Victorian Water Accounts

2015—2016

A statement of Victorian water resources

VICTORIA State Government | Environment, Land, Water and Planning

Victorian Water Accounts 2015–2016

A statement of Victoria's water resources

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Foreword

Water is central to every community in Victoria. It powers our industries and economy, sustains the natural environment and improves our daily quality of life. Victoria has a long and proud history of effectively managing its water resources.

The Victorian water accounts are an important resource which have documented annual water resource information since 2003. The Victorian Government remains committed to continuously improving the clarity of the accounts and to sharing information about the condition and use of Victoria's water resources.

Knowing how water is supplied and used is fundamental to effective planning and management of water resources. It is important that every Victorian has the information they need to manage their own water use.

The Victorian Government is committed to ensuring all water resources are managed to meet the challenges of climate change and population growth. During 2015–16 Victoria experienced a drier-than-usual winter and spring and the third-warmest summer on record. Most of Victoria received below-average streamflow, with only the far east of Victoria receiving above average streamflow.

The Victorian water accounts show the volume of surface water, groundwater and recycled water available in 2015–16 was 14,255,141 ML, compared to 17,257,234 ML in the previous year. Of the water available, 4,398,170 ML of water was taken for consumptive purposes, while 4,498,202 ML was taken in 2014–15.

The information collected for the Victorian water accounts is recorded in the *Victorian Water Register*. The register is an important management tool which accounts for all of Victoria's water resources including where water is extracted through to its end use.

Victoria's robust water entitlement and water resource planning framework is the basis for providing certainty to water users. We will continue to improve the way we collect and share water resource information to ensure this framework remains strong and to ensure we provide flexibility and certainty for water users.

THE HON LISA NEVILLE

Minister for Water

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Executive summary

Victorian Water Accounts 2015–16 at a glance

- This report provides statewide and system pictures of water availability and use for each of Victoria's 29 river basins and 20 groundwater catchments, and for each of the state's rural and urban distribution systems.
- 2015–16 was a drier-than-average year. Victoria recorded its lowest average winter rainfall since 2006. It was the sixth-driest spring and third-warmest summer on record.
- The total available volume of surface water, groundwater and recycled water was lower than the previous year.
- Water use was restricted for urban and rural users and affected 35 towns, 157 rivers and seasonal allocations.
- Storage levels ended the year lower than they began. Surface water consumption increased from the previous year.
- In most groundwater systems, water levels fell and groundwater use increased, compared to the previous year.
- Recycled water use increased marginally from the previous year.
- The Victorian Environmental Water Holder oversaw the delivery of water to many river reaches and wetlands. This benefited a wide range of water-dependent plants and animals.

About the *Victorian Water Accounts 2015–16*

The *Victorian Water Accounts 2015–16* is the thirteenth report in a series that presents annual information about the state's water resources. It covers different sources of water including surface water, groundwater and recycled water. The purpose is to report on volumes of water available and used between 1 July 2015 and 30 June 2016. This report demonstrates to the community how the government sustainably manages all water resources in Victoria.

The sharing of the information in this report is part of the government's commitment to transparency and accountability in the management of our water resources. The report provides confidence to participants in water markets and to businesses and agricultural enterprises making investments across the state that rely on secure access to water.

The *Victorian Water Accounts 2015–16* demonstrate Victoria's commitment to meet obligations under state and federal legislation to collect and publish information about the state's water resources, and they make an important contribution to meeting our reporting requirements. Ultimately, this report is a valuable resource for staff working in the water management sector, water users, other interested parties and the broader community.

The report consolidates information from rural and urban water corporations: the Department of Environment, Land, Water and Planning; the Australian Bureau of Meteorology; the Victorian Environmental Water Holder; the Essential Services Commission; the Murray–Darling Basin Authority; the Victorian Alpine Resorts Commission; power generators; and other major users of water. The information is recorded in the *Victorian Water Register*.

The *Victorian Water Accounts 2015–16* has two parts.

- Part 1 provides a statewide overview of water resources during the year. It provides context on the legal access to water and how resources are managed. There is information about rainfall, streamflows and storage levels, water taken for consumptive purposes, water trading and the management of water for the environment.
- Part 2 contains water accounts for each of Victoria's 29 river basins and 20 groundwater catchments. It also presents distribution system accounts for Victoria's 19 water corporations. The accounts track each system's inflows, outflows and storage volume changes during the year.

Dry conditions across Victoria

The 2015–16 year was drier than average, with below-average rainfall across most of the state, some average to above average conditions in the eastern regions and very dry in the south-west, with the lowest rainfall on record observed in some areas. Winter and spring of 2015 were again drier than usual, with Victoria recording its lowest average winter rainfall since 2006 and its sixth-driest spring on record. The 2015–16 summer was Victoria's third- warmest summer on record with near-average rainfall. Rainfall received in autumn 2016 was just below the long-term average, continuing a run of five consecutive seasons of drier-than-average conditions in the state.

The warm, dry conditions led to a higher-than-average proportion of rainfall leaving the catchments by evapotranspiration. As a result of low rainfall and high evapotranspiration significantly less rainfall remained for streamflows, with Victoria's total streamflows for the year reaching only 50% of the long-term average.

In 2015–16, restrictions on urban and rural users were applied and affected 35 towns, 157 rivers and seasonal allocations. The dry conditions and a blue-green algae event meant that water corporations were required to cart water to users for four towns drinking supply.

In groundwater catchments, water level trends in 2015–16 shifted from stable or rising to declining for the majority of systems, compared to 2014–15.

Reduced water availability

A total of 14,255,141 ML of surface water, groundwater and recycled water was available in 2015–16. This is lower than the 17,257,234 ML available in 2014–15. The reduction in available water is mainly due to reduced surface water volumes, attributable to below-average rainfall conditions.

Storage levels began the year at 58% of capacity, but use during the year was not completely compensated for by rainfall, leaving storages at the end of the year lower than they began at 41%. The storages remained above the low levels experienced during the driest years of the past decade.

Water recycled (both in terms of the volume of water recycled and that volume as a proportion of total wastewater) has been gradually increasing in Victoria since 2010–11. However, it has not reached the levels seen during the last drought, when extremely low water availability dramatically increased the demand for recycled water.

Most water share holders in northern Victoria received lower allocations in 2015–16, compared to those in 2014–15. Only the Murray system reached 100% allocation for high-reliability entitlement in 2015–16, compared to the previous year when all systems reached 100% allocation for high-reliability entitlement. The 2015–16 year was much drier with none of the systems in northern Victoria receiving low-reliability allocation in 2015–16. Water share holders in southern Victoria received varied allocations: the Thomson–Macalister system reached 100% allocation for high-reliability entitlements and 20% allocation for low-reliability entitlements, while the Werribee system only received 70% allocation for high-reliability entitlements.

Water use

In Victoria, 4,398,170 ML of surface water, groundwater and recycled water was taken for consumptive use in 2015–16. This volume represents 31% of the total water available during the year, higher than the 26% in 2014–15.

Surface water use was 3,845,196 ML in 2015–16 compared to 3,945,922 ML in 2014–15. A large portion of this difference is due to the revised method to estimate small catchment dams, which provided a more accurate measure of these dams and the ability to differentiate between these dams and small bodies of water such as lakes or wetlands.

Groundwater use increased in 2015–16, with Victorian water users extracting 457,374 ML of groundwater in 2015–16, compared to 404,974 ML in 2014–15.

Recycled water use was similar to the previous year, with 95,600 ML taken in 2015–16, compared to 91,277 ML in 2014–15.

In 2015–16, the Victorian Environmental Water Holder oversaw the delivery of 689,532 ML of water to 73 river reaches and 73 wetlands, providing significant benefits to a wide range of water-dependent plants and animals. This was more sites than in 2014–15, largely reflecting an increased number of wetlands that received water in the Wimmera–Mallee wetlands system.

Want to know more?

More information about **sustainable water management** across Victoria can be found at:

- Department of Environment, Land, Water and Planning – www.delwp.vic.gov.au/water.

More information about water supply and use is held by **local water corporations** and can be found at:

- Barwon Water – www.barwonwater.vic.gov.au
- Central Highlands Water – www.chw.net.au
- City West Water – www.citywestwater.com.au
- Coliban Water – www.coliban.com.au
- East Gippsland Water – www.egwater.vic.gov.au
- Gippsland Water – www.gippswater.com.au
- Goulburn-Murray Water – www.g-mwater.com.au
- Goulburn Valley Water – www.gvwater.vic.gov.au
- Grampian Wimmera Mallee Water – www.gwmwater.org.au
- Lower Murray Water – www.lmw.vic.gov.au
- Melbourne Water – www.melbournewater.com.au
- North East Water – www.newater.com.au
- South East Water – www.southeastwater.com.au
- South Gippsland Water – www.sgwater.com.au

- Southern Rural Water – www.srw.com.au
- Wannon Water – www.wannonwater.com.au
- Western Water – www.westernwater.com.au
- Westernport Water – www.westernportwater.com.au
- Yarra Valley Water – www.yvw.com.au.

More information about **environmental water** can be found at:

- Victorian Environmental Water Holder – http://www.vewh.vic.gov.au/.

More information about **rainfall and temperatures** can be found at:

- Australian Bureau of Meteorology – www.bom.gov.au.

Part 1: Overview of Victorian water resources 2015–16

Part 1 of the *Victorian Water Accounts 2015–16* summarises Victoria's water entitlement and planning framework and the mechanisms it provides for sharing available water resources.

