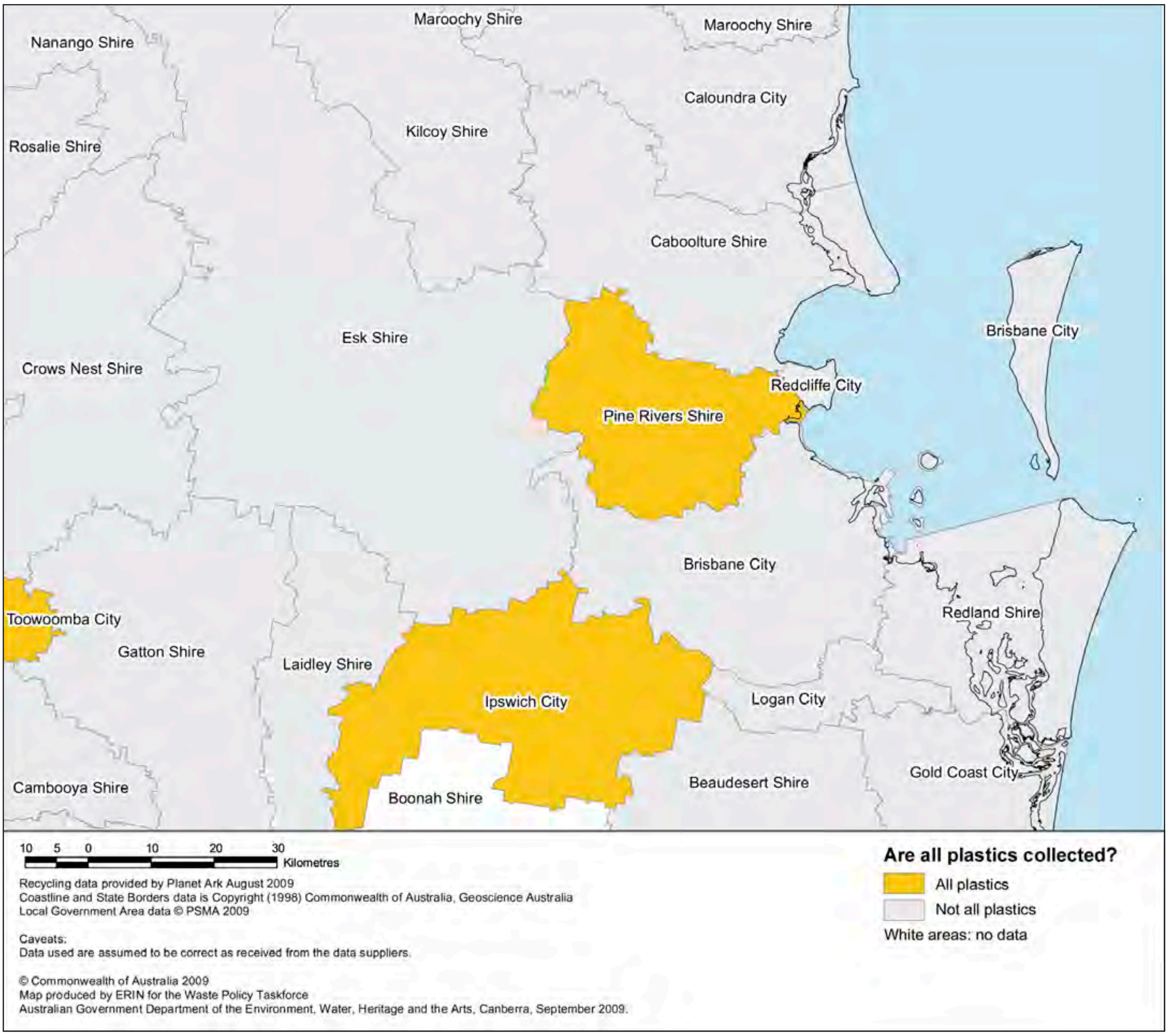
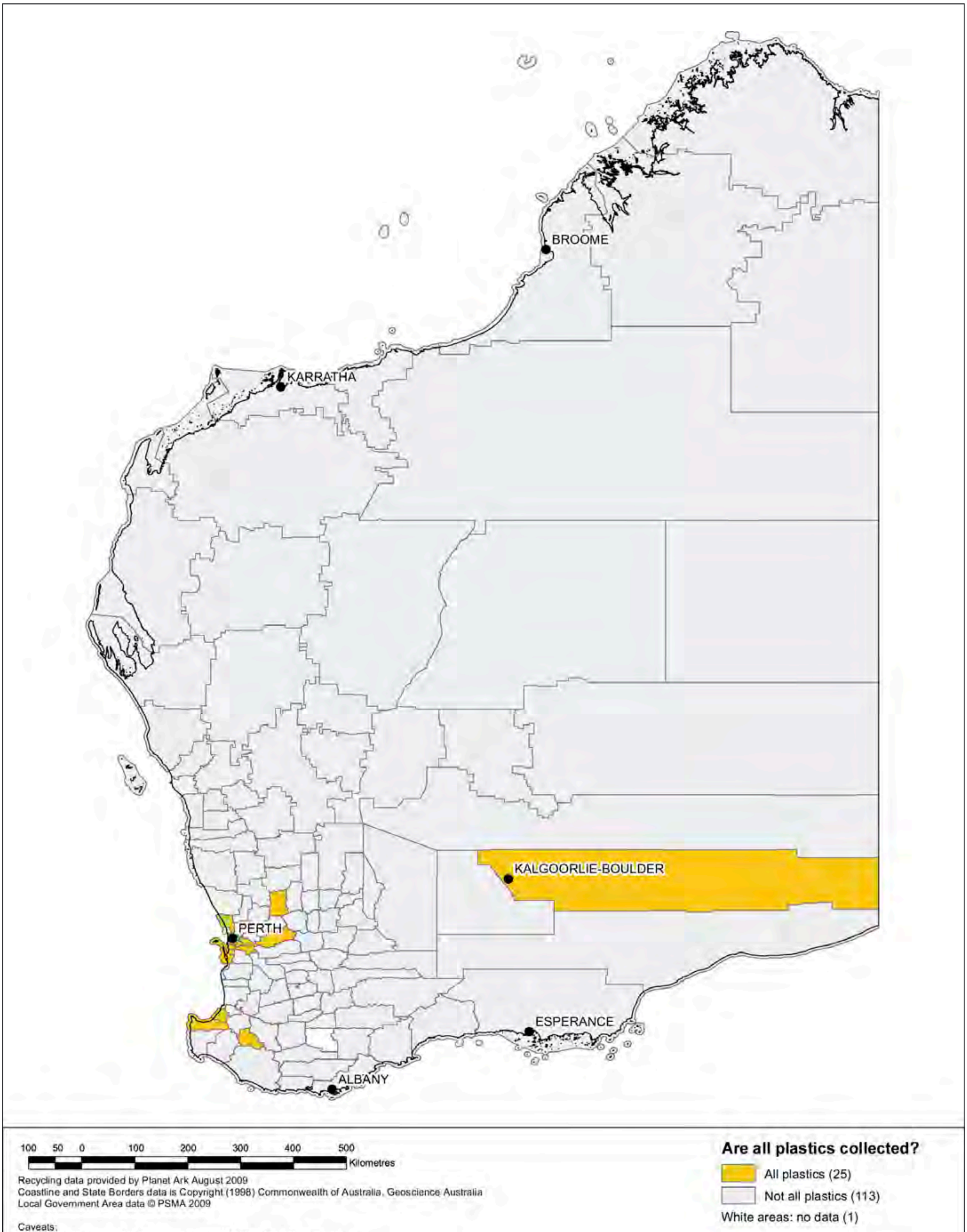


Figure B8: Western Australia—municipal collection of plastics types, by LGA



Recycling data provided by Planet Ark August 2009
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Local Government Area data © PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009

Figure B9: Perth—municipal collection of plastics types, by LGA

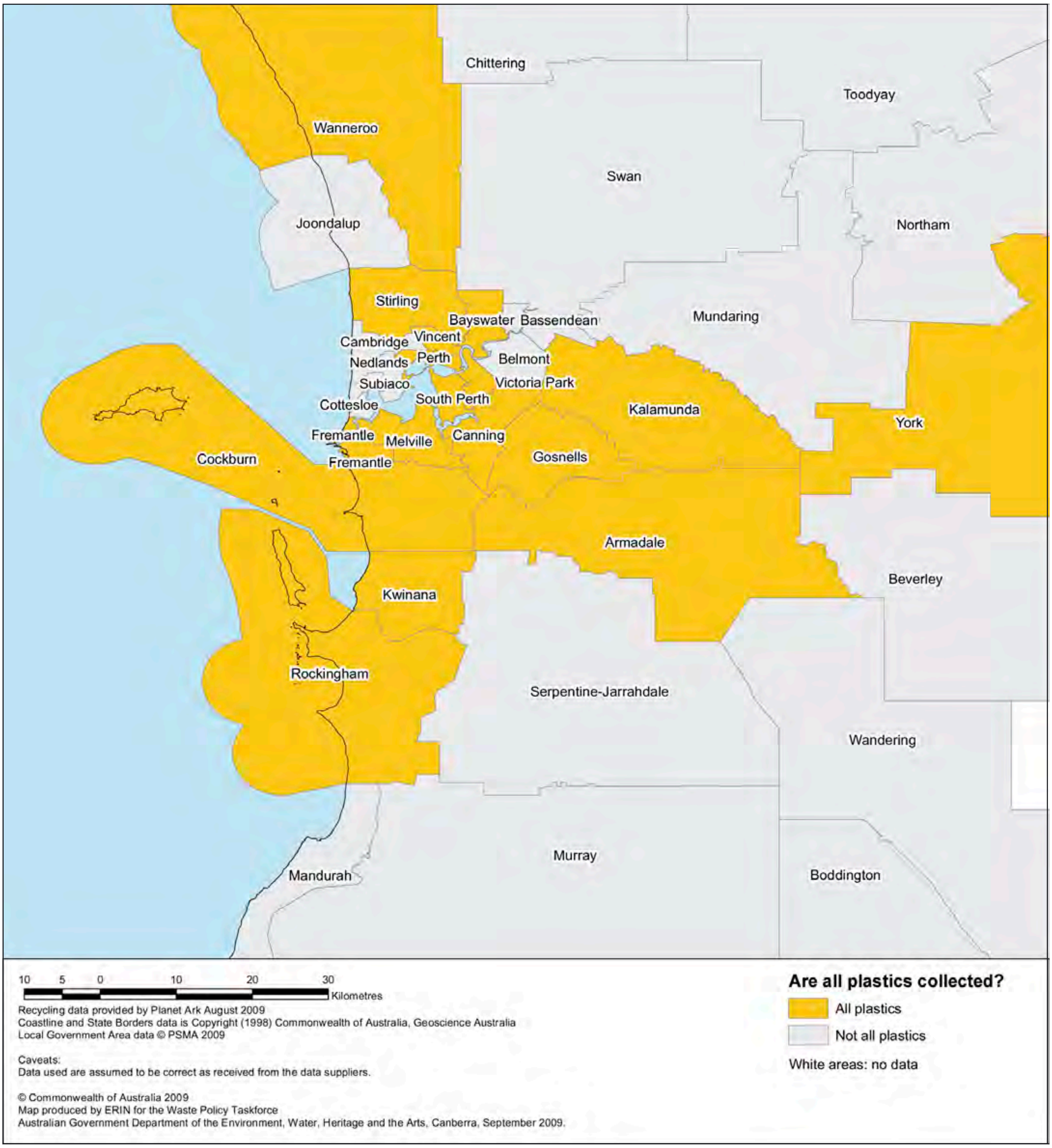


Figure B10: South Australia—municipal collection of plastics types, by LGA

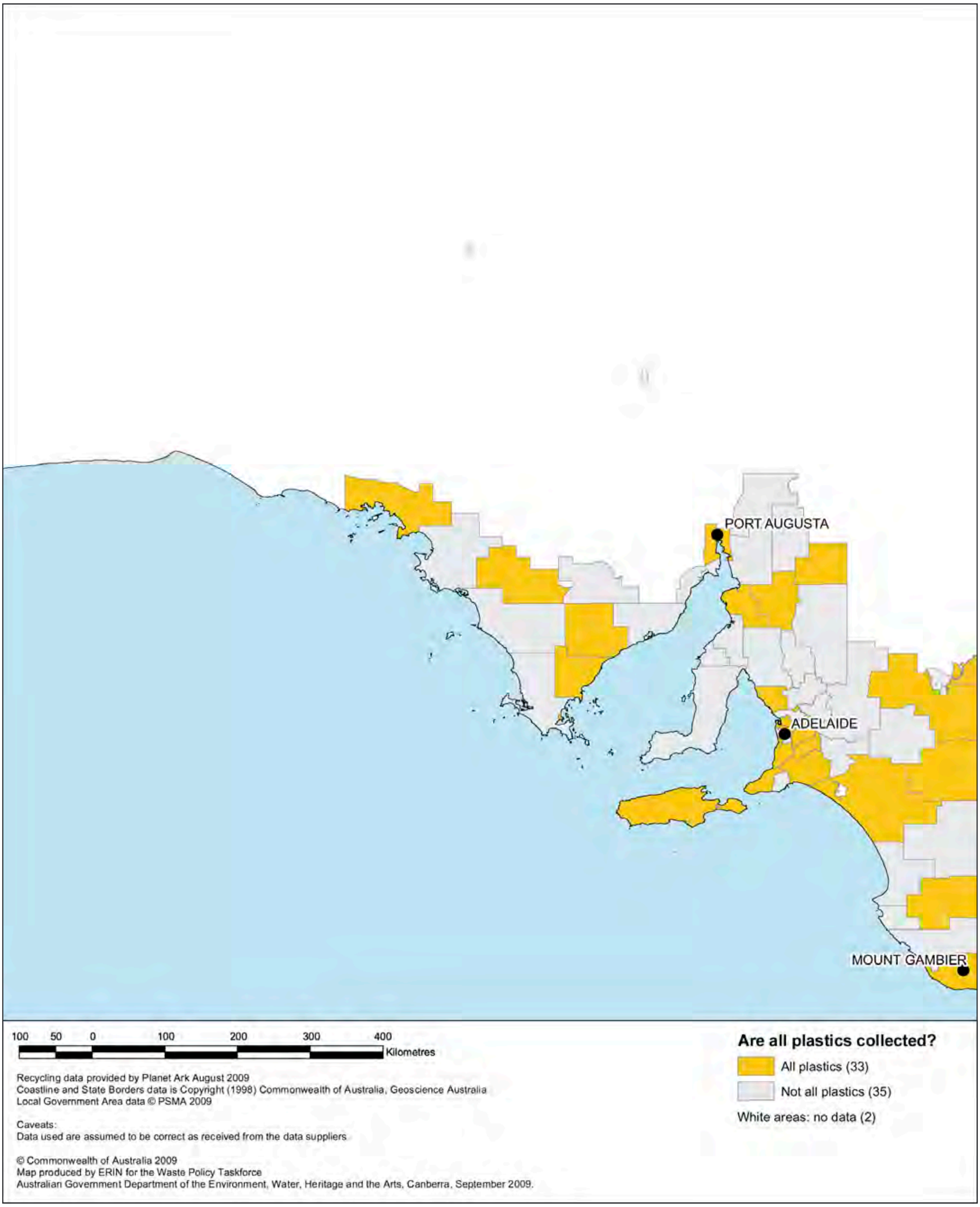


Figure B11: Adelaide—municipal collection of plastics types, by LGA

Figure B12: Tasmania—municipal collection of plastics types, by LGA

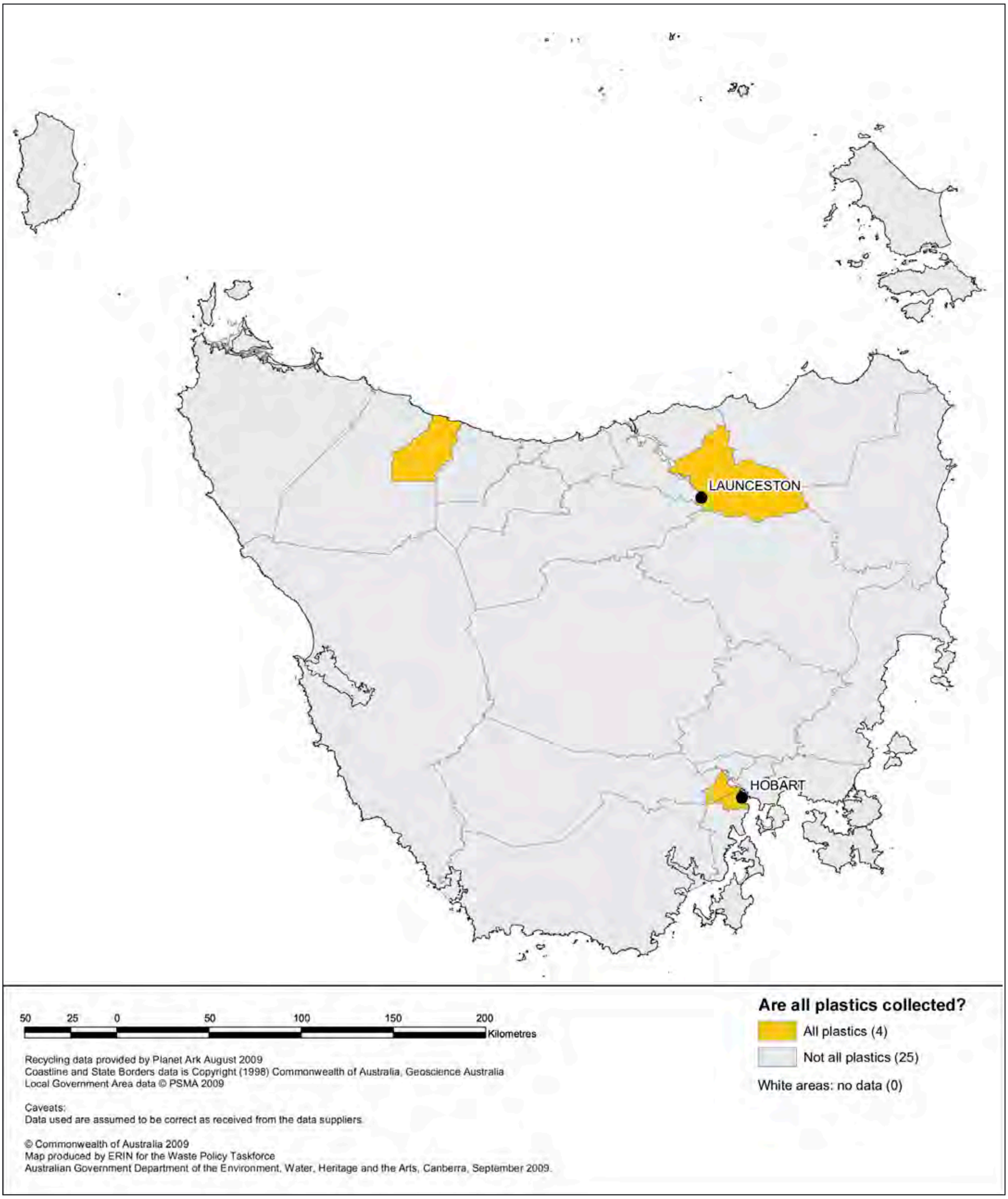


Figure B13: Hobart—municipal collection of plastics types, by LGA

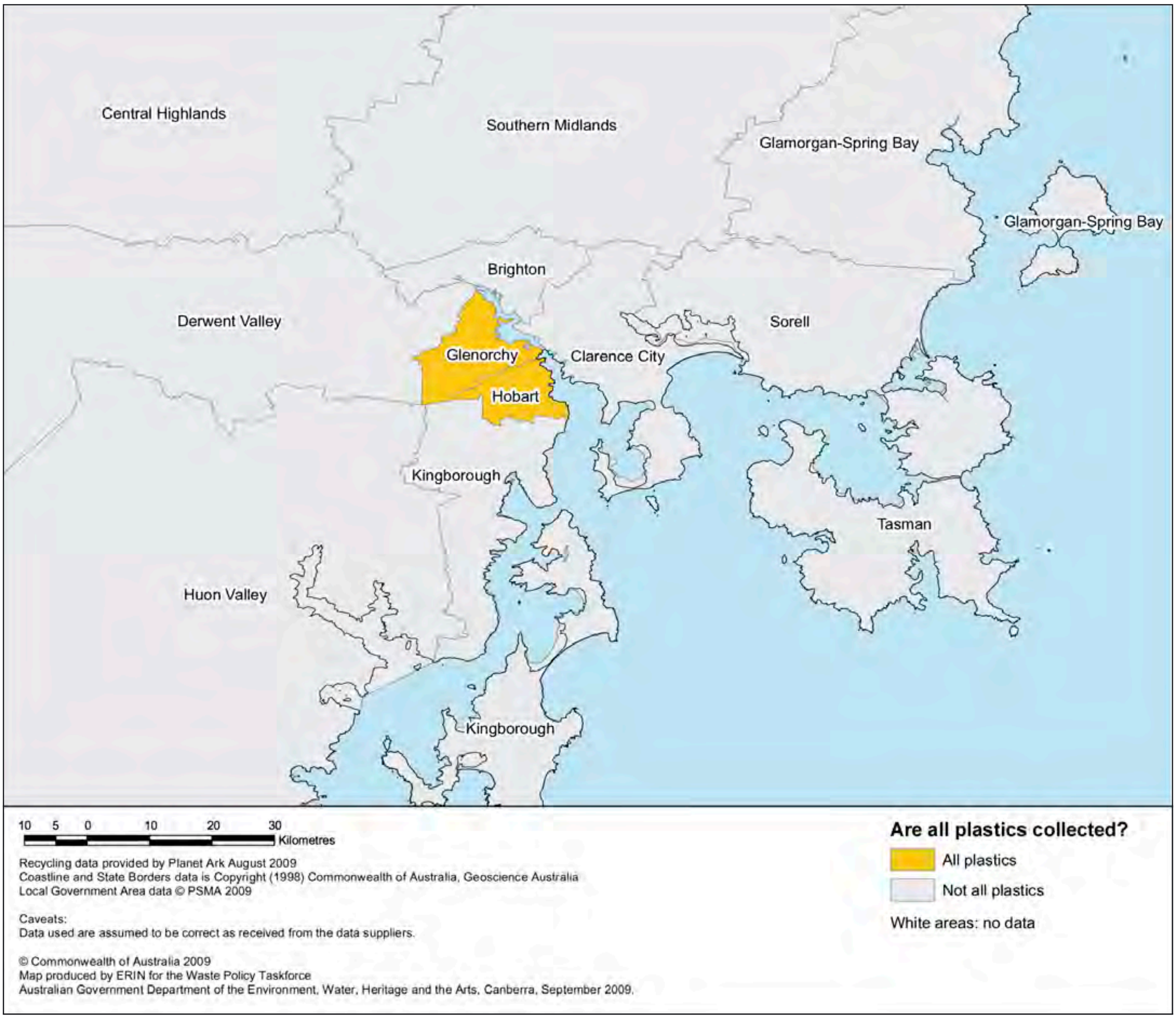
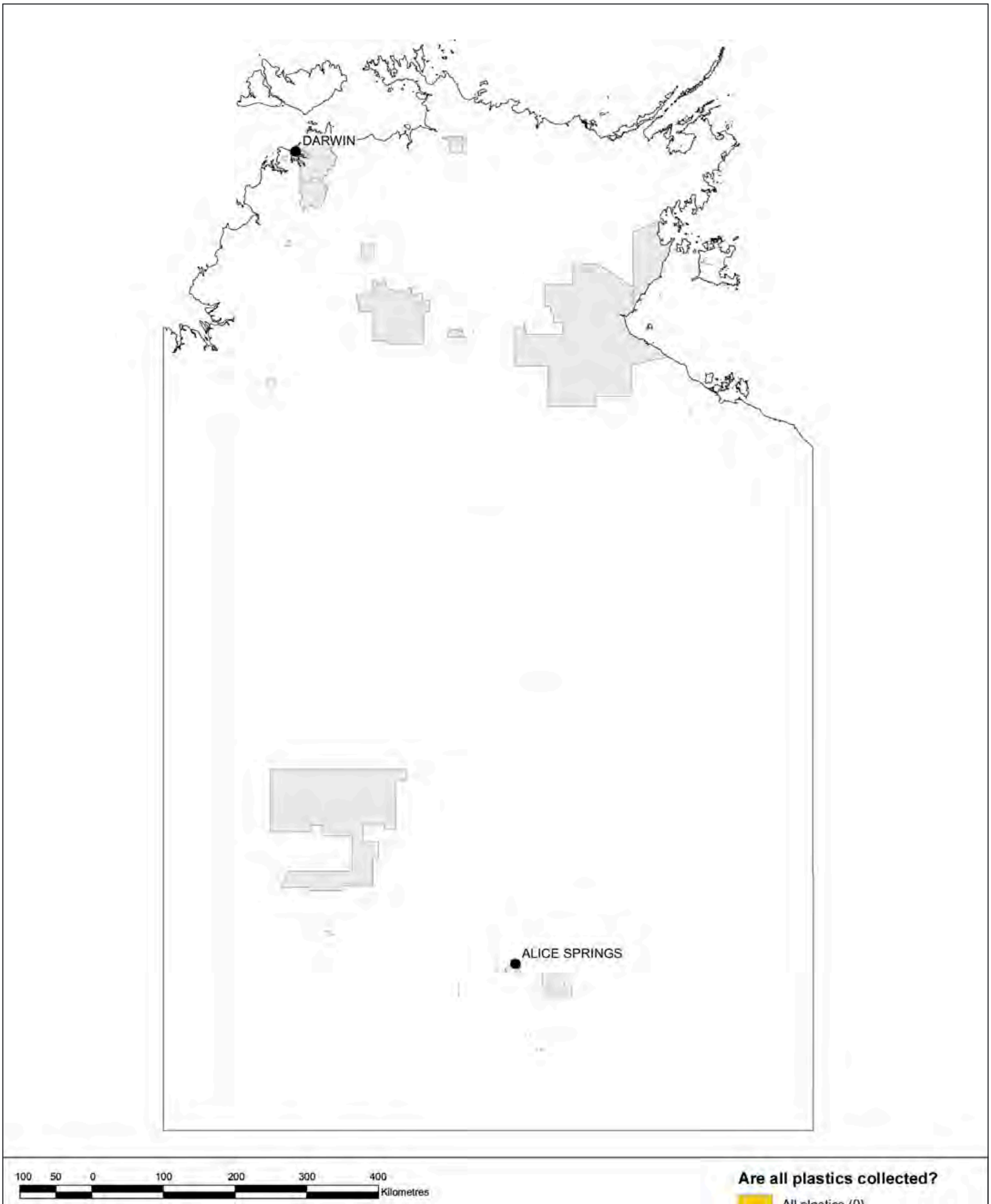


Figure B14: Northern Territory—municipal collection of plastics types, by LGA



Recycling data provided by Planet Ark August 2009
Coastline and State Borders data is Copyright (1998) Commonwealth of Australia, Geoscience Australia
Local Government Area data © PSMA 2009

Caveats:
Data used are assumed to be correct as received from the data suppliers.

Map produced by ERIN for the Waste Policy Taskforce
Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, September 2009.

APPENDIX C
WASTE CLASSIFICATION SYSTEMS BY STATE AND TERRITORY

Chapter 4.4 of the National Waste Report (Policy and Regulation) provides introductory information on waste classification arrangements in Australia. In particular, it notes the role of state and territory governments in establishing classification arrangements and some of the challenges identified by industry arising from differences between jurisdictions.

Appendix C presents diagrams of all waste classifications used by each jurisdiction in two parts. Part 1 provides summary classification diagrams or 'trees' of the major classifications. Part 2 presents more detailed versions.

The classification trees in this Appendix were compiled for the Department of Environment, Water, Heritage and the Arts by Hyder Consulting in consultation with the responsible agencies in each jurisdiction. Jurisdictions were asked to verify that the figures provide an accurate representation of this waste classification system, from a management and disposal perspective. Each figure reflects an interpretation of legislation and regulations based on implementation in that state or territory. It is important to note that some jurisdictions may use one set of classifications for regulating resource recovery and landfill disposal and a different set of classifications for data collection and reporting based on volume and types of waste to landfill, for example. End notes contain the information sources.

Each figure starts at the highest level classifications and moves down into sets of sub-categories. If a jurisdiction takes a risk-based approach (rather than a materials-based approach) to classification, this is reflected in the diagrams.

Part 1: summary classification trees

Figure C1: Australian Capital Territory—summary classification[1]

The *Environment Protection Act 1997* defines waste as any solid, liquid or gas or any combination of them, that is a surplus product or unwanted by-product of an activity, whether the product or by-product is of value or not.

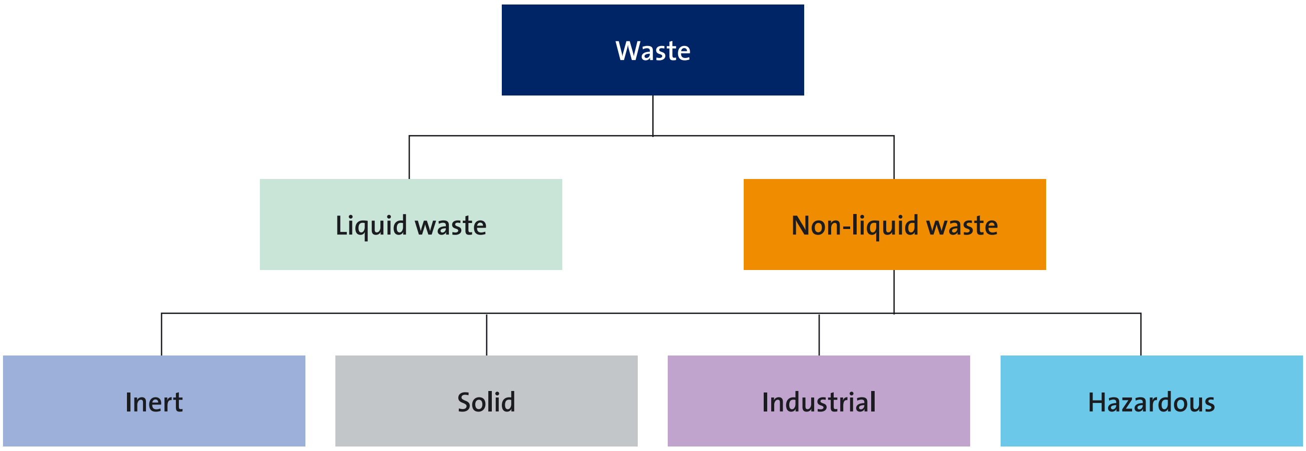


Figure C2: New South Wales—summary classification[2]

The *Protection of the Environment Operations Act 1997* defines waste as:
a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment
b) any discarded, rejected, unwanted, surplus or abandoned substance
c) any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance
d) any processed, recycled, re-used or recovered substance produced wholly or partly from waste that is applied to land, or used as fuel, but only in the circumstances prescribed by the regulations
e) any substance prescribed by the regulations to be waste

For the purposes of paragraph (d), the following circumstances are prescribed:
a) in relation to substances that are applied to land, the application to land by:
   i. spraying, spreading or depositing on the land, or
   ii. ploughing, injecting or mixing into the land, or
   iii. filling, raising, reclaiming or contouring the land,
b) in relation to substances that are used as fuel, all circumstances.
Subclause (a) does not apply where the substances concerned are either bulk agricultural crop materials or manure.

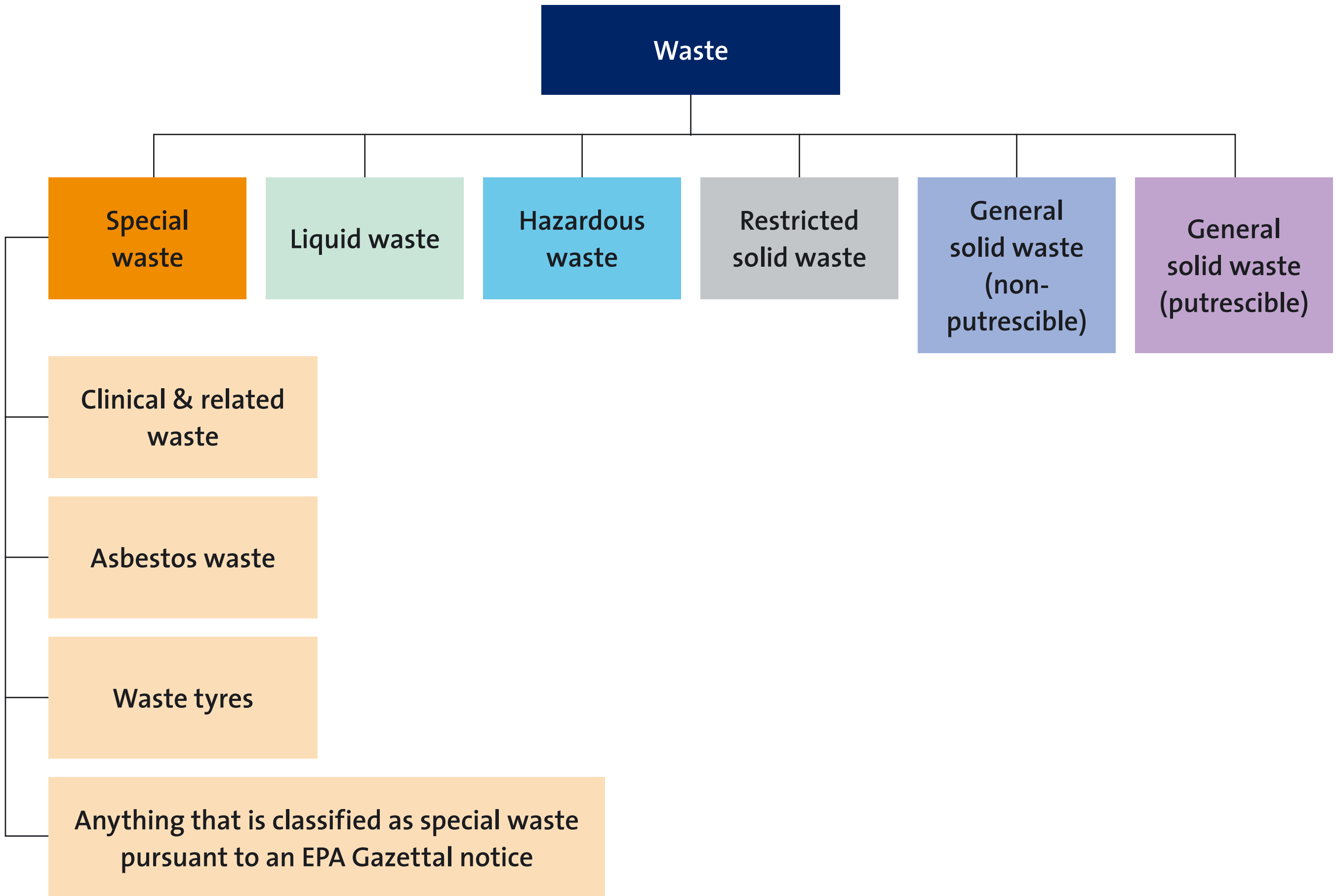


Figure C3: Northern Territory—summary classification[3]

"The *Waste Management and Pollution Control Act* (in force as of March 2009, replacing 1998 Act) defines waste as:
a) a solid, a liquid or a gas; or
b) a mixture of such substances,
that is or are left over, surplus or an unwanted by-product from any activity (whether or not the substance is of value) and includes a prescribed substance or class of substances."

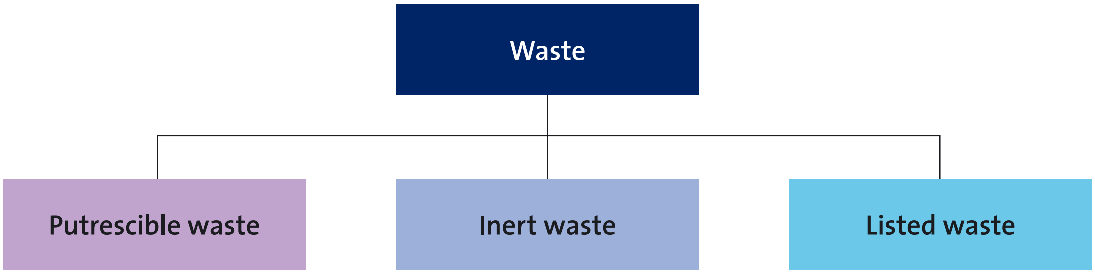


Figure C4: Queensland—summary classification[4]

The *Environmental Protection Act 1994* defines waste as: waste includes anything other than a resource approved under subsection (4), that is:
a) left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity
b) surplus to the industrial, commercial, domestic or other activity generating the waste
- Waste can be a gas, liquid, solid or energy, or a combination of any of them.
- A thing can be waste whether or not it is of value.
- The administering authority may approve a resource, or a stated type of resource, for subsection (1) if it considers the resource, or type of resource, has a beneficial use other than disposal.

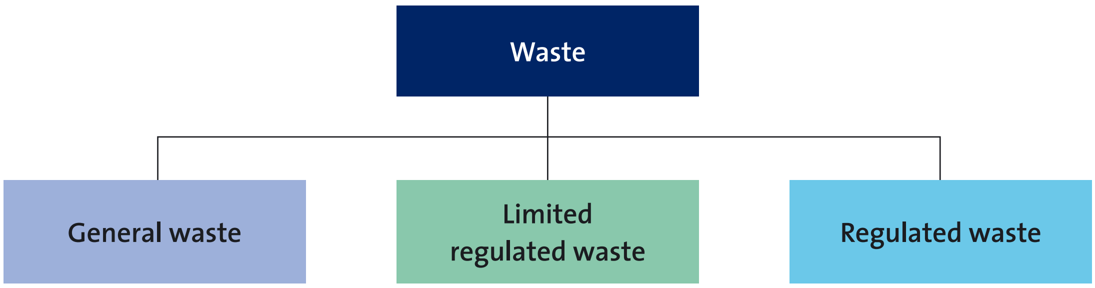


Figure C5: South Australia—summary classification[5]

The *Environment Protection Act 1993* defines waste as:

- any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for recycling, re-processing, recovery or purification by a separate operation from that which produced the matter
- anything declared by regulation or by an environment protection policy to be waste, whether of value or not.