Part 1 also provides a statewide overview of Victorian water resources during the year, reporting on:

- the quantity of water available in terms of rainfall, streamflows, reservoirs and aquifers
- the quantity of water allocated for consumptive use from reservoirs, streams and aquifers under entitlements issued by government, as well as quantities used and recycled
- water available to the environment
- Victoria's water trade activity.

1 Management of Victoria's water resources

Victoria's water entitlement and water resource planning framework provides certainty of legal rights and obligations, and flexibility for entitlement holders to manage their own risks and make decisions about how they use water to meet their needs. The strength of the entitlement and planning framework was reinforced during Victoria's driest 13 years, the Millennium Drought.

The framework provides water security for communities and the environment. This builds confidence for communities, businesses, industry and investment growth. Good-quality, timely water resource management information is an essential input into the framework. The *Victorian Water Accounts 2015–16* form part of this input.

Victoria's water entitlement and water resource planning framework is established under the *Water Act 1989* (the Act) and provides the basis for how our water resources are shared. Its key elements are:

- secure entitlements with tenure that is certain and protected including bulk entitlements, environmental entitlements, water shares, take and use licences and contractual agreements to supply
- limits on water entitlements: that is, specified volumes, extraction rates and locations, diversion rules and sharing arrangements
- seasonal water allocation rules that respond to water availability over time
- clear consultative processes before entitlements can be changed
- ability to trade, using markets to facilitate the efficient movement of water, giving users the flexibility to buy and sell water
- private rights (section 8 of the Act) enabling individuals to take small volumes of water for domestic (household) and stock watering purposes in certain circumstances without a licence.

1.1 Types of water resources

This report covers several types of water resources, which are managed under Victoria's water entitlement and water resource planning framework. These are:

- surface water: includes water in waterways, lakes, reservoirs, dams and wetlands. The Act defines a waterway as a river, creek, stream, watercourse and a natural channel where water regularly flows, whether or not the flow is continuous.
- groundwater: the reserve of water that is located beneath the earth's surface in pores and crevices of rocks and soil. These areas vary in size and volume throughout Victoria and are known as aquifers.
- recycled water: water derived from sewerage systems or industry processes that is then treated to a standard appropriate for its intended use.
- desalination water: seawater that is treated to a standard appropriate for its intended use.

Local factors influence how much rainfall flows in to streams and recharges groundwater aquifers. These factors include sub-surface geology, soil permeability and moisture levels, vegetation cover and the pattern of individual rainfall events. Victoria has an extensive network of monitoring sites that record information on rainfall and temperature, river quantity and quality, groundwater levels and quality, and the production and quality of recycled water. The amount of water that is taken from rivers and groundwater is also monitored and use is metered wherever practical.

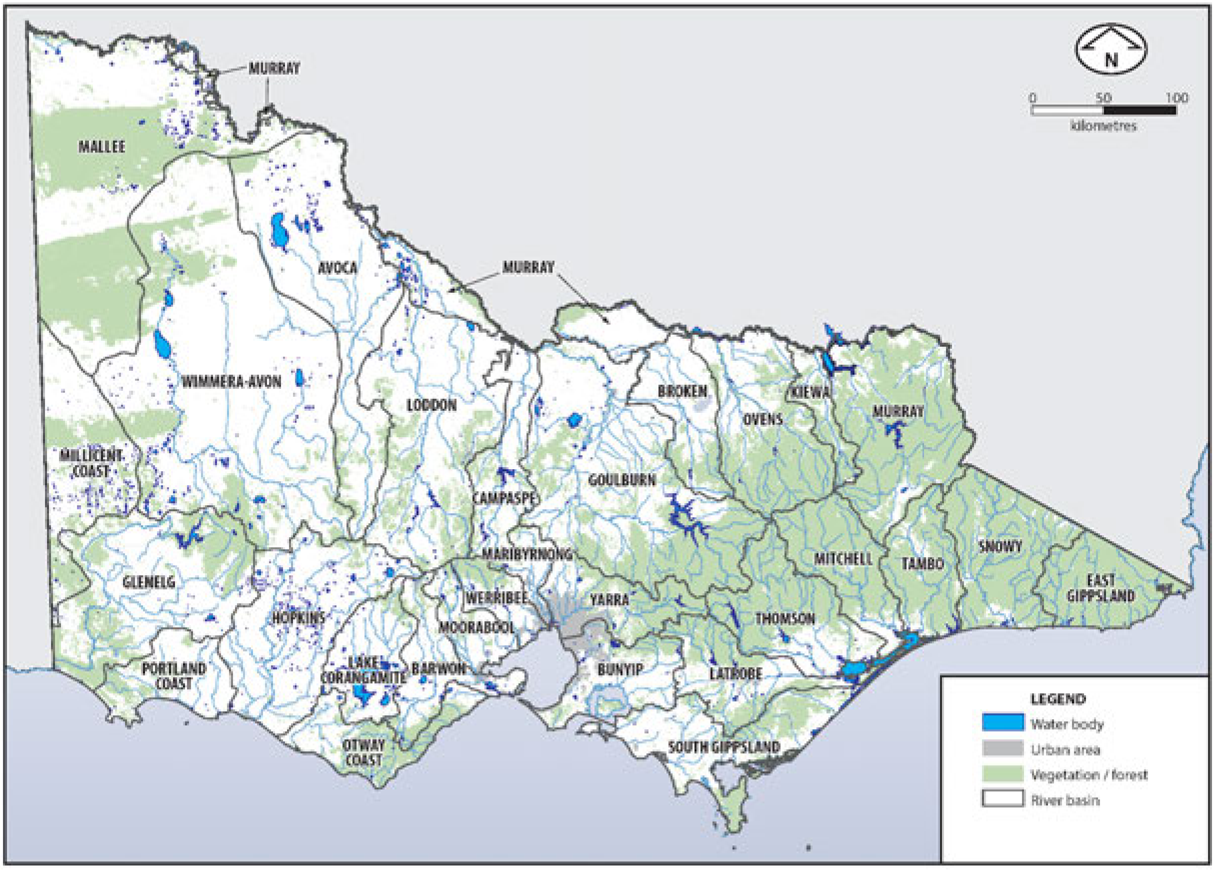
1.1.1 Surface water

Most information about surface water is summarised in this report by the river basins defined by the former Australian Water Resource Council (AWRC). The exception to this is the Murray basin which includes the Upper Murray basin as defined by the AWRC and the areas in Victoria supplied from the Murray River downstream of Lake Hume. The extent of each of Victoria's river basins is shown in Figure 1-1.

Surface water supply systems are categorised into regulated and unregulated systems. **Regulated systems** refer to systems where a river contains structures such as dams or major diversion weirs which control the flow of water in the river for licensed diverters or users in an irrigation district. Some regulated systems contain formally recognised **irrigation districts**, which are areas supplied with water by a water corporation via channels and pipelines. **Unregulated systems** do not contain any dams or major diversion weirs which control the flow of water in the river.

Surface water also includes the water captured and held in small catchment dams, which are not located on a waterway or part of any formal supply system.

Figure 1-1 River basins in Victoria



1.1.2 Groundwater

Groundwater is found in the spaces and fractures in rock and sediment beneath the ground's surface. Groundwater forms part of Earth's water cycle, when water from rainfall, surface water or snowmelt slowly seeps from the surface into the groundwater. Groundwater flows (although only very slowly) and may eventually return to the surface either as springs, as baseflows to surface rivers and streams, lakes and wetlands, as evaporation or into the ocean. Groundwater supports groundwater-dependent ecosystems, human consumption and agricultural, commercial and industrial uses and contributes to environmental flows in streams.

Where groundwater is held within a layer of underground sediments which still allows water to flow through –referred to as an aquifer – it can be pumped to the surface for use. Salinity is often the key determinant for whether groundwater is suitable for consumptive uses.

Trends in groundwater levels reflect changes in aquifer storage resulting from differences between the amount of water flowing into (recharge) and out of (discharge) an aquifer. Groundwater level trends in shallow aquifers are more likely to reflect changes in recharge from either rainfall or irrigation, whereas deeper aquifer trends may show a greater influence from pumping.

Trend determinations are made quarterly, when each reading is compared with previous readings in the same season (that is, a summer record is compared with previous summer records from five to ten years ago) to account for seasonality. The bores for each groundwater management unit are selected on the basis of a number of factors including the length and quality of records available, the geographic distribution of bores and the maximum possible distance from irrigation bores (to minimise the influence of pumping on the groundwater levels recorded). Groundwater level trends are monitored to understand if systems are stable, rising or declining. Management is altered in light of these trends.

Victoria's groundwater resources are contained in five major groundwater management basins, and each groundwater basin has several groundwater catchments (Figure 1-2). Since 2012, all groundwater in Victoria has been assigned to a groundwater catchment and basin, as the basis for planning and reporting. Within these catchments there are groundwater management units, which comprise water supply protection areas and groundwater management areas where statutory and non-statutory management plans are applied. Most groundwater management units include trading zones. Areas outside groundwater management units are referred to as unincorporated areas, which are also subject to statewide policy, reporting and licensing matters.