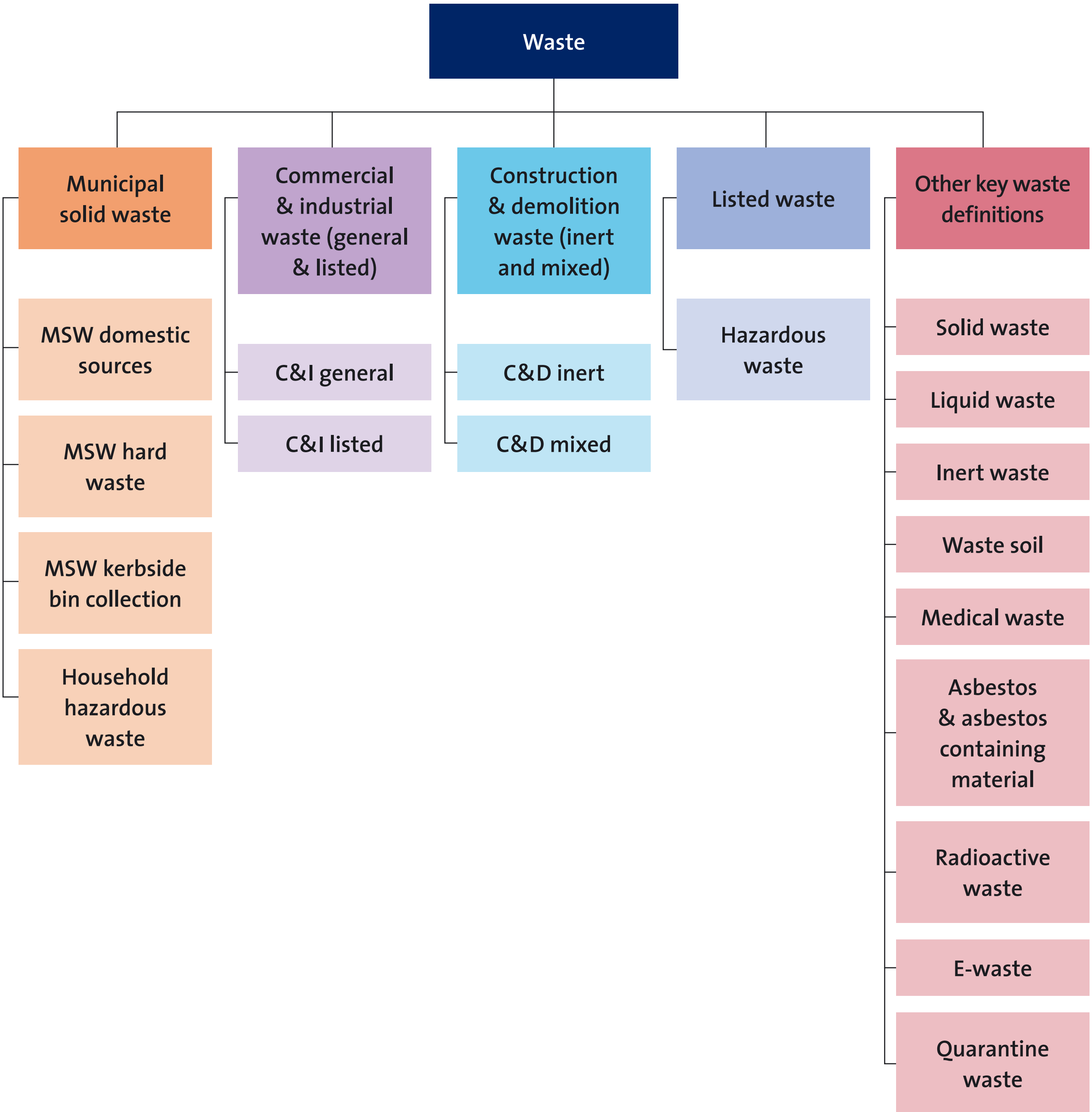


Figure C6: Tasmania—summary classification[6]

The *Environmental Management and Pollution Control Act 1994* defines waste as:

- discarded, rejected, unwanted, surplus or abandoned matter, whether of any value or not
- discarded, rejected, unwanted, surplus or abandoned matter, whether of any value or not intended for:
  - recycling, re-processing, recovery, re-use or purification by a separate operation from that which produced the matter
  - sale.

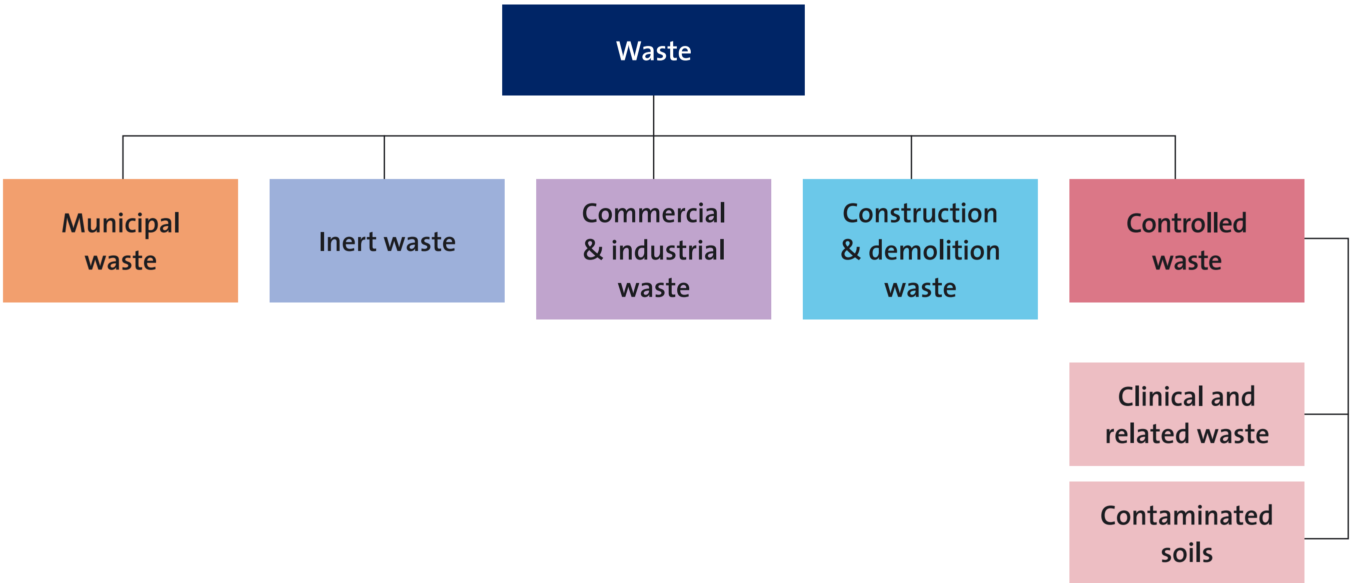


Figure C7: Victoria—summary classification[7]

The *Environment Protection Act 1970* defines waste as:

- any matter whether solid, liquid, gaseous or radio-active which is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment
- any discarded, rejected, unwanted, surplus or abandoned matter
- any otherwise discarded, rejected, abandoned, unwanted or surplus matter intended for:
  - recycling, re-processing, recovery or purification by a separate operation from that which produced the matter
  - sale
- any matter prescribed to be waste.

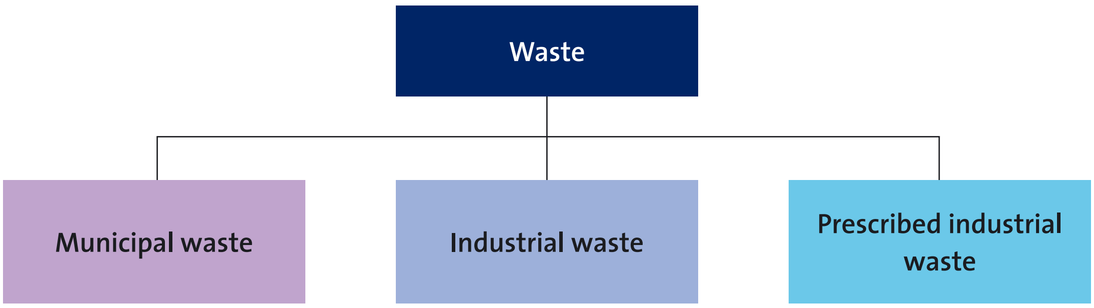
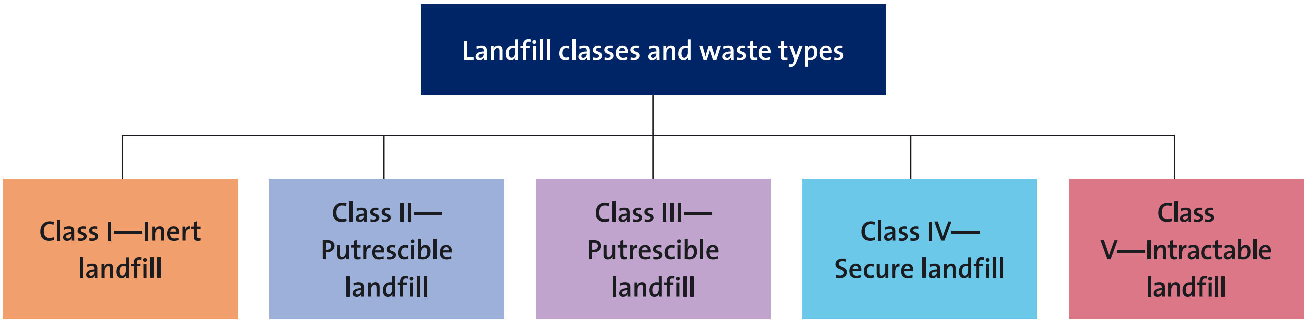


Figure C8: Western Australia—summary classification[8]

The *Waste Avoidance and Resource Recovery Act 2007* defines waste as matter whether useful or useless, which is discharged into the environment; or matter which is prescribed by the regulations to be waste.
Below are the criteria to be applied in determining classification of wastes for acceptance to landfills licensed or registered in Western Australia in accordance with Part V of the *Environmental Protection Act 1986*.



Part 2: detailed classification trees

Figure C9: Australian Capital Territory—detailed classification[9]

The *Environment Protection Act 1997* defines waste as any solid, liquid or gas or any combination of them, that is a surplus product or unwanted by-product of an activity, whether the product or by-product is of value or not.

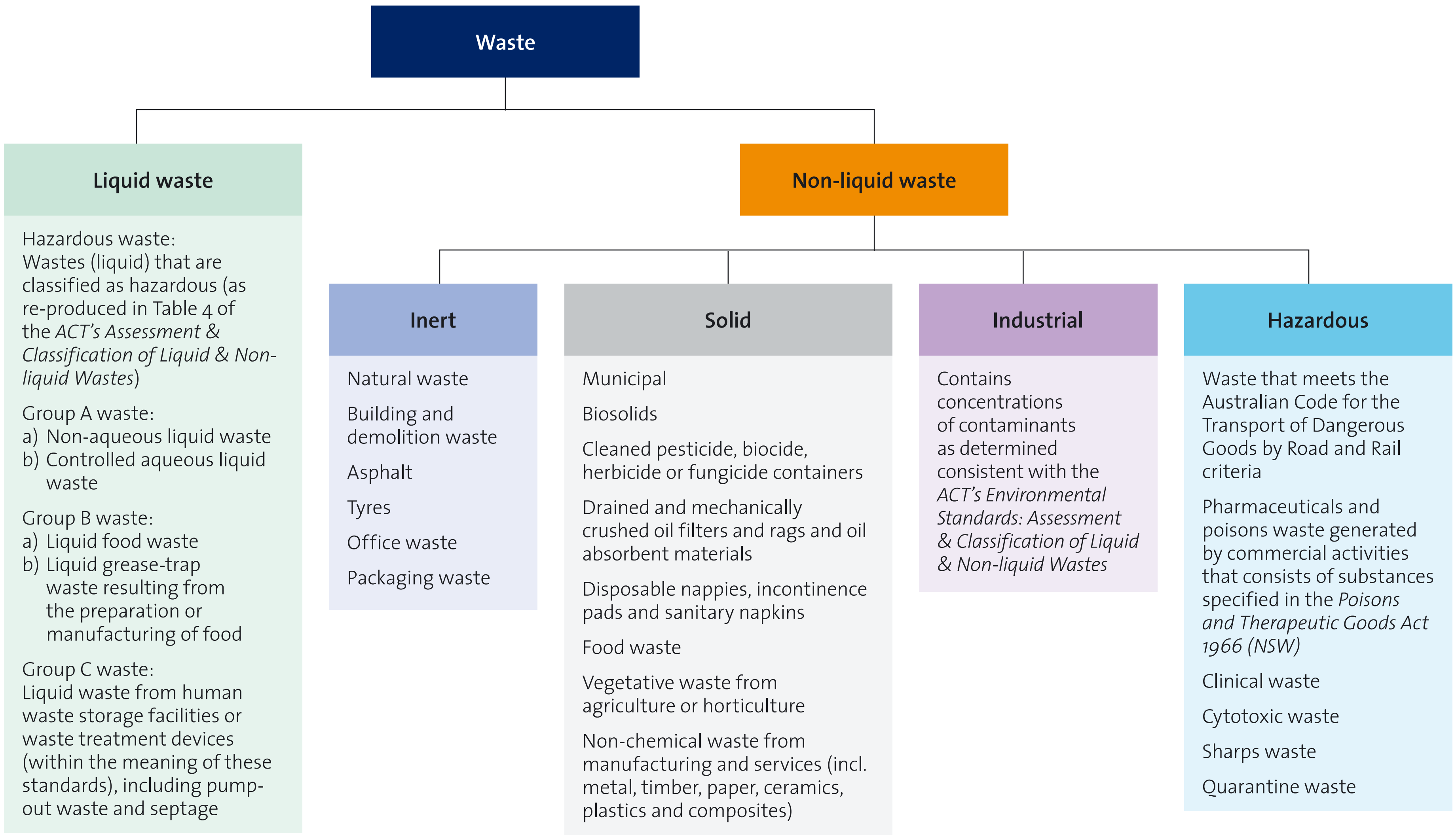


Figure C10: New South Wales—detailed classification[10]

Waste

Special waste

Means any of the following:

Clinical & related waste
- Clinical waste
- Cytotoxic waste
- Pharmaceutical, drug or medicine waste
- Sharps waste

Asbestos waste

Waste tyres

Anything that is classified as special waste pursuant to an EPA Gazettal notice

Restricted solid waste

Means any waste (other than special waste, hazardous waste or liquid waste) that includes any of the following:

a anything that is restricted solid waste within the meaning of the Waste Classification Guidelines

b anything that is classified as restricted solid waste pursuant to an EPA Gazettal notice.

Liquid waste

Means any waste (other than special waste) that includes any of the following:

- has an angle of repose of less than 5 degrees above horizontal, or
- becomes free-flowing at or below 60°C or when it is transported, or
- is generally not capable of being picked up by a spade or shovel

Anything that is classified as liquid waste pursuant to an EPA Gazettal notice

Hazardous waste

means waste (other than special waste or liquid waste) that includes:

Anything classified as a substance of Class 1, 2, 5 or 8 within the meaning of the *Transport of Dangerous Goods Code (DGC)*, or a substance to which Division 4.1, 4.2, 4.3 or 6.1 of the DGC applies

Containers, having previously contained a substance of Class 1, 3, 4, 5 or 8 within the meaning of the DGC, or a substance to which Division 6.1 of the DGC applies, from which residues have not been removed

Coal tar or coal tar pitch waste comprising of more than 1% (by weight) of coal tar or coal tar pitch waste

Lead-acid or nickel-cadmium batteries (being waste generated or separately collected by activities carried out for business, commercial or community services purposes)

Lead paint waste arising otherwise than from residential premises or educational institutions

Anything that is classified as hazardous waste pursuant to an EPA Gazettal notice

anything that is hazardous waste within the meaning of the Waste Classification Guidelines

General solid waste (non-putrescible)

means waste (other than those wastes listed in the other categories) that includes:

Glass, plastic, rubber, plasterboard, ceramics, bricks, concrete or metal

Paper or cardboard

Household waste from municipal clean-up (excluding food waste)

Street sweeping waste

Grit, sediment, litter and gross pollutants collected in, and removed from stormwater management devices/systems

Grit and screenings from potable water and water reticulation plants

Garden waste

Wood waste

Waste contaminated with lead from homes or educational institutions

Containers, previously containing dangerous goods, from which residues have been removed by washing or vacuuming

Drained oil filters, rags and oil-absorbent materials that do not contain free liquids

Drained motor oil containers that do not contain free liquids

Non-putrescible vegetative waste from agriculture, silviculture or horticulture

Building cavity dust waste removed from homes, or educational institutions, packaged securely to prevent dust emissions and contact

Synthetic fibre waste (from materials such as fibreglass, polyesters and other plastics) packaged to prevent dust emissions - excludes asbestos waste

Virgin excavated natural material

Building and demolition waste

Asphalt waste (including from road construction)

Biosolids categorised as unrestricted use or as restricted use 1,2, or 3

Cured concrete waste from a batch plant

Fully cured and set thermosetting polymers and fibre-reinforcing resins

Fully cured and dried residues of resins, glues, paints, coatings and inks

Anything that is classified as general solid waste (non-putrescible)

Anything that is general solid waste (putrescible) within the meaning of the Waste Classification Guidelines,

Any mixture of anything above

General solid waste (putrescible)

Means waste (other than special waste, hazardous waste, restricted solid waste or liquid waste) that includes any of the following:

Household waste containing putrescible organics

Waste from litter bins collected by or on behalf of local councils

Manure and nightsoil

Disposable nappies, incontinence pads or sanitary napkins

Food waste

Animal waste

Grit or screenings from sewage treatment systems that have been dewatered so that the grit or screenings do not contain free liquids

Anything that is classified as general solid waste (putrescible) pursuant to an EPA Gazettal notice

Anything that is general solid waste (non-putrescible) within the meaning of the Waste Classification Guidelines

Any mixture of anything referred to in paragraphs above

The *Protection of the Environment Operations Act 1997* defines waste as:

a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment

b) any discarded, rejected, unwanted, surplus or abandoned substance

c) any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance

d) any processed, recycled, re-used or recovered substance produced wholly or partly from waste that is applied to land, or used as fuel, but only in the circumstances prescribed by the regulations

e) any substance prescribed by the regulations to be waste.

For the purposes of paragraph (d), the following circumstances are prescribed:

a) in relation to substances that are applied to land, the application to land by:

i. spraying, spreading or depositing on the land, or

ii. ploughing, injecting or mixing into the land, or

iii. filling, raising, reclaiming or contouring the land.

b) in relation to substances that are used as fuel, all circumstances.

Subclause (a) does not apply where the substances concerned are either bulk agricultural crop materials or manure.

Note that this is a summary of NSW Waste classification framework—for full details see http://www.environment.nsw.gov.au/waste/envguidlns/index.htm

Figure C11: Northern Territory—detailed classification[11]

"The *Waste Management and Pollution Control Act* (in force as of March 2009, replacing 1998 Act) defines waste as:
a) a solid, liquid or a gas; or
b) a mixture of such substances,
that is or are left over, surplus or unwanted by-product from any activity (whether or not the substance is of value) and includes a prescribed substance or class of substances."

Waste

Putrescible waste

Putrescible wastes are those which are able to be decomposed by bacterial action or likely to become putrid over time. This includes any waste that contains organic materials and green waste

Inert waste

Inert waste are largely non-biodegradable, non-flammable and not chemically reactive and pose a negligible risk to the environment. This includes:

- Construction and demolition waste
- Blasting sand or garnet
- Casting sand
- Clean fill
- Rocks
- Concrete
- Bricks

Listed waste

Listed wastes pose a threat or risk to public health, safety or the environment and include substances which are:

- Toxic
- Infectious
- Mutagenic
- Carcinogenic
- Teratogenic
- Explosive
- Flammable
- Corrosive
- Oxidising

Figure C12: Queensland—detailed classification[12]

The *Environmental Protection Act 1994* defines waste as: waste includes anything other than a resource approved under subsection (4), that is:

a) left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity
b) surplus to the industrial, commercial, domestic or other activity generating the waste

- Waste can be a gas, liquid, solid or energy, or a combination of any of them.
- A thing can be waste whether or not it is of value.
- The administering authority may approve a resource, or a stated type of resource, for subsection (1) if it considers the resource, or type of resource, has a beneficial use other than disposal.

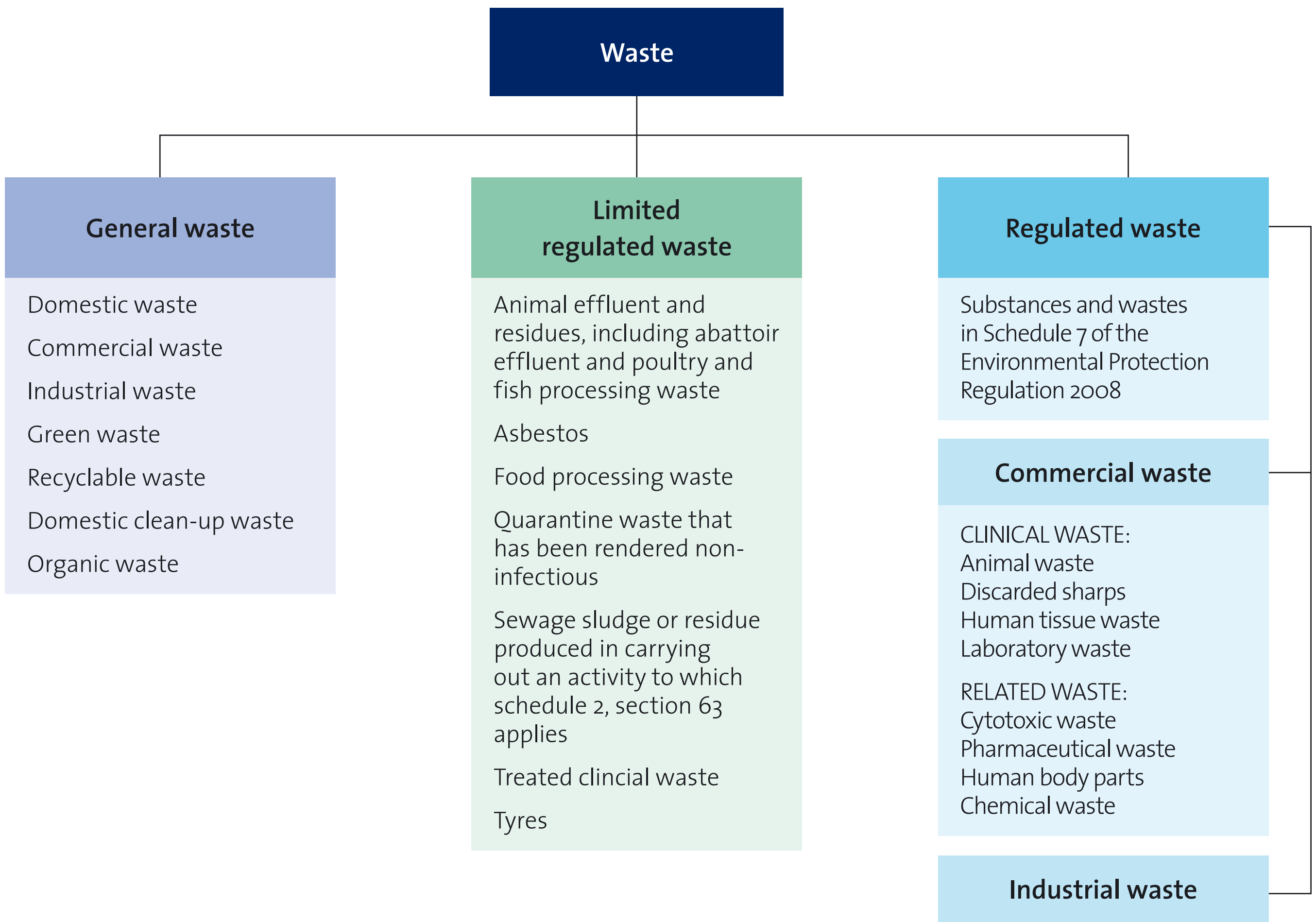


Figure C13: South Australia—detailed classification[13]

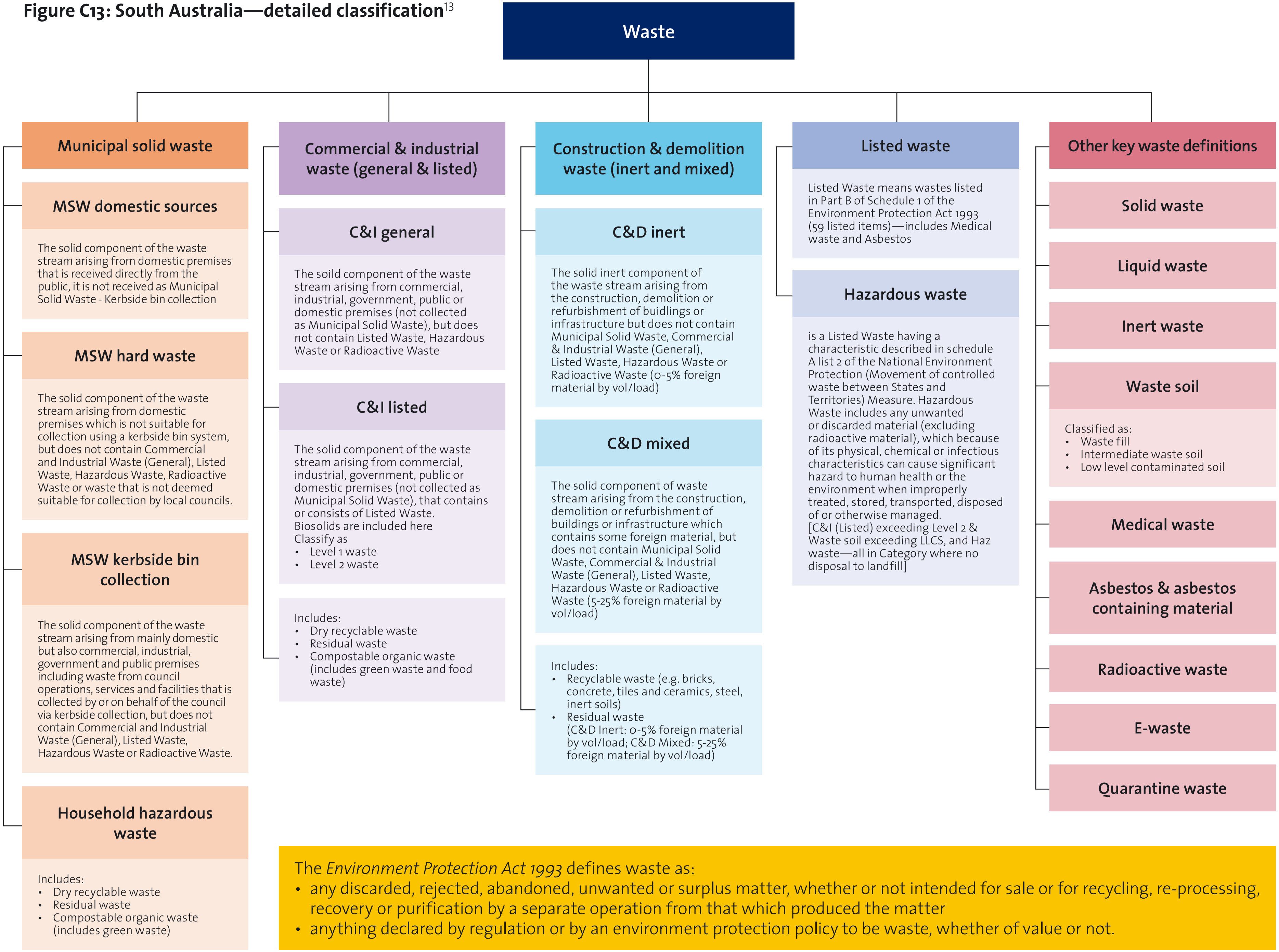


Figure C14: Tasmania—detailed classification[14]

The *Environmental Management and Pollution Control Act 1994* defines waste as:
- discarded, rejected, unwanted, surplus or abandoned matter, whether of any value or not
- discarded, rejected, unwanted, surplus or abandoned matter, whether of any value or not intended for:
  – recycling, re-processing, recovery, re-use or purification by a separate operation from that which produced the matter
  – sale.

Waste

Municipal waste

Domestic waste
Other Domestic
Other Council

Inert waste

Waste that is not:
- controlled waste
- putrescible waste
- likely to cause, either directly or indirectly, material or serious environmental harm or environmental nuisance
- contaminated with controlled waste or putrescible waste

Commercial & industrial waste

Commercial waste:
- component of waste stream originating from wholesale, retail or service establishments
- Includes non-controlled component only

Industrial waste:
- component of the waste stream arising from industrial processes and manufacturing operations
- does not include controlled waste or biodegardable material

Construction & demolition waste

Materials in the waste stream which arise from construction, refurbishment or demolition activities. Includes:
- bricks
- tiles
- concrete
- steel
- glass
- plastics
- soil or naturally occuring excavated material

Controlled waste

Controlled waste is:
- Derived or arising from agricultural or veterinary chemical products within the meaning of the *Agricultural and Veterinary Chemicals Act 1995*
- A dangerous good within the meaning of the *Dangerous Goods Act 1998*
- Derived or arising from poisons within the meaning of the *Poisons Act 1971*
- A waste within the meaning of the *Quarantine Regulations 2000* of the Commonwealth
- A scheduled waste within the meaning of a National Management Plan

Clinical and related waste

Clinical waste:
- Pathology and sampling waste directly involved in laboratory testing
- Human anatomical waste
- Blood and body fluids and materials or equipment containing human blood or body fluids
- Animal tissue, carcasses or other associated animal waste arising from laboratory investigation, or from medical or veterinary research or treatment
- Discarded sharps

Related waste:
- Cytotoxic
- Pharmaceuticals
- Chemicals
- Radioactive waste

Contaminated soils

- Low level cont. soil
- Cont. soil
- Cont. soil for remediation for treatment, re-use or disposal

Figure C15: Victoria—detailed classification[15]

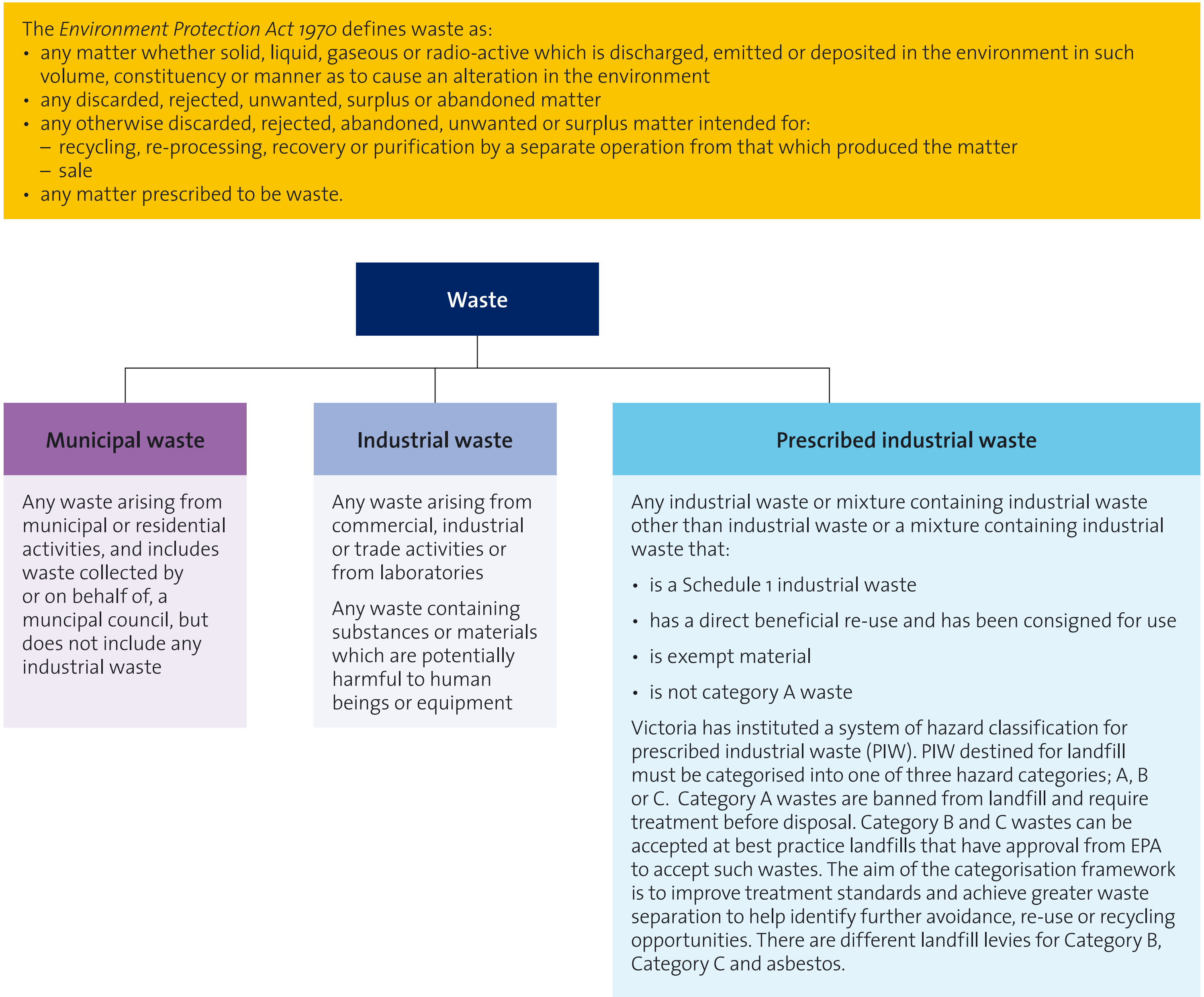


Figure C16: Western Australia—detailed classification[16]

The *Waste Avoidance and Resource Recovery Act 2007* defines waste as matter whether useful or useless, which is discharged into the environment; or matter which is prescribed by the regulations to be waste.
Below are the criteria to be applied in determining classification of wastes for acceptance to landfills licensed or registered in Western Australia in accordance with Part V of the *Environmental Protection Act 1986*.

Landfill classes and waste types

Class I—Inert landfill	Class II—Putrescible landfill	Class III—Putrescible landfill	Class IV—Secure landfill	Class V—Intractable landfill
Clean Fill	Clean Fill	Clean Fill	Clean Fill	Intractable and other wastes in accordance with the approvals for the site
Type 1 Inert Waste	Type 1 Inert Waste	Type 1 Inert Waste	Type 1 Inert Waste	
Contaminated solid wastes meeting waste acceptance criteria specified for Class I landfills	Putrescible Wastes	Putrescible Wastes	Putrescible Wastes	
Type 2 Inert Waste	Contaminated solid wastes meeting waste acceptance criteria specified for Class II landfills	Contaminated solid wastes meeting waste acceptance criteria specified for Class II or Class III landfills	Contaminated solid wastes meeting waste acceptance criteria specified for Class II, Class III or Class IV landfills	
Type 3 Inert Waste	Type 2 Inert Waste	Type 2 Inert Waste	Type 2 Inert Waste	
Type 1 Special Waste	Type 1 and Type 2 Special Wastes	Type 1 and Type 2 Special Wastes	Type 1 and Type 2 Special Wastes	

Endnotes

1 *Environment Protection (Legislation) Regulations, Subordinate Law 2000 No 36 made under the Environment Protection Act 1997*, <http://www.legislation.act.gov.au/sl/2000-36/20000921-5191/pdf/2000-36.pdf> and *Environmental Standards: Assessment & Classification of Liquid & Non-liquid Wastes, June 2000*, <http://www.austlii.edu.au/au/legis/act/num_reg/epr20002000n36532.txt/cgi-bin/download.cgi/download/au/legis/act/num_reg/epr20002000n36532.txt>

2 Department of Environment and Climate Change (DECC) NSW (2008) *NSW Waste Classification Guidelines Part 1: Classifying Waste April 2008*, <http://www.environment.nsw.gov.au/resources/waste/08202classifyingwaste.pdf>

3 *Waste Management and Pollution Control Act (NT)* (in force as of March 2009, replacing 1998 Act), <http://www.austlii.edu.au/au/legis/nt/consol_act/wmapca398.txt>

4 *Environmental Protection Regulation 2008*, <https://www.epa.qld.gov.au/about_the_epa/legislation/environmental_protection/environmental_protection_regulation_2008.html>; *Environmental Protection (Waste Management) Regulation 2000, reprinted as in force on 1 July 2009* <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtWaMR00.pdf> and *Environmental Protection Act 1994, reprinted as in force on 15 October 2009* <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtA94.pdf>

5 *Environment Protection Regulations 2009* under *Environment Protection Act 1993 (SA)*, <http://www.legislation.sa.gov.au/LZ/C/R/ENVIRONMENT%20PROTECTION%20REGULATIONS%202009/CURRENT/2009.227.UN.PDF> and *Environmental Protection Authority (SA) Draft Guidelines for the assessment, classification and disposal of solid waste September 2009*, <http://www.epa.sa.gov.au/xstd_files/Waste/Public%20consultation/draft_guidelines_waste.pdf>

6 *Tasmanian Solid Waste Classification System (based on the Australian Waste Database)*; Department of Tourism Arts and Environment (Tas) *Approved Management Method for Clinical and Related Waste (Minimum Requirements and Explanatory Notes) 2007* <http://www.environment.tas.gov.au/file.aspx?id=1973> and *Department of Tourism Arts and Environment (Tas), Information Bulletin no. 105 Classification and Management of Contaminated Soils for Disposal August 2006*, <http://www.environment.tas.gov.au/file.aspx?id=1785>

7 *Environment Protection Act 1970 (Vic)*, <http://www.austlii.edu.au/au/legis/vic/consol_act/epa1970284/>

8 Department of Environment and Conservation (DEC) WA (1996) *Landfill Waste Classification and Waste Definitions 1996 (As amended)*, <http://www.dec.wa.gov.au/component/option,com_docman/gid,1316/task,doc_download/>

9 *Environment Protection (Legislation) Regulations, Subordinate Law 2000 No 36 made under the Environment Protection Act 1997*, <http://www.legislation.act.gov.au/sl/2000-36/20000921-5191/pdf/2000-36.pdf> and Environmental Standards: Assessment & Classification of Liquid & Non-liquid Wastes, June 2000, <http://www.austlii.edu.au/au/legis/act/num_reg/epr20002000n36532.txt/cgi-bin/download.cgi/download/au/legis/act/num_reg/epr20002000n36532.txt>

10 Department of Environment and Climate Change (DECC) NSW (2008) *NSW Waste Classification Guidelines Part 1: Classifying Waste April 2008*, <http://www.environment.nsw.gov.au/resources/waste/08202classifyingwaste.pdf>

11 *Waste Management and Pollution Control Act (NT)* (in force as of March 2009, replacing 1998 Act), <http://www.austlii.edu.au/au/legis/nt/consol_act/wmapca398.txt>

12 *Environmental Protection Regulation 2008*, <https://www.epa.qld.gov.au/about_the_epa/legislation/environmental_protection/environmental_protection_regulation_2008.html>; *Environmental Protection (Waste Management) Regulation 2000*, reprinted as in force on 1 July 2009, <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtWaMR00.pdf> and *Environmental Protection Act 1994*, reprinted as in force on 15 October 2009, <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtA94.pdf>

13 *Environment Protection Regulations 2009* under *Environment Protection Act 1993 (SA)*, <http://www.legislation.sa.gov.au/LZ/C/R/ENVIRONMENT%20PROTECTION%20REGULATIONS%202009/CURRENT/2009.227.UN.PDF> and *Environmental Protection Authority (SA) Draft Guidelines for the assessment, classification and disposal of solid waste September 2009*, <http://www.epa.sa.gov.au/xstd_files/Waste/Public%20consultation/draft_guidelines_waste.pdf>

14 Tasmanian Solid Waste Classification System (based on the Australian Waste Database); Department of Tourism Arts and Environment (Tas) *Approved Management Method for Clinical and Related Waste (Minimum Requirements and Explanatory Notes) 2007* <http://www.environment.tas.gov.au/file.aspx?id=1973> and *Department of Tourism Arts and Environment (Tas), Information Bulletin no. 105 Classification and Management of Contaminated Soils for Disposal August 2006*, <http://www.environment.tas.gov.au/file.aspx?id=1785>

15 *Environment Protection Act 1970 (Vic)*, <http://www.austlii.edu.au/au/legis/vic/consol_act/epa1970284/>

16 Department of Environment and Conservation (DEC) WA (1996) *Landfill Waste Classification and Waste Definitions 1996 (as amended)*, <http://www.dec.wa.gov.au/component/option,com_docman/gid,1316/task,doc_download/>

APPENDIX D
LOOKING TO THE FUTURE

The generation of increasing quantities of waste brings with it growing demand for new recycling and landfill infrastructure and the need to set aside adequate time to plan for, fund and build that infrastructure. It also brings opportunities to use resources more efficiently, and to minimise potential impacts of the increased quantities of waste that are landfilled.