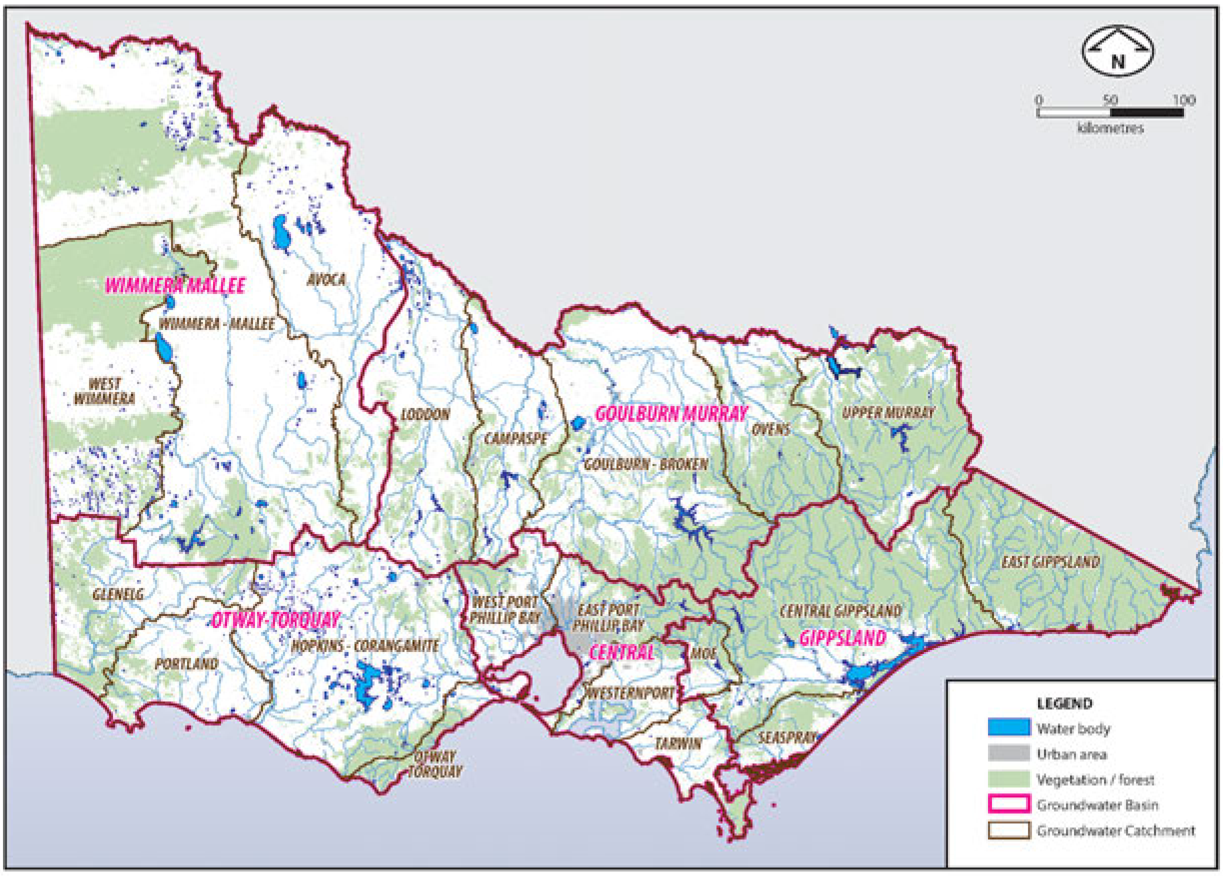
The following dot points define each of the above terms.

- Groundwater basin: the largest scale of connected hydrogeological resources, from highlands to sedimentary plains. This is also the scale of water resource plans for groundwater under *Basin Plan 2012.*
- Groundwater catchment: the longitudinal flow path of connected groundwater resources, which are interconnected laterally within a basin. These are set by Victoria's 2012 groundwater management framework.
- Water supply protection area (WSPA): an area declared under section 27 of the *Water Act 1989* to protect groundwater or surface water resources through the development of a statutory management plan.
- Streamflow and/or groundwater management plans: a management plan prepared for a WSPA to manage the surface water and/or groundwater resources of the area.
- Groundwater management area (GMA): defined for the purposes of management, most commonly an area where no new groundwater entitlement is available. It may be intensively developed or have the potential to be. It may also have a management plan approved by the relevant rural water corporation.
- Unincorporated area (UA): an area where less-intensive development of groundwater has occurred. There is limited information about resource availability, and yield or quality may vary. UAs are important for the supply of domestic and stock water. UAs in northern Victoria are included in the Murray-Darling Basin Plan.
- Trading zones: are the smallest scale of administrative management of groundwater. They are generally subsets of groundwater management units: either WSPAs or GMAs.

The State Observation Bore Network (SOBN) is the collection of bores used for monitoring the movement, availability and quality of Victorian groundwater as well as the linkages between groundwater and surface water systems throughout the state. The SOBN comprises about 1,400 bores that are monitored on a routine basis. Short-term groundwater level trends for groundwater management units have been determined based on five years' consistent monitoring data from key bores in the SOBN.

Trend determinations are made quarterly, when each reading is compared with previous readings in the same season (that is, a summer record is compared with previous summer records) to account for seasonality. The bores for each groundwater management unit are selected on the basis of a number of factors including the length and quality of records available, the geographic distribution of bores and the maximum possible distance from irrigation bores (to minimise the influence of pumping on the groundwater levels recorded).

Figure 1-2 Map of Victorian groundwater basins and catchments



1.2 Water entitlements

The volume of water authorised to be taken and used is specified in a **water entitlement**. The three tiers of water entitlements in the framework are presented in Figure 1-3.

One of the key principles of the water entitlement and water resource planning framework is that individual entitlement holders are responsible for managing the risks of water scarcity within their own contexts and systems. Water entitlements can be held by an individual, an irrigator, a water authority or an environmental water holder. The conditions of an entitlement do not change based on who owns it.

Water entitlements are held for consumptive and environmental purposes. Consumptive uses include urban, irrigation and industry uses, and power generation. Environmental uses include water flowing in a stream and diverted to wetlands.

Regulated water systems may be **declared** in accordance with section 6A of the Act. In declared water systems most water entitlements have been separated, or unbundled, from land rights. The regulated systems of northern Victoria were declared on 1 July 2007. The Werribee and Bacchus Marsh and Thomson–Macalister water systems were declared on 1 July 2008.

A **water share** is the legally recognised, secure share of the water available to be taken from a declared water system. Water shares were created as part of the unbundling reforms. Water shares may be high-reliability or low-reliability, and are specified as a maximum volume of seasonal allocation that may be made against that share.

A **take and use licence** is issued under section 51 of the Act. It is a fixed-term entitlement to take and use water from a waterway (typically in unregulated systems), catchment dam, spring, soak or aquifer. Each licence is subject to conditions set by the Minister for Water and specified on the licence.

Section 8 of the Act allows individuals to take water for domestic and stock purposes from a range of surface water and groundwater sources without a take and use licence. This is commonly referred to as a **private right**.

Note that small catchment dams that are not located on a waterway require a take and use licence if they are used for any purpose other than domestic and stock.

Most Victorian water supply systems have a **cap** or a limit placed on the total amount of water that can be taken from a system within a given timeframe, typically one year. Effectively these caps limit the entitlements issued in these systems. To facilitate the efficient use of water resources within Victoria, water can be traded between users and locations in accordance with trading rules which are designed to protect third parties from unacceptable impacts.

All Victorian water entitlements are recorded in the *Victorian Water Register*, which provides an authoritative record the entitlements, and associated transactions including carryover, allocation and trade. Useful information for water users about water entitlements, seasonal allocations, trade and transfers can be found on the Victorian Water Register website (http://waterregister.vic.gov.au).