Appendix D is in two parts:

Part 1—estimated projections of the quantities of waste that may be generated and may need to be landfilled or recycled between 2006–07 and 2020–21, with three future scenarios.

Part 2—national estimates of future resource recovery infrastructure that would be needed to manage the waste should any of the three scenarios be realised.

PART 1: ESTIMATES OF FUTURE WASTE GENERATION AND LANDFILL DISPOSAL

Chapter 2 of the National Waste Report provides simple projections of the growth in waste generation, recycling and landfill disposal to 2020–21. Based on a growth in waste generation of 4.5% per annum (including the contribution from 1.5% per annum population growth), and maintenance of the 2006–07 recycling rate (52% recycling), the report estimates that in 2020–21 Australians could

- generate 81 072 593 tonnes of waste
- recycle 52% of that waste (42 157 748 tonnes), and
- send 48% to landfill (38 914 845 tonnes).

These simple projections, which use current trends and a static recycling rate, can help clarify important issues such as the implications of growth in waste generation for recycling infrastructure, but they do not recognise the likely effects of government strategies, policies and actions on waste. Most states and territories have waste strategies or policies, and most are acting to support waste targets. Such decisions by jurisdictions are likely to reduce the quantity of waste generated, and increase recycling rates, into the future.

To complement that simple projection approach, the Department of the Environment, Water, Heritage and the Arts commissioned Hyder Consulting to develop indicative projections for three alternative future waste generation and recycling scenarios. The first two scenarios adopted low and high growth trajectories for waste generation, and the third scenario incorporated the expected results from state and territory waste strategies and targets.

Scenario 1—A 'base case' scenario which includes projections of waste generated and landfilled (from which the quantity recycled can be imputed). This assumes that tonnages within each waste stream increase in line with the projected rate of population, plus an additional 1%.* This growth rate is consistent with information gained in planning studies conducted at state level. It may represent a relatively low growth projection.

Scenario 2—A projection of waste generated (but not landfilled) at a higher growth rate, equivalent to population plus 3%. This projection is consistent with average rates for growth in Victorian solid waste generation.† This is a relatively high growth projection, although lower than actual growth between 2002–03 and 2006–07 (which was at 7.75% a year—see **Chapter 2**).

Scenario 3—A projection of waste generated and landfilled, assuming that state and territory waste strategy targets are achieved. Target achievement years are between 2010 and 2014. Where states do not have a target for waste generation or recycling, the relevant projection is not included. For the years following the target year, the projection of generation and landfill is assumed to continue along the same trajectory as in Scenario 1.

The most recent data available were used in this modelling, including some recent performance data from states and territories for July 2007 onwards.

* Where a jurisdiction is performing well against an impending target, the base case rate of growth in waste to landfill may be readjusted so that rates are not less than in the 'targets' scenario.

† These Victorian data extend back to the mid 1990s.

Indicative Projections

Hyder Consulting developed indicative projections for the three scenarios involving the three main waste streams: municipal solid waste (MSW), commercial and industrial (C&I) waste, and construction and demolition (C&D) waste. Hyder then combined this information into aggregate state/territory and national projections. The graphs presented below capture this information.

Note: The projections do not take into account likely changes to policy—for example, more rigorous targets for reduced waste generation and landfill disposal—or changes in the community's attitudes and behaviours in relation to waste generation, recycling and landfill disposal between 2006–07 and 2020–21. Changes in the patterns of industrial activity and human settlement are also outside the scope of these scenarios, but could be expected to affect actual future waste generation, recycling and landfill disposal performance. Other waste-specific factors, such as increased uptake of waste-to-energy technologies, or changes in the material composition of the waste stream, may also affect future performance.

For each jurisdiction, baseline data for 2006–07 come from Hyder Consulting's *Waste and Recycling in Australia* (updated 2009). Population projections come from ABS data (3222.0 *Population Projections Australia 2006–2101, series B*, published September 2008).

Interpreting the graphs

The measurement unit for the Y axes in each of the graphs below is millions of tonnes. Note that scaling of the graphs to ensure that they are readable resulted in a different range of weights being used on those axes between one jurisdiction and another.

Most of the graphs below present data for each of five series—A, B, C, D and E:

Series A: Waste generated under Scenario 1—population plus 1%

Series B: Waste generated under Scenario 2—population plus 3%

Series C: Waste generated under Scenario 3—where there are targets

Series D: Waste landfilled under Scenario 1—population plus 1%

Series E: Waste landfilled under Scenario 3—where there are targets

Two series, C and E, relate to projections that involve targets; therefore, where a jurisdiction has no targets, data are limited to the three series A, B and D.

The following factors can influence projections:

- Over time, rates of growth in generation and trends in landfill disposal may not be identical for each stream in a particular jurisdiction. These differences may occur because the number of households (which produce MSW waste) may grow more rapidly than commercial and industrial activity (producing C&I waste); because there are specific patterns of construction and demolition activity in different jurisdictions; or due to other variables.
- A jurisdiction may have a target and strategy specific to only one of the three waste streams (such as increased recycling in MSW). This can lead to different trajectories for volumes generated, recycled and disposed of to landfill among streams within a jurisdiction.

Where possible, projections are provided for each stream, as well as in aggregate, to provide information that may lead to recycling or infrastructure development opportunities in those streams. Knowledge about likely growth in volumes of C&D waste may help to inform decisions about provision of infrastructure for recycling materials such as concrete, brick and asphalt.

C&I projections could not be made for the Northern Territory, and C&D projections could not be made for Tasmania or the NT, due to insufficient data about landfill and recycling.

Some broad observations can be made about the graphs:

- the level of waste generation is closely related to population;
- in each jurisdiction and for each waste stream there are different patterns of growth;
- the graphs illustrate the potential value of some policies and targets in slowing the rate of waste generation;
- the graphs also illustrate the increasing difference between total waste generation under either high-growth or low-growth scenarios and the quantity of waste likely to be landfilled.

National

Data for each jurisdiction were consolidated by Hyder Consulting to produce a national picture of waste generation, disposal and recycling for each of the three scenarios and for each waste stream. As not all jurisdictions have targets, it is not possible to produce data for each of them under Scenario 3. To enable national waste projections under each scenario and for each waste stream, results from applying Scenario 1 (population plus 1%) were included under Scenario 3 (where targets exist). **Figure D2** excludes landfill data from the Northern Territory, which were unavailable, and **Figure D3** excludes landfill data from Tasmania and the Northern Territory for the same reason. Similarly, **Figure D4** excludes these data.

Figure D1: National—MSW projections 2006–07 to 2020–21

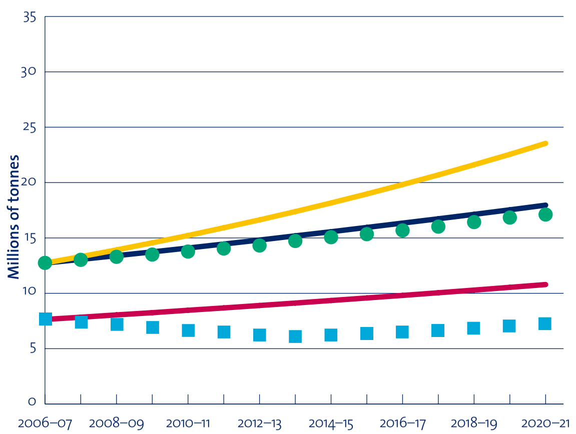


Figure D2: National—C&I waste projections 2006–07 to 2020–21

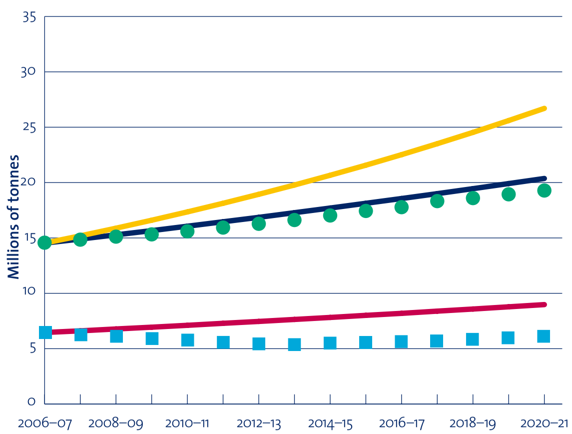


Figure D3: National—C&D waste projections 2006–07 to 2020–21

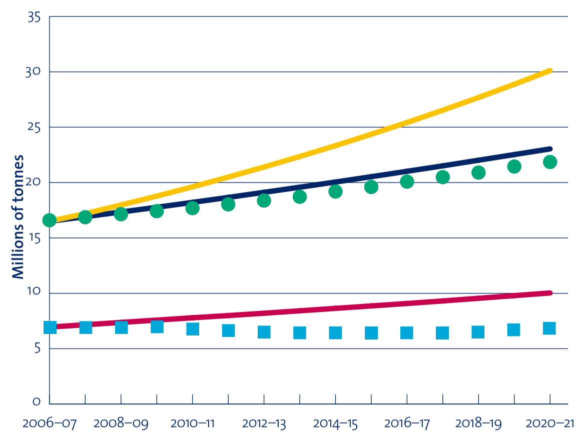
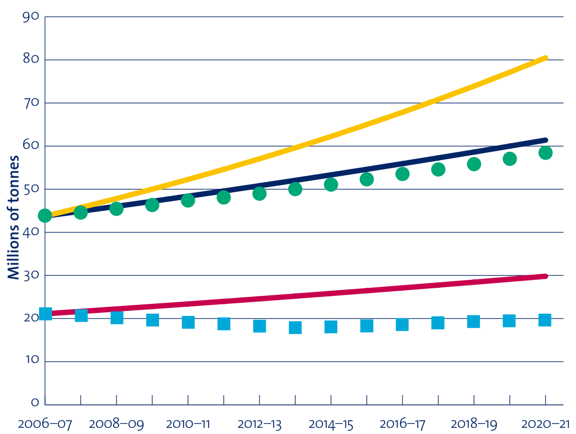
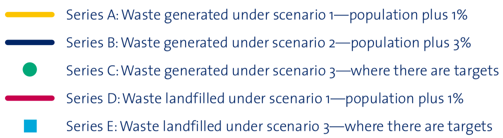


Figure D4: National—total waste projections 2006–07 to 2020–21





New South Wales

The NSW *Waste Avoidance and Resource Recovery Strategy* 2007 contains waste generation and recovery targets. The most recent review of the strategy indicated that the waste generation target, to stabilise waste generation for five years from a 2003 baseline, has not been achieved. For this reason, the target achievement scenario assumes growth in waste generation in line with population plus 1%—the assumption applied to those jurisdictions which do not have waste generation targets. The target achievement case assumes that recovery will increase steadily between 2006–07 and 2014–15 to meet waste stream recovery targets.

Figure D5: NSW—MSW projections 2006–07 to 2020–21

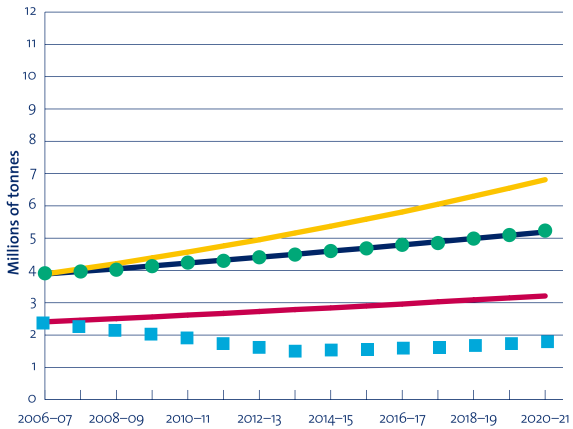


Figure D6: NSW—C&I waste projections 2006–07 to 2020–21

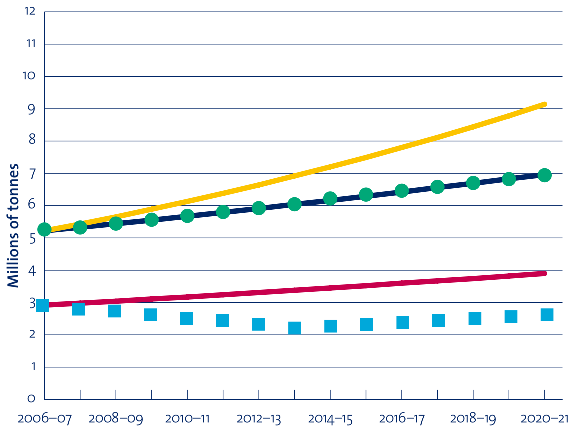


Figure D7: NSW—C&D waste projections 2006–07 to 2020–21

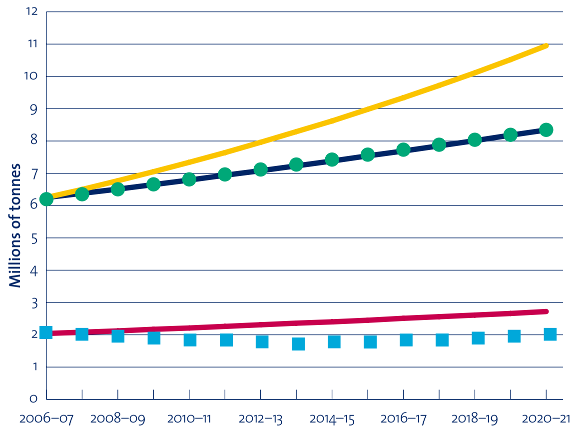
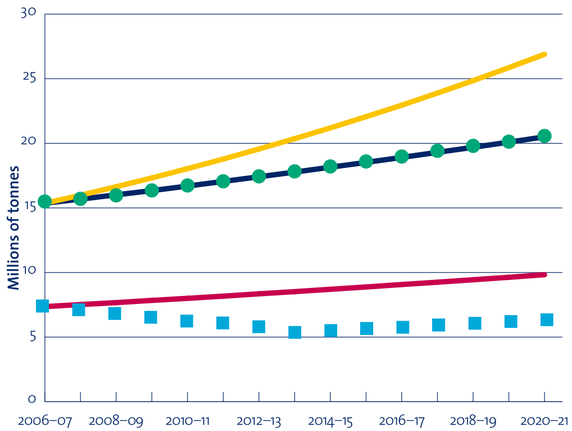


Figure D8: NSW—total waste projections 2006–07 to 2020–21



Series A: Waste generated under scenario 1—population plus 1%
Series B: Waste generated under scenario 2—population plus 3%
Series C: Waste generated under scenario 3—where there are targets
Series D: Waste landfilled under scenario 1—population plus 1%
Series E: Waste landfilled under scenario 3—where there are targets

Victoria

Victoria's *Towards Zero Waste* strategy sets percentage recovery targets for each stream for 2008–09 and 2013–14, and a waste reduction target for 2013–14. Series C (scenario where targets exist) is derived from a Sustainability Victoria projection. A steady increase to meet the target figures is assumed.