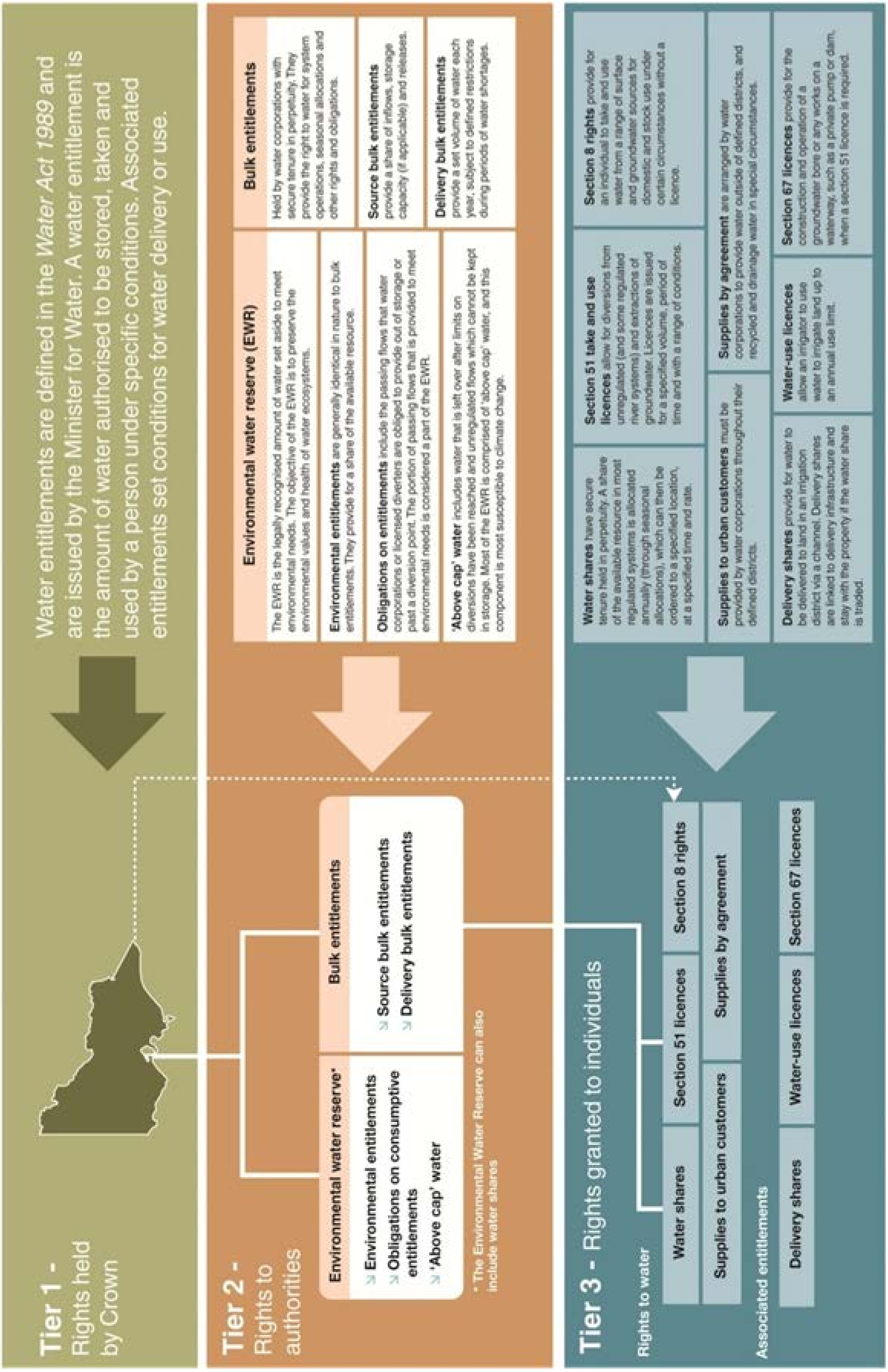


Figure 1-3 Victoria's water entitlement tiers

1.3 Water planning framework

To support and guide the management of water allocated under the entitlement framework, Victoria has an integrated water resource planning framework, supported by legislation and with specified timeframes for review.

This planning framework incorporates:

- short-term (annual) planning through measures such as seasonal resource determinations on rural regulated systems and drought response plans in urban systems
- medium-term local planning, to balance the demand for water and the available supply every two-five years
- medium-term local planning, to maintain and improve the health of rivers and wetlands through the development of regional waterway management strategies every five years
- medium- and long-term statewide strategic planning, through the development of regional sustainable water strategies every 10 years
- long-term planning, with formal assessments of the resource base and river health every 15 years.

1.4 Water sector institutional arrangements

Under the Act, rural water corporations are required to provide irrigation, drainage and storage services. These services are critical for agricultural water users and underpin on-farm investment decisions. They are also responsible for administering the diversion of water from waterways and the extraction of groundwater on behalf of the Minister.

Urban water corporations manage water resources and deliver water supply and sanitation services within our cities and towns. Ninety-five per cent of total water corporation expenditure is spent by the urban water sector to provide these services.

The Victorian Environmental Water Holder (VEWH) is the independent statutory body responsible for the use of environmental water across the state. It holds a number of environmental water entitlements in its own right and manages some entitlements on behalf of Snowy Recovery and the Living Murray Program. The Victorian Environmental Water Holder relies on the services of storage managers to deliver environmental water where it is required.

At the national level, the Commonwealth Environmental Water Holder (CEWH) holds and manages water entitlements in line with the Murray-Darling Basin Plan. The CEWH's entitlements have been recovered for the environment through water purchases and infrastructure investments in the Murray-Darling Basin. Delivery of the Commonwealth's environmental water in Victoria is managed by the VEWH in partnership with the CEWH and catchment management authorities.

The Victorian economic regulation framework, established under the *Essential Services Commission Act 2001* and the *Water Industry Act 1994*, guides water corporation pricing and investment decisions. This economic regulatory framework is overseen by the Essential Services Commission. The quality of water supplied by water corporations is independently regulated by the Department of Health and Human Services in accordance with the *Safe Drinking Water Act 2003* and the environmental performance of water corporations is independently regulated by the Environment Protection Authority Victoria in accordance with the *Environment Protection Act 1970*.

Victoria has a well-established catchment management framework to conserve our environment while maintaining and increasing productivity from our land and water resources. The *Catchment and Land Protection Act 1994* is the legislative basis for catchment management in Victoria. It provides for 10 catchment management authorities across the state that each develop a regional catchment strategy for their area. It also establishes the Victorian Catchment Management Council to advise on statewide matters.

In regulated water systems, system operators (nominated water corporations) are responsible for managing the available water resource on behalf of entitlement holders: the urban water corporations, the Victorian Environmental Water Holder and individuals. Each year, system operators plan for the management of their systems to supply the specified entitlements. System operators must also develop low-flow contingency plans for managing severe water shortages. System operators provide regular information to entitlement holders to assist with their planning.

Planning in unregulated surface and groundwater systems generally involves developing management arrangements so that available resources are managed equitably and sustainably. The management arrangements set out the triggers for rosters, restrictions and bans on extractions during low-flow periods.

1.5 Responding to water availability

The amount of water available for consumptive use and environmental purposes will vary from year to year. The entitlement and planning framework includes mechanisms to conserve and share water between users in response to seasonal variability and water shortages. These mechanisms include:

- urban water restrictions
- seasonal allocations in regulated systems
- restrictions on licence holders in groundwater systems and unregulated surface water catchments.

When these mechanisms for managing the variability of water availability are not sufficient, water corporations may also undertake other measures (such as water carting) to augment local supplies.

In exceptional circumstances, the Minister for Water has emergency powers under section 33AAA of the Act to declare that a water shortage exists and to qualify rights to water. This results in a temporary change in water-sharing arrangements in a given area to ensure critical water needs are met in extreme circumstances. Rights to water that may be qualified include licences, water shares, bulk entitlements and environmental entitlements.

Water markets are also an important mechanism for individual entitlement holders to manage seasonal variation in water availability and facilitate the sharing of available resources. Chapter 5 has information about trade in 2015–16.

1.5.1 Urban water restrictions

All Victorian towns are subject to a uniform scale of water restrictions under the Victorian Uniform Drought Water Restriction Guidelines. The scale has four stages of restrictions, with increasing levels of severity as water shortages become more severe. While water corporations can tailor the restrictions under each stage to suit local conditions (that is, by providing exemptions), the nature of restrictions are fairly consistent across the state for each stage. The trigger points for each stage of water restrictions are outlined in the drought response plan of each water corporation. These plans also include contingency measures for temporary water supplies or savings beyond stage 4. Each urban water corporation also has a permanent water savings plan which applies at all times and sets basic conditions for water use when water restrictions are not in place.

1.5.2 Seasonal allocations in regulated systems

The volumes of water available for use in some regulated systems are determined by the seasonal allocation process. This process differs from urban restrictions in that each water entitlement is allocated a share of the available water resource in proportion to the entitlement volume. Seasonal allocations are expressed as a percentage of entitlement. (which can have differing levels of reliability, termed either high-reliability or low-reliability entitlements).

Seasonal allocations are determined for each system using a water budget. The water budget calculates how much water is currently in the dams and is expected to flow into them over a specified period to decide how much water can be allocated to entitlement holders in that system. Allocation policies vary between supply systems, and in some cases there is a reserve policy which means once allocations reach a certain level some water starts to be set aside for the following year. Opening seasonal allocations can be low, particularly in systems where there is no reserve policy, but the water budget is reviewed by rural water corporations throughout the year and seasonal allocations are increased as more water becomes available. In declared systems this process is called a seasonal determination.

1.5.3 Restrictions on licence holders

Streamflow management plans and local management plans determine how water in unregulated streams will be shared between consumptive uses and the environment in times of water shortage. Under these plans, water corporations impose rosters, restrictions and bans on the water taken from streams by licensed diverters when streamflows drop below specified thresholds. Rosters and restrictions set out the order in which licence holders are allowed to take water and the quantity allowed to be taken (for example, 75% of licensed volume). When water is particularly scarce, bans on diversions from waterways are imposed.

The need to implement restrictions on diversions from unregulated streams fluctuates during the course of the year, depending on rainfall and streamflows. Restrictions and bans are usually most severe in summer and autumn and are more likely to be eased over the winter and spring seasons.

Access to groundwater resources uses the same entitlement framework and private rights as for surface water, but the greater reliability of groundwater means year-to-year variations are usually lower. Other than shallow aquifers near the coast where seawater intrusion risks are managed, groundwater management can consider longer timeframes. As for surface water, it is important that any proposals do not impact existing users and the environment, or exceed caps (permissible consumptive volumes and sustainable diversion limits).

Seasonal allocations are announced in accordance with the statutory management plans of water supply protection areas (WSPAs) and local management plans of groundwater management areas (GMAs). Where a management plan provides for setting allocations at less than entitlements, an allocation of less than 100% of the licensed entitlement may be put in place to:

- reduce the risks from falling groundwater levels (risks can include reduced access in other licensed bores or domestic and stock groundwater supply, impacts on groundwater dependent ecosystems and potential long-term irreversible impacts on the quality of the resource)
- allow the resource to be shared between all users
- recognise and reduce the social and environmental costs of lowering groundwater levels.