Figure D9: Vic—MSW projections 2006–07 to 2020–21

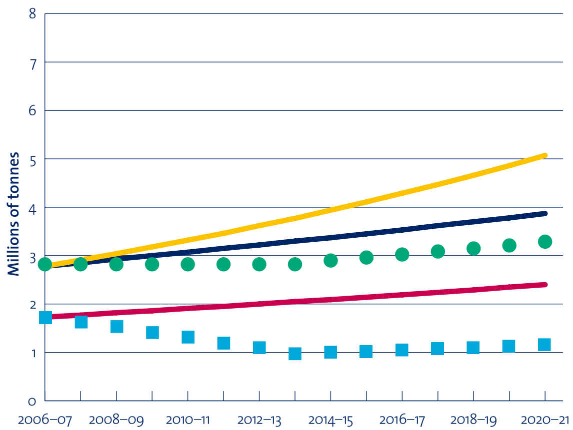


Figure D10: Vic—C&I waste projections 2006–07 to 2020–21

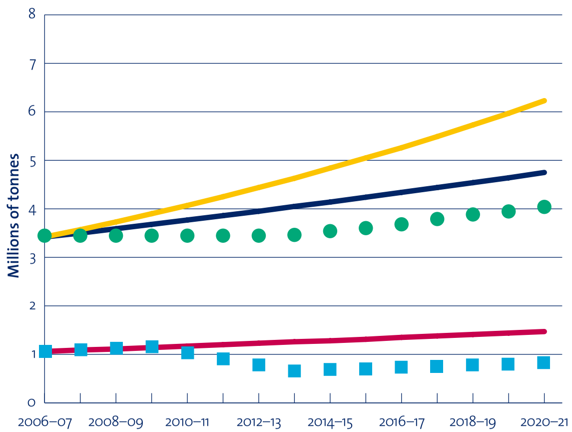


Figure D11: Vic—C&D waste projections 2006–07 to 2020–21

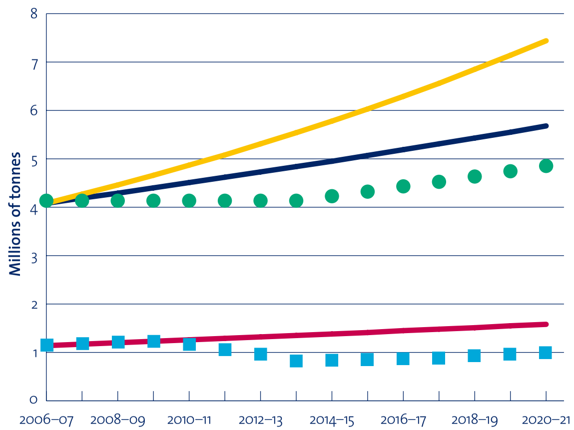
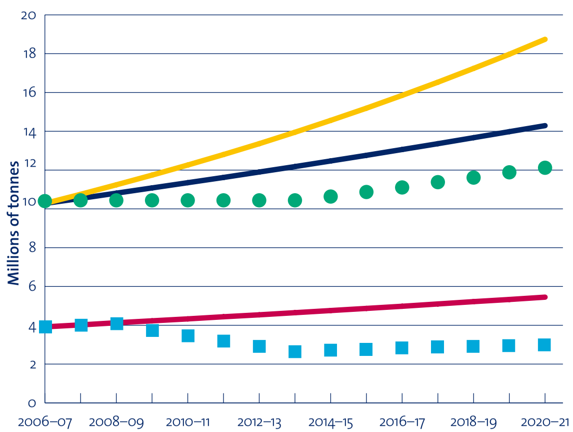


Figure D12: Vic—total waste projections 2006–07 to 2020–21



Series A: Waste generated under scenario 1—population plus 1%
Series B: Waste generated under scenario 2—population plus 3%
Series C: Waste generated under scenario 3—where there are targets
Series D: Waste landfilled under scenario 1—population plus 1%
Series E: Waste landfilled under scenario 3—where there are targets

Queensland

As noted in **Chapter 4.4**, Queensland has not established targets and is developing a Waste Strategy, with an early step being the release of a discussion paper, 'Let's Not Waste Our Future', in 2007.

Figure D13: Qld—MSW projections 2006–07 to 2020–21

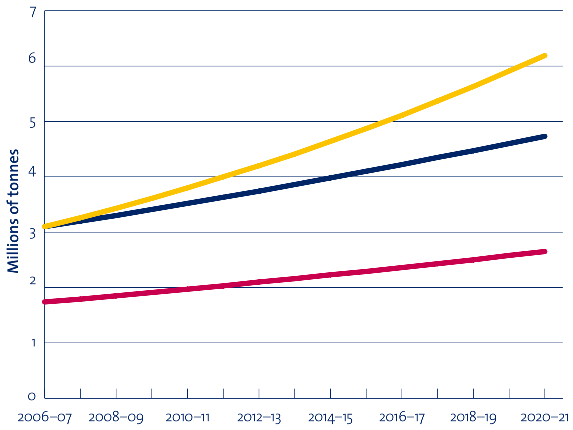


Figure D14: Qld—C&I waste projections 2006–07 to 2020–21

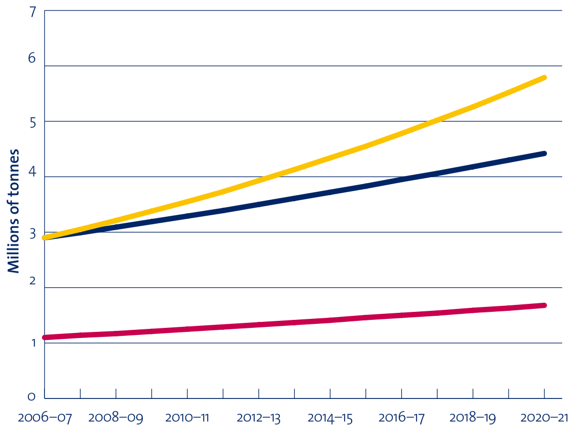


Figure D15: Qld—C&D waste projections 2006–07 to 2020–21

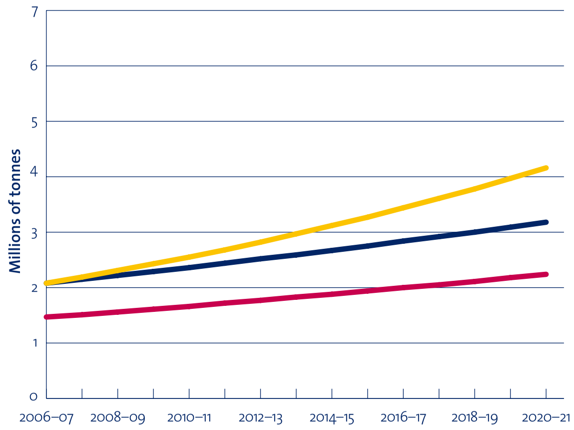
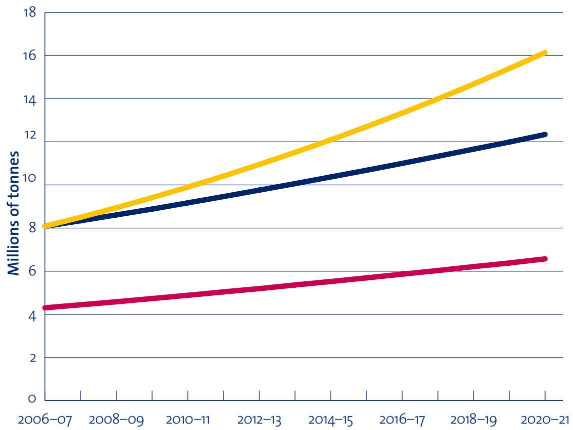


Figure D16: Qld—total waste projections 2006–07 to 2020–21



Series A: Waste generated under scenario 1—population plus 1%
Series B: Waste generated under scenario 2—population plus 3%
Series D: Waste landfilled under scenario 1—population plus 1%

Western Australia

To produce its models, Hyder Consulting used the targets proposed in Western Australia's draft *Waste Strategy* ('Draft Strategy'), which states that waste reduction targets from a 2006–07 baseline will be specified in the final strategy, but implies that these will involve a per capita reduction in waste. For the purposes of this analysis it is assumed that waste generation in the targets case will increase in line with the projected increase in population. The Draft Strategy contains both metropolitan (metro) and non-metropolitan (non-metro) recovery targets for MSW. It is assumed that metro targets are applicable to Perth only. The draft WA strategy specifies that the non-metro recovery target applies to non-metro, regional centres of populations greater than 25 000. Hyder Consulting assumed that this includes 50% of the non-Perth population (or 13% of WA's total population). As there is no MSW target specified for the remainder of the population, it is assumed that the recycling rate remains constant for this proportion of the population. The Draft Strategy specifies that C&I recovery is expected to continually improve over the lifetime of the strategy. It is assumed that there will be an increase in recovery of 2% per annum until 2019, for consistency with the latest date of the C&D targets. A steady increase in recovery targets to meet 2015 and 2019 targets is assumed.

Figure D17: WA—MSW projections 2006–07 to 2020–21

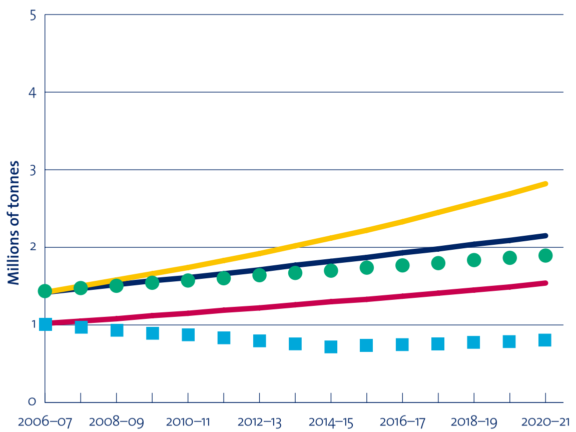


Figure D18: WA—C&I waste projections 2006–07 to 2020–21

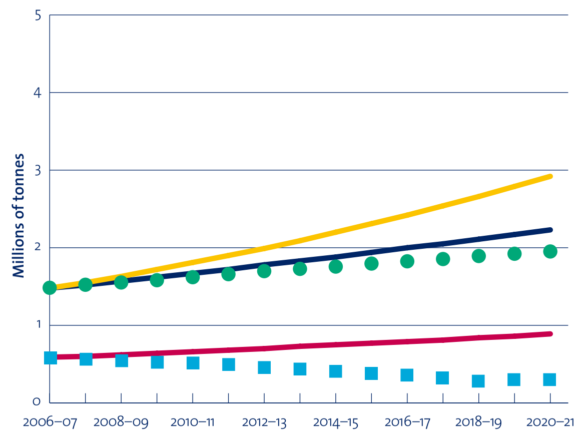


Figure D19: WA—C&D waste projections 2006–07 to 2020–21

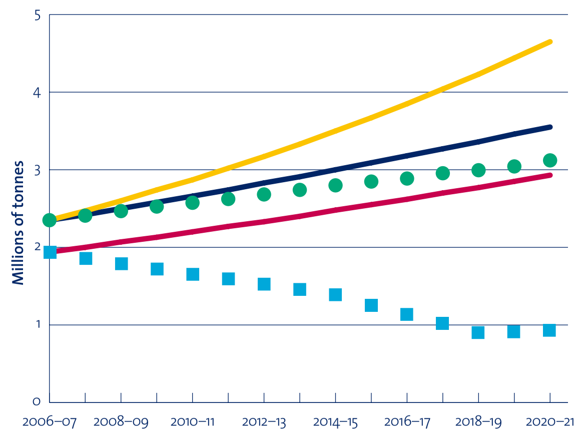
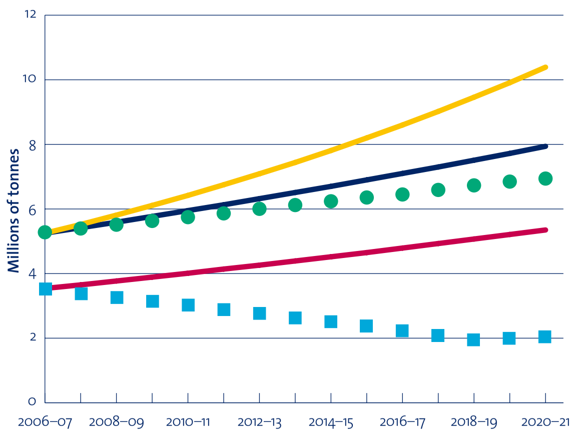
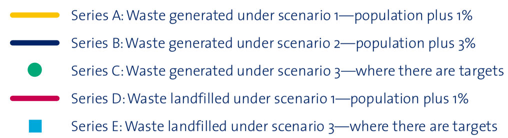


Figure D20: WA—total waste projections 2006–07 to 2020–21





South Australia

South Australia's waste strategy sets stream-based recycling targets, as well as an overall target of reducing waste to landfill. Achievement of recycling targets will meet the overall waste to landfill reduction target by 2014. Published reports do not divide the tonnages for waste generated, waste disposed to landfill, and recycling, into separate waste streams. The trend lines for Scenario 3 were informed by applying a division based on 2006–07 data to tonnages from 2003–04 , to determine 2004 amounts by waste stream.

Figure D21: SA—MSW projections 2006–07 to 2020–21

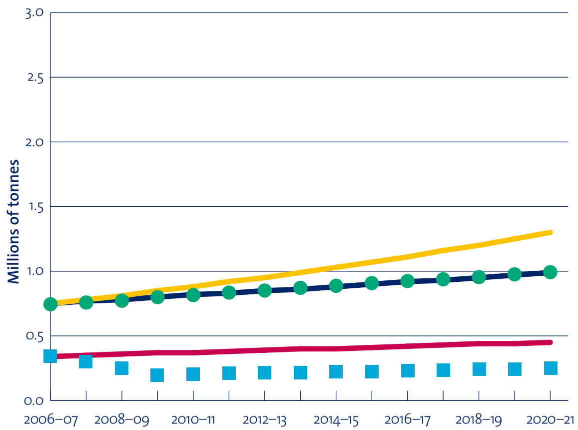


Figure D22: SA—C&I waste projections 2006–07 to 2020–21

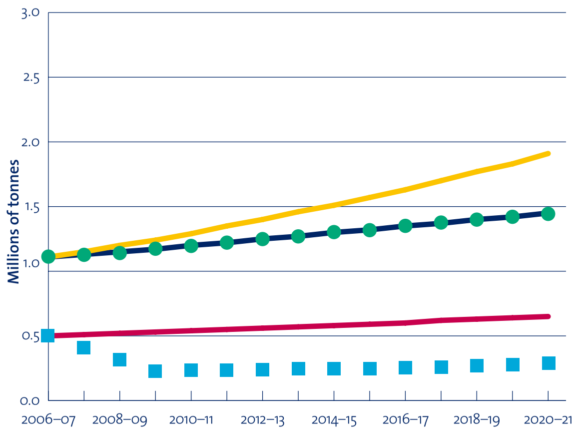


Figure D23: SA—C&D waste projections 2006–07 to 2020–21

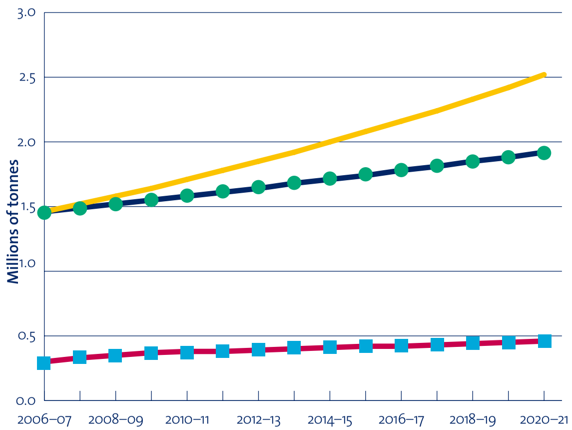
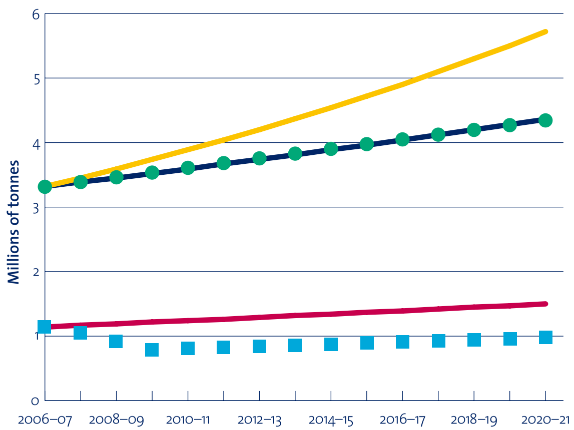
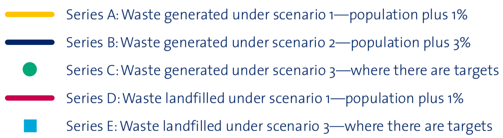


Figure D24: SA—total waste projections 2006–07 to 2020–21





Tasmania

As noted in **Chapter 4.4**, Tasmania has not established targets. Data are therefore only presented as Series A , B and D. Note that no C&D graph is provided for Tasmania.

Figure D25: Tas—MSW projections 2006–07 to 2020–21

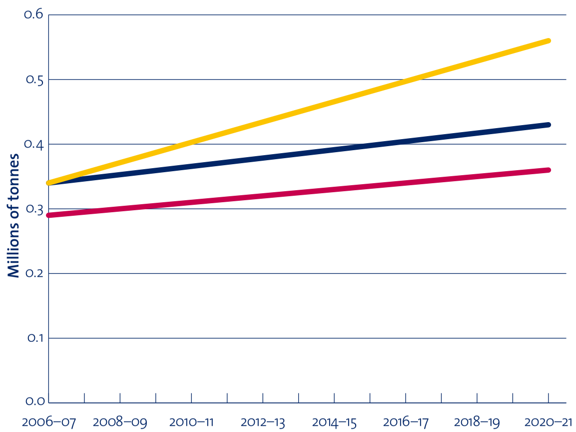


Figure D26: Tas—C&I waste projections 2006–07 to 2020–21

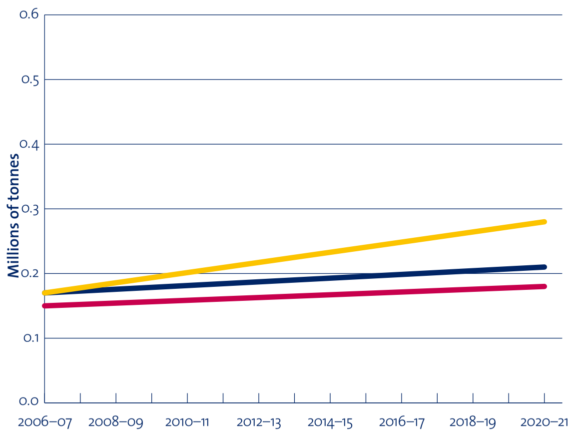
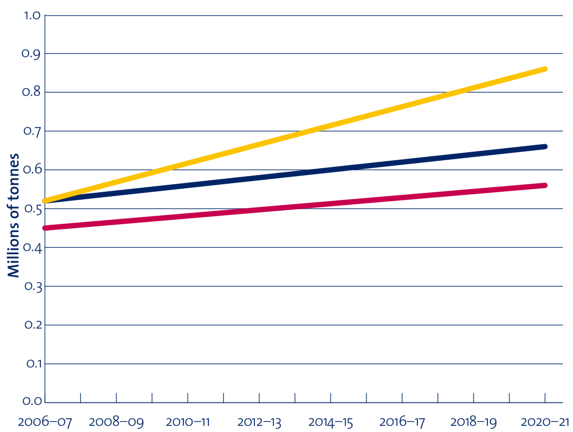


Figure D27: Tas—total waste projections 2006–07 to 2020–21



Series A: Waste generated under scenario 1—population plus 1%

Series B: Waste generated under scenario 2—population plus 3%

Series D: Waste landfilled under scenario 1—population plus 1%

Australian Capital Territory

In 1996, the ACT government set a target of ‘no waste by 2010’. The relationship between this target and quantities of waste sent to landfill and recycling is unclear, and it has not been modelled. The ACT government advises that it is preparing a new waste strategy which is expected to retain an aspirational goal of no waste to landfill. It also advises that the new strategy will incorporate specific recycling targets and actions targeted to sectors, and that new infrastructure requirements will be identified in the strategy. For the present, data are presented as Series A (population plus 1%), Series B (population plus 3%), and Series D (amount landfilled under Scenario 1).