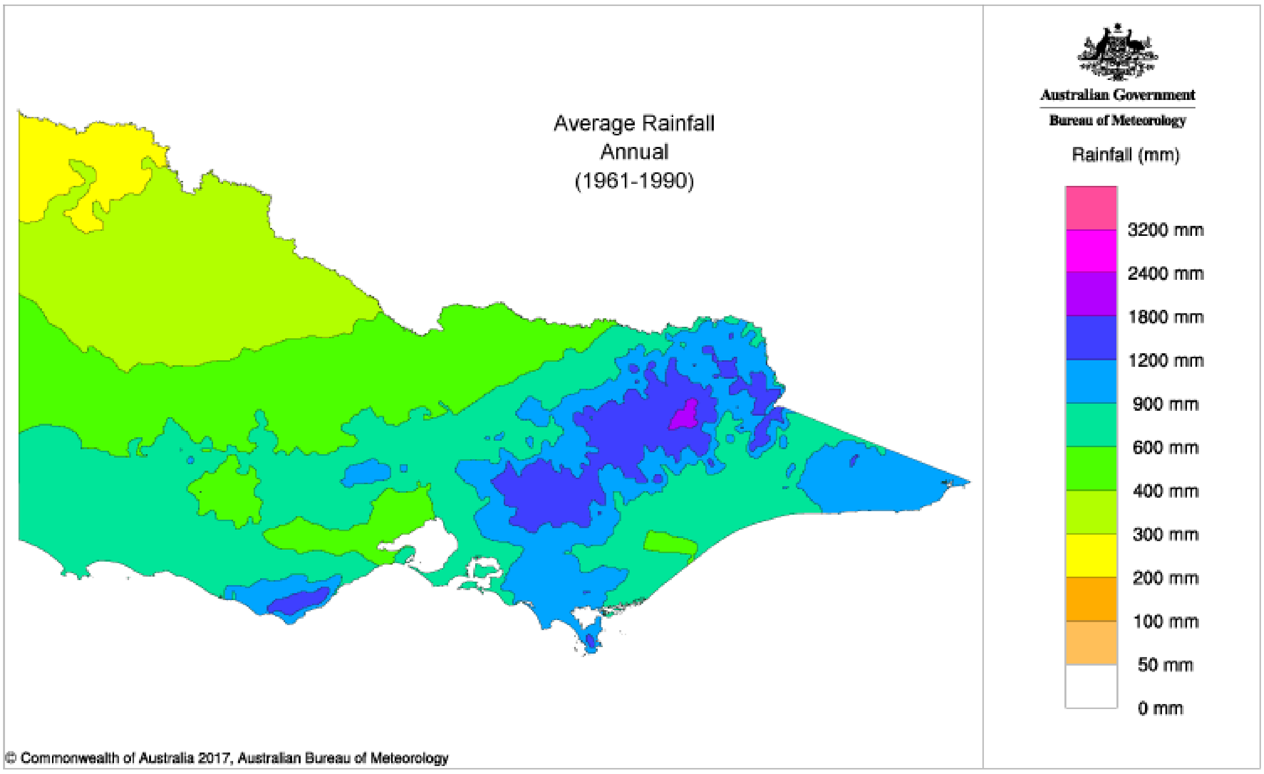
2 Water availability

This chapter presents an overview of surface water and groundwater availability in Victoria in 2015–16. It reports rainfall, streamflows and levels in major reservoirs, compared to previous years and the long-term averages. It also reports the annual trend in groundwater levels in groundwater management areas (GMAs) and water supply protection areas (WSPAs). The management response to water availability is also summarised in this chapter.

2.1 Rainfall

Long-term average rainfall in Victoria varies from less than 300 mm a year in the north-west of the state to 2,400 mm a year in the alpine area of the north-east (Figure 2-1).

Figure 2-1 Victorian long-term average annual rainfall (1961–90)



In 2015–16, the overall rainfall conditions were below average for most of the state. The range for total annual rainfall varied from 100 to 300 mm in the north-west, 300 to 1200 mm in the north-east and East Gippsland and 1,200 to 1,800 mm in parts of the Highlands and Cape Otway (Figure 2-2).

Rainfall for 2015–16 was categorised as below-average across most of western and south-central Victoria (Figure 2-2), generally rainfall was greater than 60% but less than 100% of the long-term average, with small patches which only received 40% and 60% of the long-term average. Rainfall in the north-east, east Gippsland and parts of central Gippsland was mostly above-average (Figure 2-3), receiving up to 125% of the long-term average.

Below-average rainfall across the state was reflected in the statewide evapotranspiration rate, which was 498 mm in 2015–16. This is about 9% below the long-term average evapotranspiration rate (1961–90). The difference between the long-term average and modelled evapotranspiration for 2015–16 was greatest in the north-west of the state, where evapotranspiration was up to 24% below the long-term average. In the east of the state the evapotranspiration estimates were closer to the long-term average, and slightly greater in two river basins in the north east, the Ovens and the Kiewa. Across most of the state, evapotranspiration represented a higher-than-average proportion of rainfall. As a result, less rainfall flowed into streams and recharged groundwater aquifers (Appendix A).

Figure 2-2 Victorian rainfall, 2015–16, millimetres

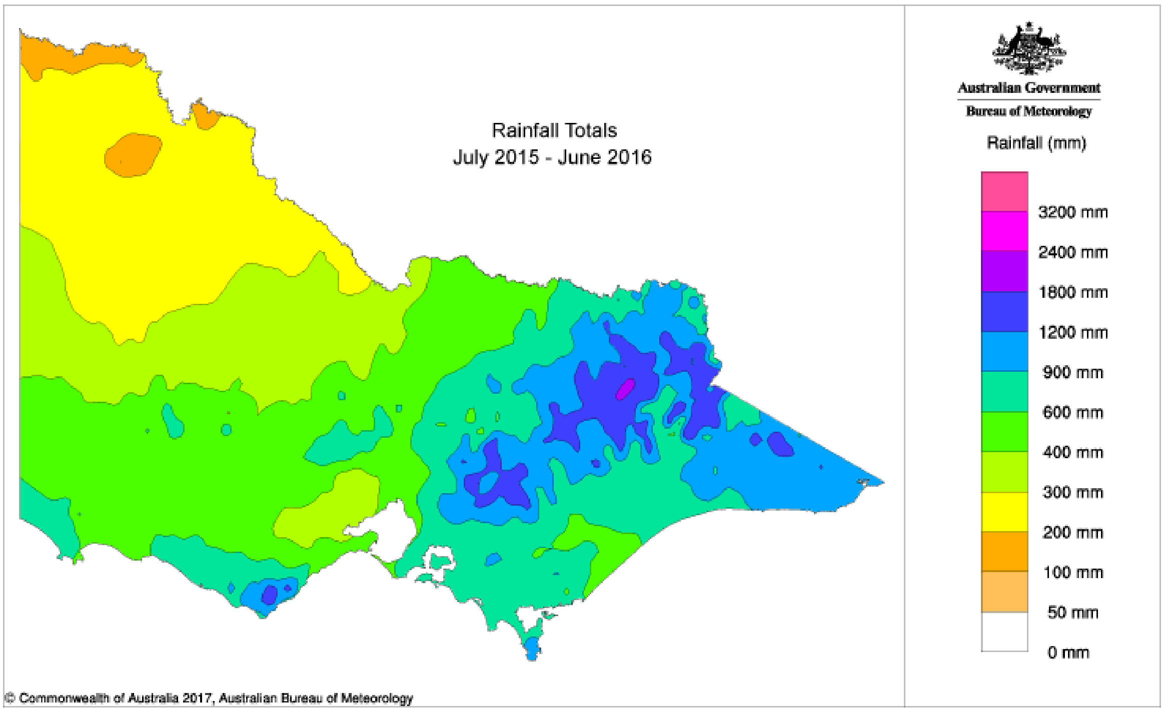
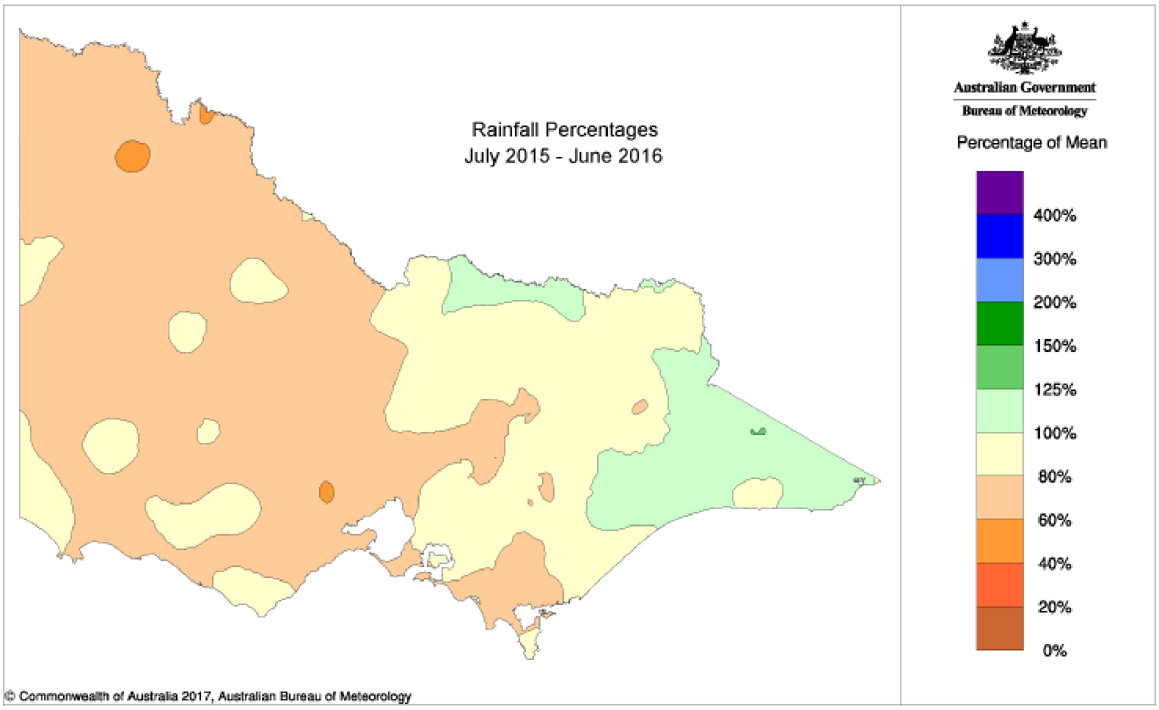


Figure 2-3 Victorian rainfall, 2015–16, as a percentage of long-term average rainfall



In winter 2015, Victoria recorded its lowest average rainfall since 2006. Most of the state was below average to very much below average, except for a few areas along the Murray and parts of Gippsland where near-average to above-average rainfall was recorded (Figure 2-4A).