Figure D28: ACT—MSW projections 2006–07 to 2020–21

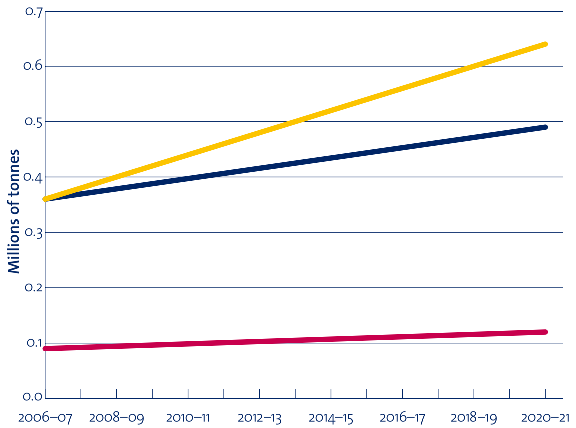


Figure D29: ACT—C&I waste projections 2006–07 to 2020–21

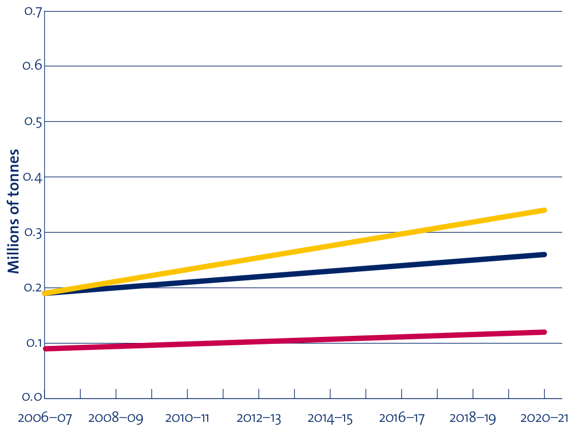


Figure D30: ACT—C&D waste projections 2006–07 to 2020–21

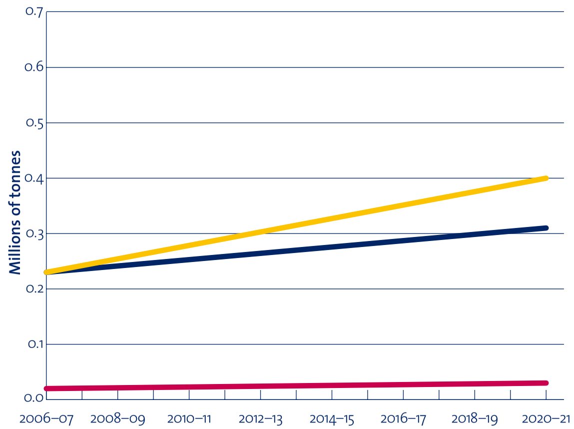
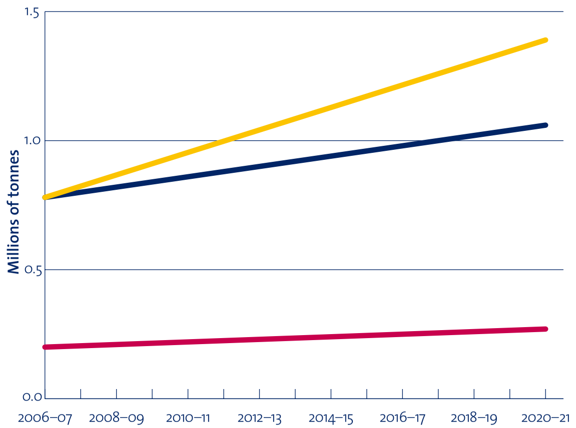


Figure D31: ACT—total waste projections 2006–07 to 2020–21

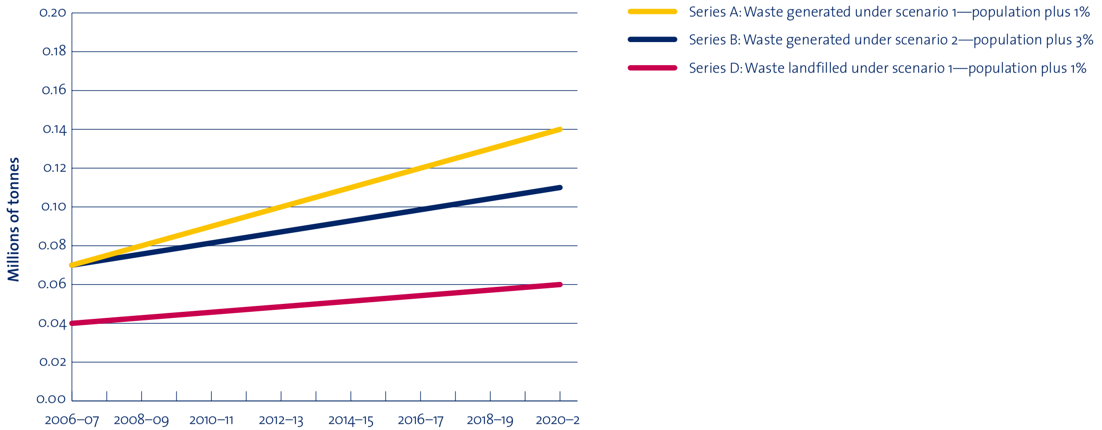


Series A: Waste generated under scenario 1—population plus 1%
Series B: Waste generated under scenario 2—population plus 3%
Series D: Waste landfilled under scenario 1—population plus 1%

Northern Territory

As noted in **Chapter 4.4**, the Northern Territory has not established targets, and data are only available for MSW.

Figure D32: NT—MSW projections 2006–07 to 2020–21



PART 2: METHODOLOGY FOR ESTIMATING FUTURE RESOURCE RECOVERY INFRASTRUCTURE NEEDS

Projections of future waste and recycling infrastructure needs

The projections presented below provide some insight into the consequences for infrastructure of trends in population growth, waste generation, recycling and landfill disposal. This work provides, for the first time, a picture of potential national waste infrastructure challenges leading up to 2020–21.

The projections focus on four main types of treatment facility currently in operation:

(1) **Alternative waste treatment (AWT) plants, using mechanical biological treatment (MBT).** These process mixed wastes from MSW or C&I, remove contamination, and recover solid materials before processing organics materials to recover soil additive and/or solids or gases that can be used for fuel.

(2) **C&D facilities (sorting and beneficiation):** These facilities sort construction and demolition materials such as cement and steel into separate streams and remove contamination in readiness for re-use or recycling into new products or applications.

(3) **Organics facilities:** Facilities dedicated to processing sorted or source-separated organic material, most commonly by composting, whether open windrow or in-vessel.

(4) **Mixed/Municipal/Materials Recycling/Recovery Facility (MRF):** These receive MSW and/or C&I material, remove contamination, and sort materials such as paper, plastics, metals and glass into separate streams in readiness for re-use or recycling into new products.

It is assumed that these facilities will play a major role in resource recovery in 2020–21.

The projections take into account the typical processing capacity or throughput of these types of facility, estimate the increased level of waste that will need to be recovered in 2020–21, and calculate the additional number of facilities that will be needed in that year to service this increased demand. Note that additional analysis of infrastructure planning would be needed to generate the type of information necessary for business planning purposes.

Assumptions and explanations

Equilibrium OMG was commissioned to develop indicative projections and focused on possible future infrastructure for transfer and consolidation of waste, sorting, re-processing and beneficiation, and organics processing, across municipal solid waste (MSW), commercial and industrial waste (C&I), and construction and demolition waste (C&D). The projections did not consider possible collection and transport infrastructure or facilities for re-manufacturing materials.

The Equilibrium OMG modelling assumed that similar types and capabilities of the four main types of facility in operation will exist in the future, and that they would have a similar throughput capacity. It did not take into consideration other innovative technologies and technologies which are available now and which could become commercially viable (such as waste-to-energy and biochar). The modelling did not consider whether markets would be available for the recovered resources generated by such facilities—this factor will play a vital role in determining the viability of future infrastructure.

Equilibrium OMG used the results from the Hyder Consulting work that projected future tonnages of all waste streams from 2006–07 to 2020–21,[1] and data from Hyder's *Waste and Recycling in Australia (2009)*,[2] to project future waste infrastructure for each of the three scenarios.

Quantities of the three main waste streams and of specific materials in each stream were projected for 2020–21. The quantities of different types of materials were extrapolated from the materials composition of Australian wastes reported in *Waste and Recycling in Australia* (Hyder Consulting, 2009)[3] and the *National Greenhouse and Energy reporting (Measurement) Amendment Determination 2009*.[4]

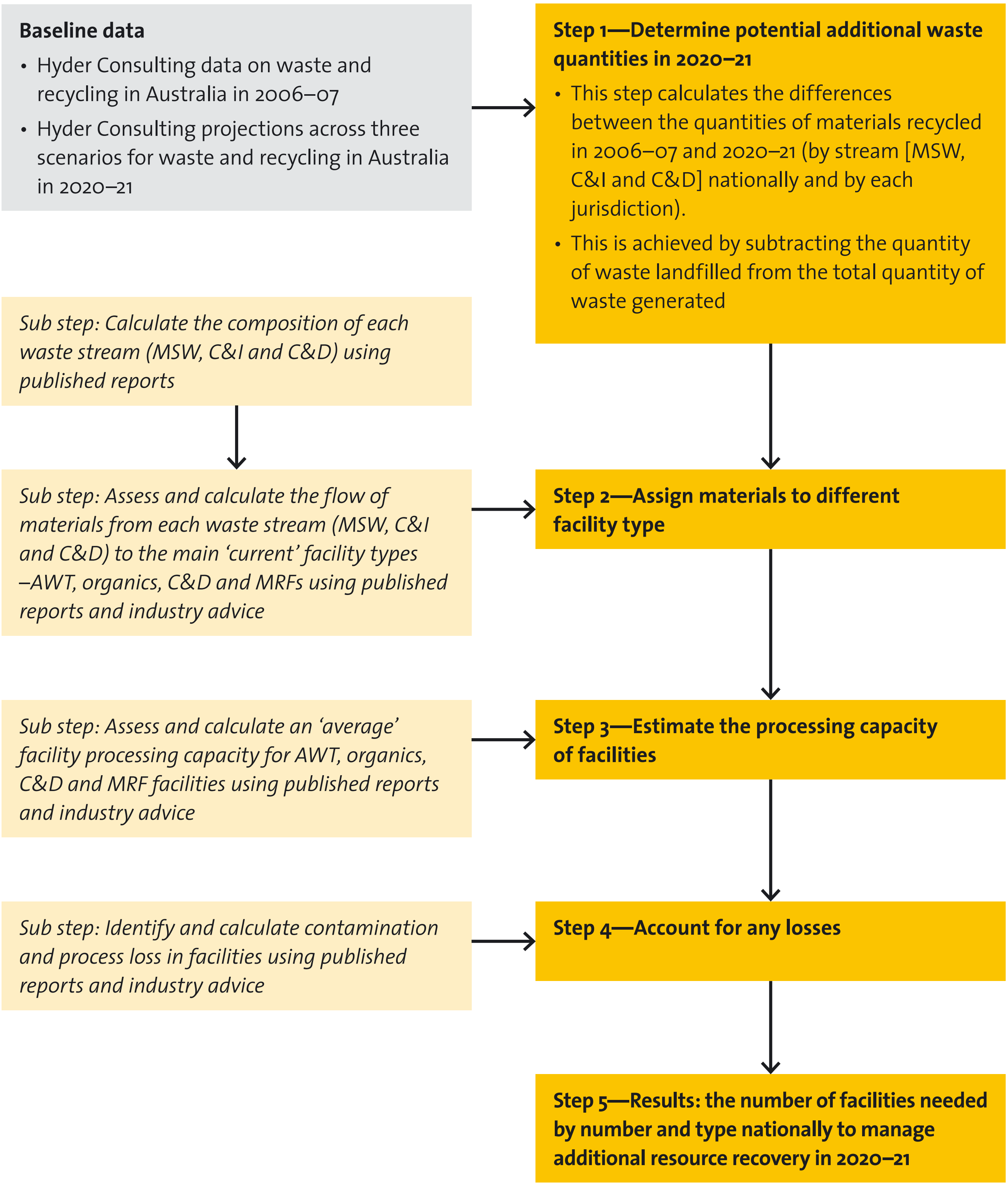
These data, along with that on the quantity of materials typically processed by current Australian waste management facilities, were then used to estimate the number of facilities that would be needed to manage and process the different types and volumes of materials in 2020–21. These estimates were based on existing systems and technologies, and the estimates project infrastructure needs in 2020–21 although existing jurisdictional strategic plans do not extend beyond 2015.

The indicative projections focused on large-scale infrastructure solutions, and did not address other opportunities for managing waste and recycling, such as small-scale processing, mobile facilities, biodigesters‡ for individual sites, or major changes in onsite residential organics management.

The following flow chart (**Figure D33**) shows the methodology employed by Equilibrium OMG.

‡ The term 'biodigesters' refers to systems such as composting that break organic materials down into potential soil additives and/or creates solids or gases that can be used as fuel.

Figure D33: Future resource recovery infrastructure methodology flow chart



Step 1—Determine potential additional waste quantities in 2020–21

The future waste generation and resource recovery calculations presented in **Part 1** of this appendix for the three main waste streams is replicated in **Table D1** for the three scenarios.

Step 2—Identify material quantities and assign materials to different facility types

The material composition (percentages) of waste streams in Australia taken from Hyder Consulting's *Waste and Recycling in Australia, 2009*[5] and the *National Greenhouse and Energy reporting (Measurement) Amendment Determination 2009*[6] were applied to the quantities identified under Step 1. **Table D2** shows the aggregate national compositional breakdown.

Table D1: Total quantities recycled by stream at 2020–21 under three scenarios

Scenario	Quantities recycled for each waste stream (million tonnes)		
	MSW	**C&I**	**C&D**
Scenario 1—projected rate of population, plus an additional 1%	7.17	11.50	13.02
Scenario 2—a higher growth rate, equivalent to population plus 3%	9.40	15.07	17.15
Scenario 3—assuming that state and territory waste strategy targets are achieved	9.96	13.45	15.05

Table D2: Material composition of waste streams

Material	MSW %	C&I %	C&D %
Food	35	21.5	0
Paper	13	15	3
Garden	17	4	2
Wood	1	12.5	6
Textiles	2	4	0
Sludge	0	1.5	0
Nappies	4	0	0
Rubber, leather	1	3.5	0
Glass	10	12	5

Using this breakdown of materials, information from the *Australian Recycling Values* report[7] and Hyder Consulting's *Waste and Recycling in Australia* (2009)[8], plus information gathered in a review of current practices across jurisdictions, Equilibrium OMG were able to estimate the likely facilities where materials from MSW, C&I and C&D would be processed for resource recovery in 2020–21. (See **Table D3**)

This table assumes that, for example, in 2020–21 46% of the MSW stream (nationally) will be processed by AWTs and 17% by organics facilities. These assumptions of what percentages of the waste stream are predicted to go to which types of facilities were then used in the modelling.

Step 3—Estimating the average processing capacity of facilities

The first element of this step is to calculate the average throughput for each of the four main types of resource recovery facilities used in this projection work. **Table D4** provides a range of processing capacities for current and future resource recovery facilities using a mixture of actual current facilities and intended or likely capacity.

Table D3: Percentages of waste streams processed, by facility type, for 2020–21

Waste stream	Facility type			
	AWT %	Organics %	C&D %	MRF %
MSW	46	17	1	36
C&I	14.5	38	2.5	45
C&D	0	2	95	3

Table D4: Waste and recycling facility types used in future infrastructure assessment

Type of resource recovery facility	Example facility *Note: some facilities have not been named to protect confidentiality*	Size of example facility (tonnes per year)	Range of processing capacities for category (tonnes per year)
Mixed and alternative waste treatment (AWT)	WSN Environmental, Jacks Gully NSW SITA, Kemps Creek NSW SITA, Mindarie WA	90 000 120 000 100 000	90 000 - 120 000
Organics	Facility 1 Facility 2 Facility 3 Facility 4	20 000 - 50 000 40 000 - 50 000 40 000 - 50 000 40 000 - 50 000	20 000 - 50 000§
C&D sorting and beneficiation	Facility 5 Alex Fraser QLD Alex Fraser VIC	100 000 250 000 1 000 000	100 000 - 1 000 000
MRF	Facility 6 Facility 7 Facility 8 Facility 9 WSN Environmental NSW	120 000 240 000 20 000 10 000 80 000	10 000 - 240 000

§ Organics processing facilities of 80 000 tonnes per annum are feasible.

Equilibrium OMG used the information in the above table to estimate an average facility capacity for each facility type (**Table D5**).

The term 'processing capacity' refers to the amount of material a facility can receive and process a year, rather than the amount of recycled or recovered material it produces.

Step 4—Accounting for any losses

In this resource recovery projection work it is important to account for any material losses. If output volumes from recycling facilities are used to determine future infrastructure needs, it is likely that those needs will be underestimated. This is because the quantities of recycled or recovered material *produced* by a facility are less than the total quantity of materials initially *accepted* at the facility gate. For example, some residual wastes accepted at a recycling facility may be sent to landfill, or volumes of organic material may be lost through evaporation in composting. It is necessary to correct for such losses. Facility input and throughput (processing) capacity will therefore be a larger quantity than facility output records (such as Hyder 2009)[9] would suggest.

To address these factors, Equilibrium OMG developed an 'Australian average loss factor' to account for contamination and process loss in the facilities. Where appropriate, a factor for contamination loss (such as residual material unable to be processed being sent to landfill), and a factor for processing loss (including evaporation) were estimated. The loss factors were developed on the basis of industry advice and information contained in *Australian Recycling Values*, produced by the Australian Council of Recyclers and Hyder Consulting in July 2008.[10]

Equilibrium OMG applied these loss factors to facility output volumes (such as those provided by Hyder 2009)[11] to generate estimates of the facility input or throughput capacity (tonnages) for future infrastructure. These are provided in **Table D6**.

Table D5: Average waste and recycling facility capacities used in projections of future infrastructure needs

Facility type	Processing capacity per year (tonnes)
Alternative waste treatment (AWT) plant, using mechanical biological treatment (MBT)	105 000
Organics facilities	50 000
C&D facilities (sorting and beneficiation)	400 000
Mixed/Municipal Recycling/Recovery Facility (MRF)	145 000¶

¶ Technological developments with MRF sites indicate these facilities perform well. While MRF capacity ranges from 10 000 to 240 000 tonnes, larger facilities are more common and increasingly so, therefore future processing capacity is based on larger MRFs.

Table D6: Facility processing capacities, losses and output tonnages

	Processing capacity (tonnes)	Contamination loss	Process loss	Output (tonnes)
AWT	105 000	0%	40%	63 000
Organics	50 000	0%	40%	30 000
C&D	400 000	21%	0%	316 000
MRF	145 000	12%	0%	127 600

Tonnages of future material recovered and recycled, as estimated by Hyder in the projections presented in **Part 1** of this appendix, needed to be increased by the loss factors above in order to represent the actual amounts of materials future facilities will accept and process (their throughput capacity). Equilibrium OMG then considered this information along with the average facility capacities for the four types of future infrastructure to generate the results presented in Step 5.

Step 5—Results

Based on the above assumptions, the projected waste streams from Hyder Consulting were assessed across the three scenarios, and nationally.

Table D7 details the number of additional facilities, by type, needed in 2020–21 at the national level.