Spring rainfall (Figure 2-4B) was generally below average to very much below average for most parts of the state, making it the sixth-driest spring on record. A few areas in southern Victoria experienced the lowest spring rainfall on record. Patches of average rainfall were received in East Gippsland, the Mallee, Shepparton and Cobram.

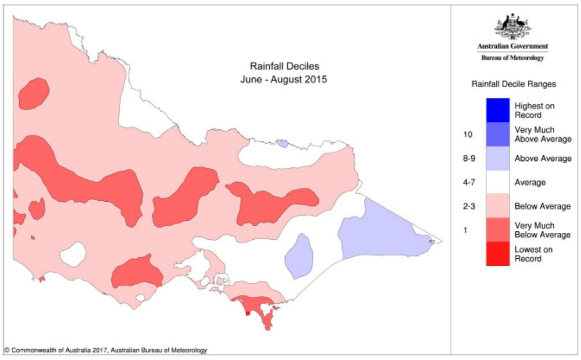
It was Victoria's third-warmest summer on record, with both daytime and night-time temperatures well above average. Overall summer rainfall was near average, ranging from below average in coastal and central districts and in the north-west of the state, to above average in isolated patches of the north and east (Figure 2-4C). Areas around

Geelong, the western plains and the central and northern districts received up to half their summer rainfall in the last five days of January. Wilsons Promontory and Carboor, each with over 100 years of rainfall data, had their highest summer daily rainfall on record.

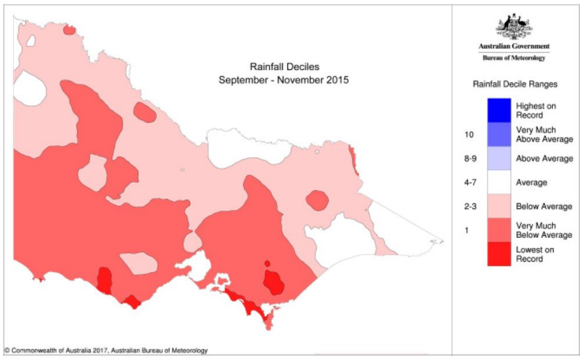
Autumn rainfall for Victoria was 6% below the long-term average (Figure 2-4D), continuing a run of five consecutive seasons of drier-than-average conditions in the state: only three of the past 14 seasons have recorded above-average rainfall in Victoria. The season began with near-average rainfall in March followed by a much drier-than-normal April. Larger parts of the state's western and northern areas received additional rainfall in May, including areas that did not receive any in March. These regions had above-average rainfall in autumn.

Figure 2-4 Victorian seasonal rainfall deciles, 2015–16

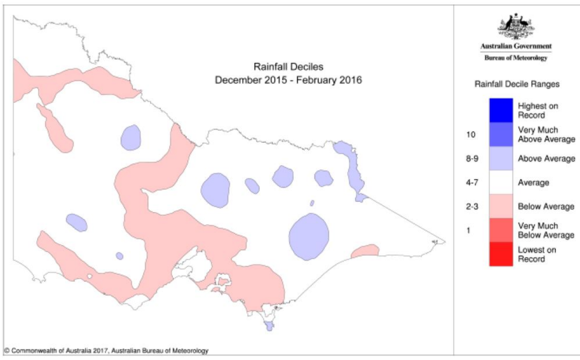
A. Rainfall deciles for winter 2015



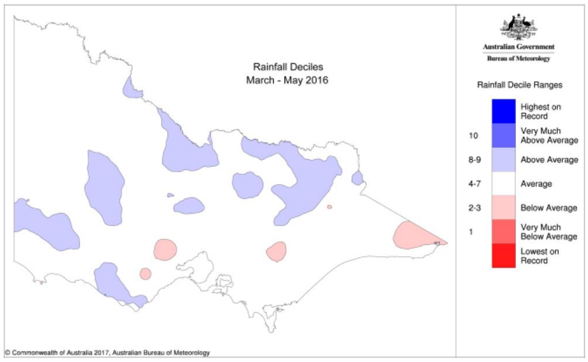
B. Rainfall deciles for spring 2015



C. Rainfall deciles for summer 2015–16



D. Rainfall deciles for autumn 2016

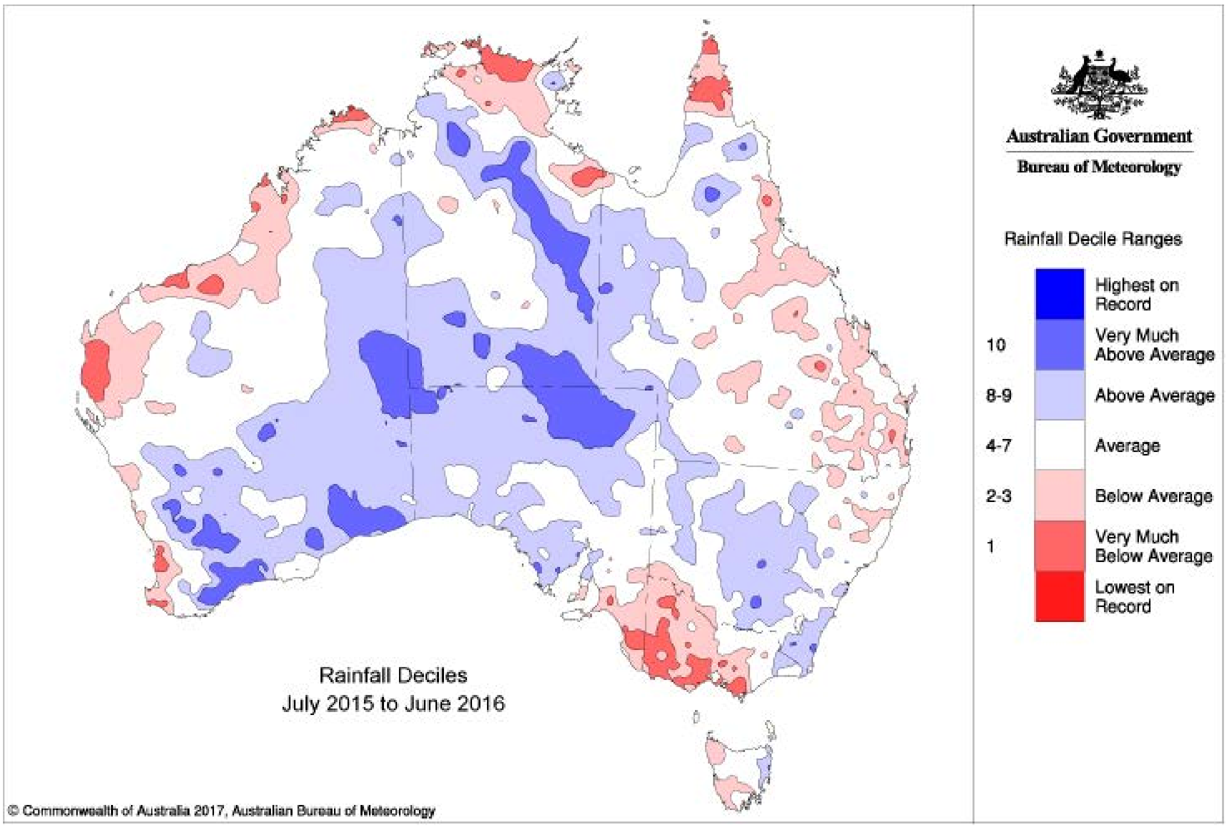


Overall, Victoria had its second consecutive year of below-average rainfall in 2015–16, with the same trend observed in Queensland and coastal regions of Western Australia. The average rainfall in other states was generally near the long-term average (Figure 2-5).

The Bureau of Meteorology declared the development of an El Niño event in autumn 2015. During El Niño events, winter and spring rainfall is typically below-average across much of eastern Australia. In contrast, La Niña events are typically associated with higher winter and spring rainfall.

The El Niño event continued to develop in winter 2015, reaching its climax during summer 2015–16. The temperatures in the tropical Pacific Ocean suggested that the 2015–16 El Niño event was one of the top three strongest El Niño events of the past 50 years. The strong El Niño event continued with a slow and steady decline well into autumn 2016. In May 2016, the El Niño – Southern Oscillation index (a key indicator of prevailing climatic conditions) returned to a neutral level, ending the 2015–16 El Niño event.