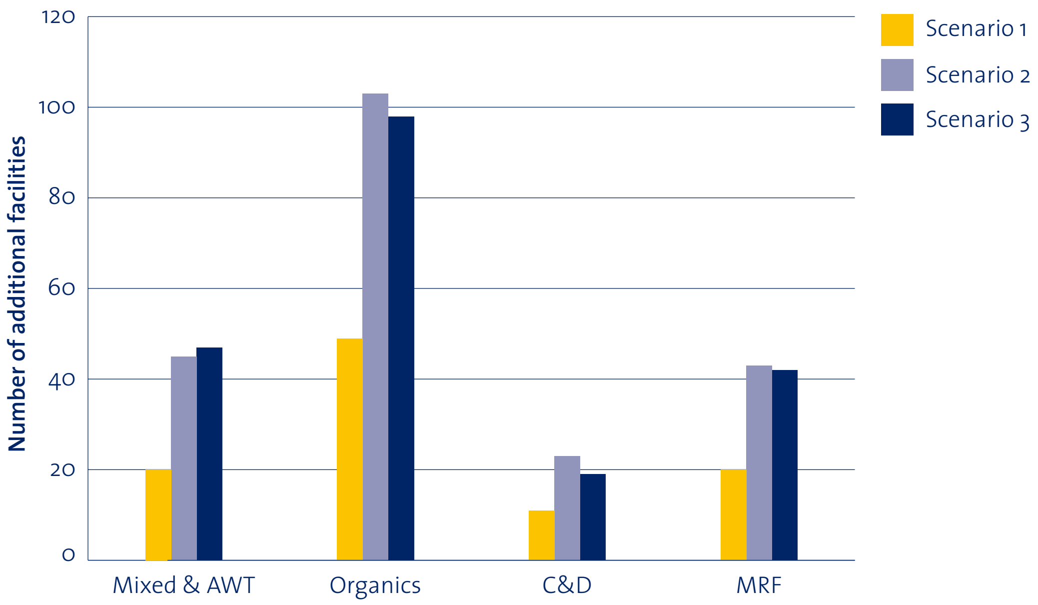
This table indicates that the difference between the Scenario 2 (population growth plus 3%) case and Scenario 3 (where targets exist) is that 4% fewer waste and recycling infrastructure facilities will be required in 2020–21. **Figure D34** shows that the largest need for additional facilities (by facility type) in 2020–21 will be for organics processing, including composting, shredding and mulching facilities.

Table D7: National future waste and recycling infrastructure needs for 2020–21

	Number of additional facilities at 2020–21		
Resource recovery activity	**Scenario 1**—population growth plus 1% (additional infrastructure needs for recovery of 9.23 million tonnes of extra recyclables nationally at 2020–21)	**Scenario 2**—population growth plus 3% (additional infrastructure needs for recovery of 19.32 million tonnes of extra recyclables nationally at 2020–21)	**Scenario 3**—Targets achieved (additional infrastructure needs for recovery of 18.24 million tonnes of extra recyclables nationally at 2020–21)
Mixed waste and alternative waste treatment (AWT)	20	45	47
Composting, consolidate, shred and mulch organics	49	103	98
C&D sorting and beneficiation	11	23	19
MRF	20	43	42
Total	100	214	206

Note: The potential future infrastructure needs are presented in rounded whole numbers. Numbers of facilities, based on the average capacities noted above, do not precisely match the volume of additional materials processed.

Figure D34: Additional waste and recycling infrastructure needed in 2020–21 (excluding landfill), by scenario and facility type



Endnotes

1 Based on data in Hyder Consulting, *Waste and Recycling in Australia*, report to the Department of the Environment, Water, Heritage and the Arts, amended 2009.

2 Ibid.

3 Ibid.

4 http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/asmade/bytitle/F9F9C00E4F78EC03CA2575E000014EB6?OpenDocument, accessed 9 February 2010.

5 Hyder Consulting, *Waste and Recycling in Australia*, report to the Department of the Environment, Water, Heritage and the Arts, amended 2009.

6 <http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/asmade/bytitle/F9F9C00E4F78EC03CA2575E000014EB6?OpenDocument> accessed 9 February 2010.

7 Australian Council of Recyclers, *Australian Recycling Values: a net benefits assessment*, July 2008, <http://www.acor.org.au/pdfs/Recycling%20Values%20- %20Net%20Benefit%20Study%20280708.pdf>

8 Hyder Consulting, Waste and Recycling in Australia, report to the Department of the Environment, Water, Heritage and the Arts, amended 2009.

9 Ibid.

10 Australian Council of Recyclers, *Australian Recycling Values: a net benefits assessment*, July 2008, <http://www.acor.org.au/pdfs/Recycling%20Values%20-%20Net%20Benefit%20Study%20280708.pdf>

11 Hyder Consulting, *Waste and Recycling in Australia*, report to the Department of the Environment. Water, Heritage and the Arts, amended 2009.

Glossary

Aerobic composting: the controlled biological decomposition of organic materials under aerobic conditions (i.e. in the presence of oxygen), accomplished in **windrows** (see below) or open static piles. Aerobic composting involves the action of thermophilic (heat loving) micro-organisms that thrive under increased temperature conditions. If correctly managed, it results in the destruction of seeds and disease-causing organisms.

Alternative waste treatment (AWT): usually refers to facilities and/or technologies that accept and process mixed waste (such as MSW waste that would be sent to landfill) and extract recyclable materials and organic waste, before the residual waste goes to landfill.

Anaerobic digesters: technology that uses anaerobic digestion to break down biodegradable material. Anaerobic digestion is a series of processes in which micro-organisms break down biodegradable material in the absence of oxygen, and is widely used to treat waste water. As part of an integrated waste management system, anaerobic digestion reduces the emission of landfill gas into the atmosphere.

Bagasse: the fibrous residue of the sugar cane milling process that is used as a fuel in sugar mills (to raise steam), or as mulch.

Bedminster process: a mechanical and biological digestion and sorting process to remove organic and recyclable materials from wastes.

Beneficiation: the sorting of materials and removal of contamination to enable further processing. In resource recovery it is most commonly used to describe sorting glass into colour streams and removing contamination before recycling.

Bio-accumulation: the accumulation of substances such as pesticides or other organic chemicals in an organism. These accumulate in the tissues of plants and animals to a concentration higher than that of the surrounding environment. Hence **bio-accumulative**.

Biochar: a type of charcoal which is produced when natural organic materials such as crop waste, wood chips or manure, are heated in an oxygen-limited environment. This process is referred to as pyrolysis.

Biodegradable: capable of being decomposed by micro-organisms.

Biodigesters: systems that break organic materials down into potential soil additives and/or create solids or gases that can be used as fuel, usually through the actions of anaerobic and/or aerobic digestion.

Biofuels: renewable fuels derived from biological materials that can be regenerated. This distinguishes them from fossil fuels which are considered non-renewable. Examples of biofuels include ethanol, methanol, and biodiesel.

Biogas: refers to landfill (garbage tip) gas and sewage gas.

Biomass: a renewable energy source. It encompasses living and recently dead biological material that can be used as fuel or for industrial production. In this report, biomass refers to plant matter grown to generate electricity or to produce heat.

Bio-monitoring: surveys of the biodiversity of selected biological groups or families, and comparison to a reference site for a similar ecosystem, as a measure of the health of an ecosystem.

Bioreactor landfills: a type of landfill that enhances microbiological processes to accelerate the decomposition of organic waste in a conventional landfill. Leachate recirculation, waste shredding, nutrient addition and temperature management are some of the applicable enhancements.

Biosolids: solid, semi-solid or slurry material produced by the treatment of urban sewage.

Brominated flame retardants (BFRs): chemicals commonly used to reduce the flammability of office and household items, including computers, carpet, furniture fabrics and mattresses. They are also used in insulation products and in the upholstery and internal fittings of motor vehicles. Approximately 80 different types of brominated flame retardant are used commercially. The more widely used are the polybrominated diphenyl ethers (PBDEs).

Business as usual: a term often used in modelling of futures or development of scenarios to refer to a current or future situation in which little or nothing changes. It may represent the status quo and be used as the baseline or base case for estimating the consequences of particular actions over a period of time.

Carbon tetrachloride: a colourless nonflammable liquid used as a solvent for fats and oils; because of its toxicity, its use as a cleaning fluid or fire extinguisher has declined.

Carbon dioxide equivalent (CO_2-e): a metric measure used to compare the emissions of various different greenhouse gases based on their **global warming potential** (see below).

Clinical waste/medical waste: normally refers to waste products that cannot be considered general waste and are produced from health care activities. May also refer to health-related wastes produced by households and discarded into the municipal waste stream.

Commercial and industrial (C&I) waste: waste that is produced by institutions and businesses; includes waste from schools, restaurants, offices, retail and wholesale businesses, and industries including manufacturing.

Compost: material resulting from the controlled microbiological transformation of organic materials such as animal manures, bark fines, biosolids, leaf mulch, sawdust and shredded green waste, under aerobic and thermophilic conditions, rendering them safe for use in growing situations. Compost may also be produced through anaerobic processes.

Composting: the aerobic or anaerobic processes that produce compost, with or without mechanical treatment and processing.

Construction and demolition (C&D) waste: refers to waste produced by demolition and building activities, including road and rail construction and maintenance and excavation of land associated with construction activities. The C&D waste stream usually covers only some of the generation, disposal and recycling of C&D wastes, as these materials can also be found in the MSW and C&I streams, or as hazardous wastes.

Contaminant: any physical, chemical or biological substance (usually man-made) which is introduced into the environment. Can be used to specifically refer to materials that, if found in recycling streams above certain thresholds, can contaminate recyclables and cause them to be disposed of in landfill.

Controlled wastes: in some jurisdictions the term 'controlled waste' refers to hazardous wastes.

Cullet: glass that is crushed finely for recycling into new glass.

Depolymerisation: the decomposition of a polymer into smaller fragments.

Digestate: a solid material remaining after the anaerobic digestion of a biodegradable feedstock.

Dioxin: a group of toxic substances hazardous to human health and the environment that can be produced from combustion and other processes.

Diversion: the act of diverting a waste away from landfill for another purpose such as re-use or recycling.

Eco-design: see **Green design**.

Eco-efficiency: the relationship between economic output (product, service, activity) and environmental impact caused by production, consumption and disposal.

Eco-innovation: a term used to describe products and processes that contribute to sustainable development. Eco-innovation is the commercial application of knowledge to generate direct or indirect ecological improvements. It is often used to describe a range of related ideas, from environmentally-friendly technological advances to socially-acceptable innovative paths towards sustainability.

Ecotoxic: toxic to the environment.

Electronic waste: discarded electronic or electrical equipment, typically televisions, video and DVD players, stereos, mobile phones, computers, photocopiers, fax machines and printers as well as cartridges, batteries and peripheral devices. Often referred to as 'e-waste'.

Energy from waste: a process whereby waste is converted into energy in the form of heat or electricity.

Energy recovery: processes or opportunities to recover energy from waste materials, usually through thermal processes.

Environment Protection and Heritage Council (EPHC): a council set up by the Council of Australian Governments in 2001 to ensure the protection of the environment and heritage of Australia and New Zealand. It is made up of ministers, not necessarily environment ministers, from participating jurisdictions (i.e. Commonwealth, State and Territory Governments, the New Zealand Government, and the Papua New Guinea Government). It addresses broad national policy issues relating to environmental protection, particularly in regard to air, water, and waste matters. It also addresses natural, Indigenous and historic heritage issues.

Extended Producer Responsibility (EPR): places primary responsibility on producers for the re-use, recycling or disposal of their products once they are no longer required by consumers.

External costs/externalities: costs that are not private costs. Externalities in waste and recycling usually refer to costs and benefits that accrue to society, organisations or individuals, which are not included (internalised) in the pricing of goods and services.

Flaring: mainly used to refer to the collection of gas from landfills (primarily methane), which are then burnt, but not used for energy generation, so that CO_2 rather than methane is emitted to the atmosphere.

Fly-ash: a product of burning coal to produce electricity. It is a very fine, powdery material, composed mostly of silica, nearly all particles of which are spherical.

Gas capture: refers to the capture of landfill gas (mainly methane) from landfill sites using a range of technologies. Gas capture systems may include, or be connected to, power generation. Captured gas may also be flared or transferred offsite.

Global warming potential: a system of multipliers devised to enable comparison among warming effects of different gases. For example, over the next 100 years, a gram of methane in the atmosphere is currently estimated as having 25 times the warming effect of a gram of carbon dioxide; methane's 100-year global warming potential is thus 25.

Green design: the design and development of products that are intentionally created to be more durable and energy efficient, avoid the use of toxic materials, and are easily disassembled for recycling. May also be called 'design for environment'.

Green waste: generally refers to biodegradable garden or park waste such as grass clippings or leaves.

Greenhouse gas emissions: releases to the atmosphere of substances that contribute to the enhanced greenhouse effect and climate change. The main greenhouse gases generated by human activity are carbon dioxide (CO_2), methane and nitrous oxide. There are also manufactured gases such as chlorofluorocarbons (CFCs), halocarbons and some of their replacements.

Greenwash: the practice of making incorrect or misleading claims portraying products, organisations or policies as environmentally friendly.

Gyre: circulation or rotation of ocean water, usually dictated by prevailing winds and the 'Coriolis effect'. Can lead to accumulations of marine debris, including plastic wastes.

Hazardous substances: substances which are capable of causing serious damage to human health. Serious damage is classed as that where a clear functional disturbance or morphological change, which has toxicological significance, results from repeated or prolonged exposure.

Hazardous waste: waste that is potentially harmful to humans and the environment. For more specific definitions, see the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal or the *Hazardous Waste (Regulation of Exports and Imports) Act 1989*.

Heavy metal: a metallic element with relatively high atomic mass (over 5.0 specific gravity) such as lead, cadmium, arsenic and mercury; generally toxic in relatively low concentrations to plant and animal life.

Hydrocarbon: an organic compound consisting entirely of hydrogen and carbon.

Inert: describes a substance which has little or no chemical reactivity. Thus 'inert waste' is waste that has few or no putrescible materials.

In-vessel composting: a form of composting of biodegradable waste that occurs in enclosed reactors. These generally consist of metal tanks or concrete bunkers in which air flow and temperature can be controlled.

Landfill gas: gas generated by the natural degradation and decomposition of solid waste by anaerobic micro-organisms in landfills. Consists of approximately equal parts methane (the primary component of natural gas) and carbon dioxide, as well as traces of non-methane organic compounds.

Leachate: liquid that has percolated through solid waste or other solids and has extracted materials from it by leaching.

Liquid waste: wastes that are not solid or gaseous. May refer to sludges and slurries, or other liquids discharged to sewer. May also refer to waste water.

Listed wastes: general term with a range of uses; often refers to wastes determined by regulators to require specific management effort.

Materials Recovery Facility (MRF): a specialised facility that receives, separates and prepares recyclable materials for marketing to end-user manufacturers. May also be referred to as municipal/mixed recycling or recovery facility, and usually involves mechanical sorting and separation of materials. An MRF does not process residual organic waste, or cover sites that are mainly transfer stations.

Medical waste: waste products that cannot be considered general waste and are produced from health care activities.

Monofill: a landfill, or part of a landfill, which accepts only one type of waste.

Municipal solid waste (MSW): waste produced primarily by households and council facilities, including biodegradable material, recyclable materials such as bottles, paper, cardboard and aluminium cans, and a wide range of non-degradable material including paint, appliances, old furniture and household lighting.

Organic waste: waste materials from plant or animal sources, including garden waste, food waste, paper and cardboard.

Persistent organic pollutants: hazardous and environmentally persistent substances which can be transported between countries by the earth's oceans and atmosphere. The substances bioaccumulate and have been traced in the fatty tissues of humans and other animals. Persistent organic pollutants include dieldrin, polychlorinated biphenyls, DDT, dioxins and furans. Countries have agreed to control the manufacture and trade of persistent organic pollutants through the Stockholm Convention on Persistent Organic Pollutants.

Polychlorinated biphenyls: a group of chlorinated organic compounds that are non-corroding and resistant to heat and biological degradation. They are used as insulation in electrical equipment; they can accumulate in some species and disrupt re-production.

Prescribed waste: wastes that are closely regulated because of their potential adverse impacts on human health, the environment, or public amenity.

Product stewardship: a policy approach recognising that manufacturers, importers, governments and consumers have a shared responsibility for the environmental impacts of a product throughout its full life cycle. Product stewardship schemes establish a means for relevant parties in the product chain to share responsibility for the products they produce, handle, purchase, use and discard.

Putrescible: waste liable to decay and decompose.

Pyrolysis: the transformation of a substance into another compound or compounds by the application of heat alone.

Recyclate: material able to be processed for recycling in a facility. Sometimes used only to refer to materials actually recovered from recycling, excluding residual wastes.

Recycling: a resource recovery method involving the collection and processing of waste for use as a raw material in the manufacture of the same or similar non-waste product.

Regulated waste: in some jurisdictions the term 'regulated waste' is used to refer to hazardous wastes.

Residual waste: the waste that remains after resource recovery processes, is unable to be recovered, and may require disposal in landfill.

Resource recovery: the process of extracting materials or energy from a waste stream through re-use (using the product for the same or a different purpose without further production), recycling or recovering energy from waste.

Sewage sludge: refers to the residue that remains after sewage treatment processes.

Transfer station: a facility which temporarily houses waste prior to its transfer for treatment elsewhere. May involve some sorting, separation and baling, but not extensive processing such as at an MRF or AWT plant.

Waste: any discarded, rejected, unwanted, surplus or abandoned matter; discarded, rejected, unwanted, surplus or abandoned matter intended for recycling, re-processing, recovery, re-use, or purification by a separate operation from that which produced the matter, or for sale, whether of any value or not.

Waste (management) hierarchy: a nationally and internationally used guide which prioritises waste management practices in order of preference (from most to least preferred) to achieve the best environmental outcome. The order of practice it sets out is avoidance, re-use, recovery, and recycling, with disposal as a last resort.

Waste-to-energy technologies and processes: those that generate electricity or heat from waste.

Windrow composting: the production of compost by piling biodegradable waste in long rows known as windrows.

Abbreviations

3Rs: 'reduce', 're-use' and 'recycle'

ABS: the Australian Bureau of Statistics

ACCC: Australian Competition and Consumer Commission

ACOR: the Australian Council of Recyclers

ANZECC: the Australian and New Zealand Environment and Conservation Council

AWT: alternative waste treatment

CO_2: carbon dioxide

CO_2-e: carbon dioxide equivalent

C&D: construction and demolition waste

C&I: commercial and industrial waste

COAG: the Council of Australian Governments

E-waste: electronic waste

EPA: environment protection agency/environment protection authority

EPHC: the Environment Protection and Heritage Council

EPR: extended producer responsibility

GDP: gross domestic profit

HDPE: high-density polyethylene

LDPE: low-density polyethylene

LGA: local government area

LLDPE: linear low-density polyethylene

MRF: Materials Recovery Facility

MSW: municipal solid waste

NEPM: national environment protection measure

OECD: the Organisation for Economic Co-operation and Development

PC: polycarbonates

PCB: polychlorinated biphenyls

PET: polyethylene terephthalate

POPs: persistent organic pollutants

PP: polypropylene

PS: polystyrene

PVC: polyvinyl chloride

WMAA: the Waste Management Association of Australia

Units of measurement

GL: gigalitres

kg: kilograms

KwH: kilowatt-hour

m^2: square metre

MJ: megajoules

ML: megalitres

Mt: megatonne

MW: megawatt

t: tonne

TJ: terajoule

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