Figure 2-5 Australian rainfall deciles, 1 July 2015 to 30 June 2016



2.2 Streamflow

In this report, streamflow is equivalent to 'catchment inflow' in the water balances presented in chapter 6. Streamflow in waterways can vary between months. The government reports on this via Victoria's *Monthly Water Report*, published online at www.delwp.vic.gov.au (search 'DELWP Monthly Water Report').

In 2015–16, 25 of 29 river basins had annual streamflow volumes lower than those received in 2014–15 (Table 2-1). When compared to long-term annual average streamflows, 24 basins had below-average streamflows for 2015–16. Overall, the total annual streamflow volume for Victoria was 50% of the long-term average (Table 2-1). This a drop from the 61% of the long-term average reported for 2014–15. Although the west of the state was dry with low streamflow, east of the state experienced closer to average conditions.

The driest basins in 2015–16 were the Glenelg, Corangamite, Hopkins, Wimmera and Avoca basins, receiving below 15% of the long-term average streamflows. The Campaspe, Maribyrnong and Werribee basins were also dry, only receiving between 15% and 21% of the long-term annual average.

Other basins in the north of the state including the Loddon, Broken, Goulburn, Murray, Ovens and Kiewa received between 21% (Loddon) and 69% (Kiewa) of their long-term average annual streamflows.

As in 2014–15, the highest-yielding river basins relative to their long-term annual averages in 2015–16 were all in the east, with Snowy recording the highest streamflows of 189%. East Gippsland and Tambo were not far behind, receiving 163% and 146% respectively. Other Gippsland basins — the Thomson, Mitchell, South Gippsland, Latrobe and Bunyip — had between 51% (Thomson) and 86% (Bunyip) of their long-term annual average streamflows.

In the central and south-west areas of the state, the Moorabool, Barwon and Portland Coast basins received between 24% and 29% of the long-term average annual streamflows. The Otway Coast and Yarra basins both received 47% of their long-term average annual streamflows.

Table 2-1 Basin streamflows compared to long-term average

Basin	Average annual streamflow (ML)	2015–16 streamflow [1]		2014–15 streamflow [1]	
		(ML)	(% of average)	(ML)	(% of average)
Murray	7,618,000	2,840,189	37%	3,436,013	45%
Kiewa	689,000	473,861	69%	482,119	70%
Ovens	1,758,000	713,835	41%	943,000	54%
Broken	308,000	77,457	25%	139,328	45%
Goulburn [2]	3,363,000	1,041,566	31%	1,581,734	47%
Campaspe	352,000	54,467	15%	88,951	25%
Loddon	373,000	79,107	21%	117,053	31%
East Gippsland	714,000	1,161,495	163%	1,359,269	190%
Snowy [3]	1,022,000	1,927,323	189%	1,544,877	151%
Tambo	297,800	435,656	146%	337,832	113%
Mitchell	884,500	514,485	58%	660,176	75%
Thomson	1,101,760	559,677	51%	740,389	67%
Latrobe	847,400	552,528	65%	703,081	83%
South Gippsland	911,500	579,308	64%	729,705	80%
Bunyip	541,000	466,417	86%	505,591	93%
Yarra	1,054,000	495,720	47%	597,406	57%
Maribyrnong	113,000	19,806	18%	22,282	20%
Werribee	102,000	21,233	21%	23,922	23%
Moorabool	97,000	23,457	24%	50,588	52%
Barwon	360,000	104,820	29%	125,208	35%
Corangamite	316,000	40,645	13%	147,448	47%
Otway Coast	884,000	419,384	47%	574,874	65%
Hopkins	635,000	80,845	13%	222,928	35%
Portland Coast	361,000	104,323	29%	273,021	76%
Glenelg	964,000	116,794	12%	349,324	36%
Millicent Coast [4]	-	4	-	4	-
Wimmera	316,400	44,378	14%	44,990	14%
Mallee [4]	-	-	-	-	-
Avoca	136,200	18,377	13%	22,507	17%
Total	**26,119,560**	**12,967,156**	**50%**	**15,823,619**	**61%**

Notes:

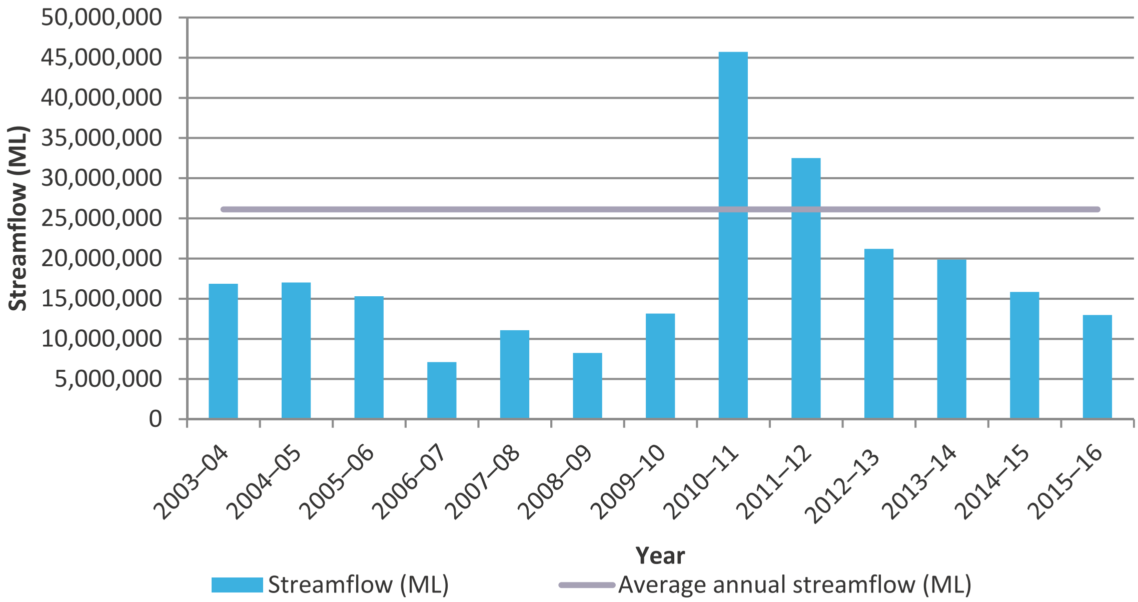
(1) 'Streamflow' is equivalent to 'catchment inflow' in the water balances presented in chapter 6.

(2) Includes inflows from Broken River.

(3) Volumes shown for the Snowy basin exclude catchment inflows from NSW (upstream of Burnt Hut Crossing).

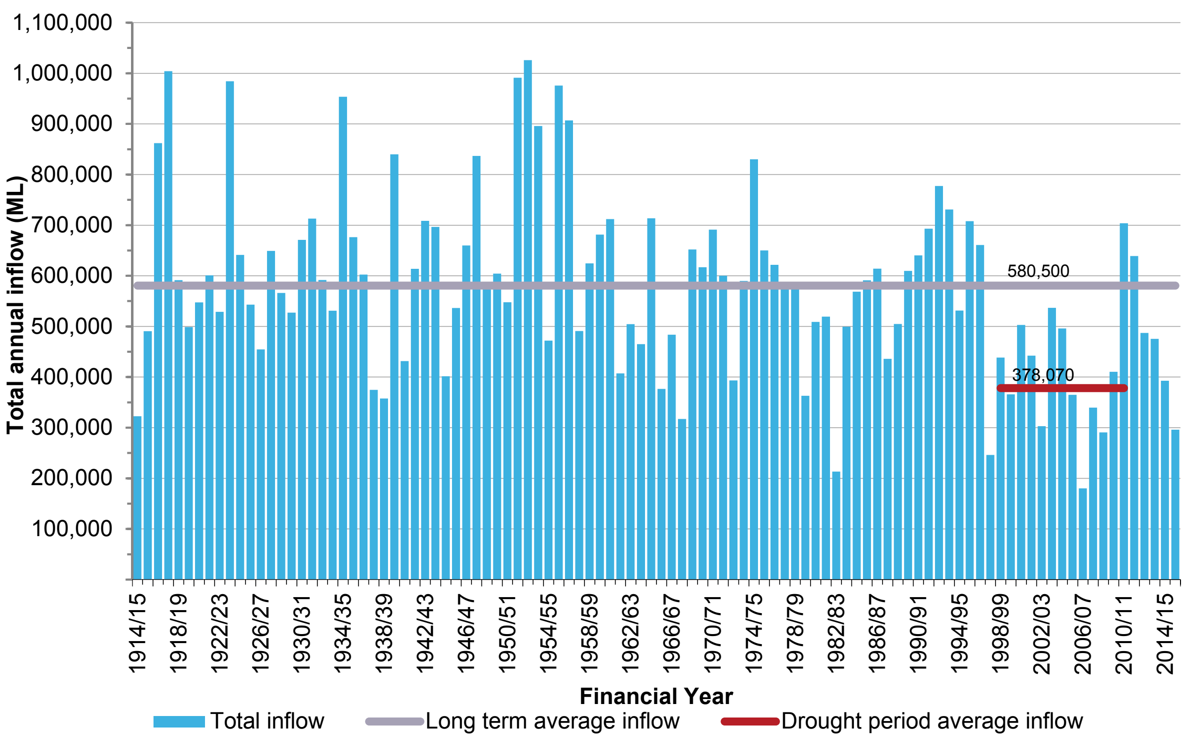
(4) Surface water resources within the Mallee and Millicent Coast basins are limited and there are currently no streamflow gauges in these basins. Streamflows in the Millicent basin are estimated be equal to the volume of licensed diversion from unregulated streams within the basin. There are no licensed diversions in the Mallee basin and it is assumed it has no streamflows.

Figure 2-6 Total Victorian streamflow compared to the long-term average



Streamflows have a major influence on Victoria's water storages. As shown in Figure 2.6 and Figure 2-7, the total annual streamflows received in 2015–16 were the lowest received since 2009–10. In line with the below-average annual streamflows presented in Table 2-1 and Figure 2-7, the annual inflows to Melbourne's harvesting reservoirs in the Yarra and Thomson basins in 2015–16 were also below the 100 year long-term average and also less than the average inflows of the last drought (Figure 2-7).

Figure 2-7 Annual inflows to Melbourne's main harvesting reservoirs (1)



Note:

(1) Maroondah, O'Shannassy, Upper Yarra and Thomson reservoirs.

2.3 Storages

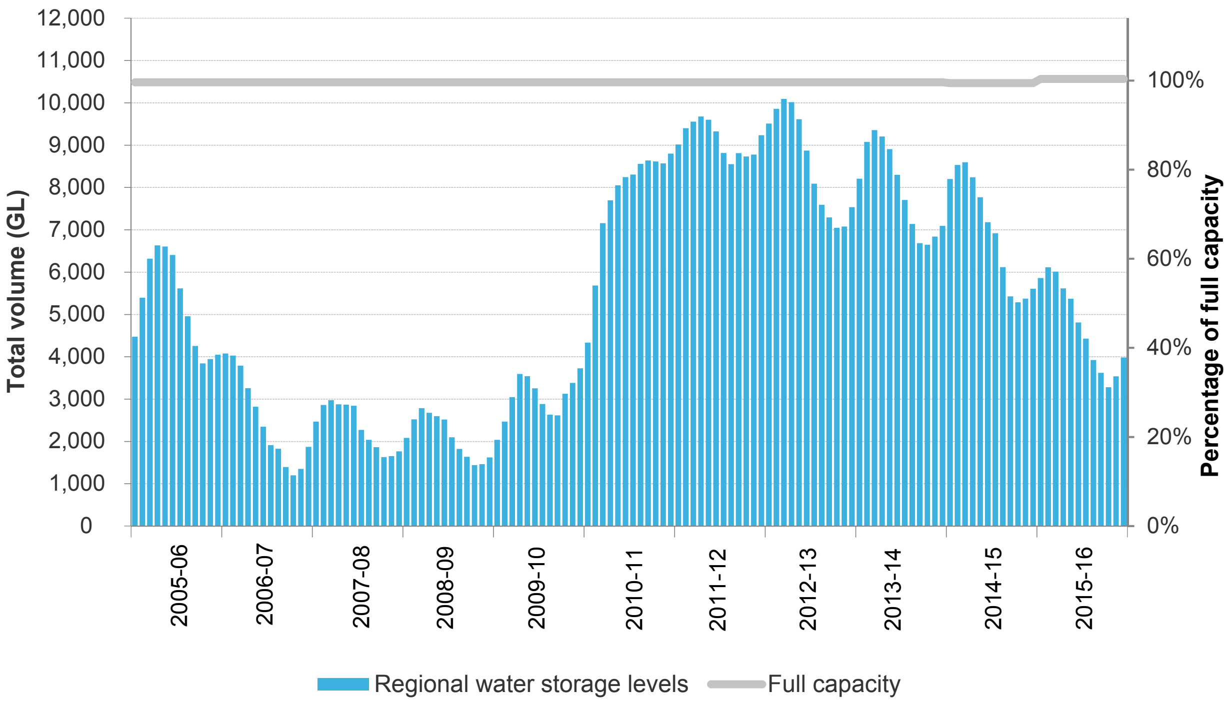
Victoria's major water storages can hold 12,430,004 ML. Of this, Melbourne's storage capacity is 1,812,175 ML and the combined capacity of the state's major regional storages is 10,617,829 ML. Information about levels held in all major storages across Victoria's river basins is in Appendix B and in the water balances in chapter 6.

A subset of about 60 of the major storages was used to provide the summary information below and in Figure 2-8 and Figure 2-9. This data shows that in 2015–16, Victoria's total storage levels started the year at 7,120,970 ML (58% of capacity) and ended at 5,058,252 ML (41% of capacity). The combined volume of water stored in Victoria's reservoirs varies both within a given year and between years (Figure 2-8 and Figure 2-9).

Storage levels in Victoria's regional reservoirs started the year at 5,861,124 ML (55% of capacity) and ended at 3,982,250 ML (38% of capacity). Storage levels increased during winter, reaching a peak of 58% of capacity in August, and declined through the summer to a minimum of 31% of capacity by April 2016 (Figure 2-8). Regional water storages levels have not been as low as they were in 2015–16 since 2009–10. During 2015–16, minor revisions were made to the operating capacities of various storages and the inaccessible portion of Victoria's share of the Menindee Lakes was added to the total capacity. This is reflected in the increased total capacity of the regional storages (Figure 2-8).

Melbourne's water storages started the year at 1,259,846 ML (70% of total capacity) and ended at 1,076,002 ML (59% of total capacity) after reaching a peak of 74% in September 2015 (Figure 2-9). The pattern in 2015–16 — of storage levels being lower at the end of the year than at the start of the year — is in contrast to the pattern in 2010–14, when Melbourne's storage levels were higher at the end of the year than they were at the start. During the latter years of the Millennium Drought — between 2006–09 — storages consistently ended each year at lower levels than they had begun (Figure 2-8).

Figure 2-8 Volume in major regional water storages, 1 July 2005 to 30 June 2016 (1) (2) (3)



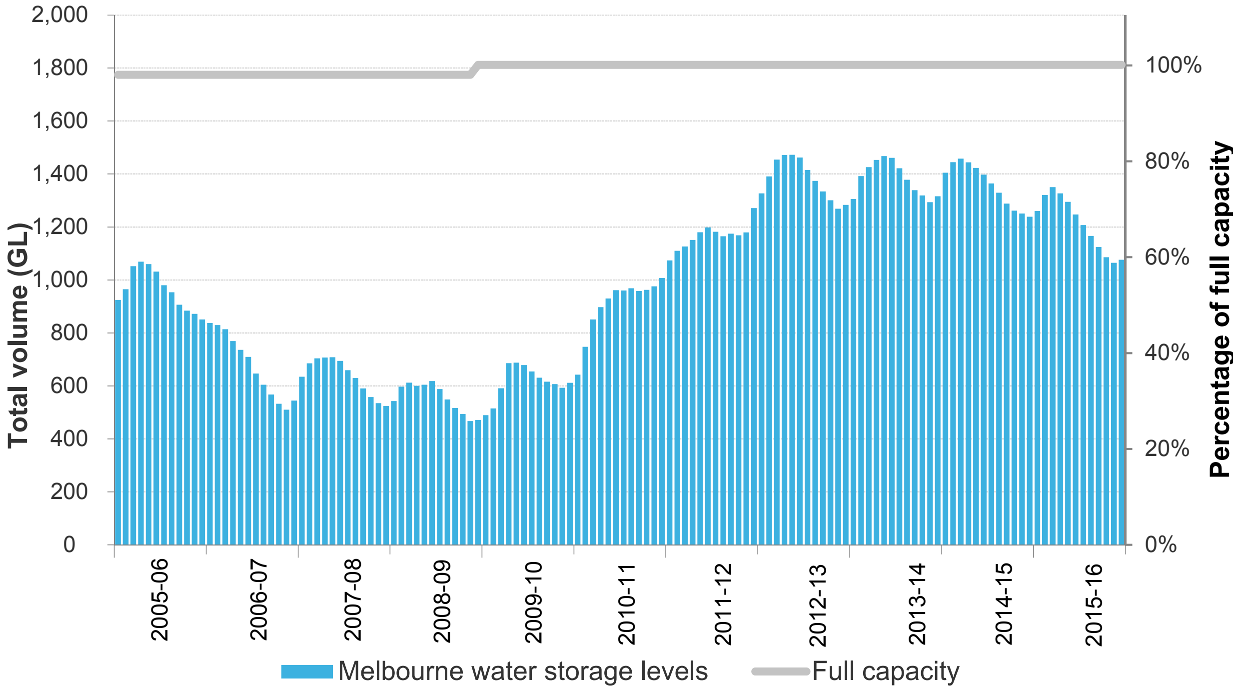
Notes:

(1) In April 2016, the Blue Rock Lake storages were revised following a bathymetric survey and reduced by 89,908 ML. This is reflected in the reduced total operating capacity of the regional storages.

(2) The 2015–16 total capacity value includes Victoria's inaccessible share of the Menindee Lakes (240,000 ML). This share was not included in the 2014–15 total capacity.

(3) The Y axis percentage relates to the current storage capacity (i.e. after the addition of the Menindee Lakes 240,000 ML).

Figure 2-9 Volume in Melbourne's water storages, 1 July 2004 to 30 June 2016 (1) (2)



Notes:

(1) The Tarago Reservoir became an active storage in 2010, adding 37,500 ML of storage volume to the Melbourne system's operating capacity.

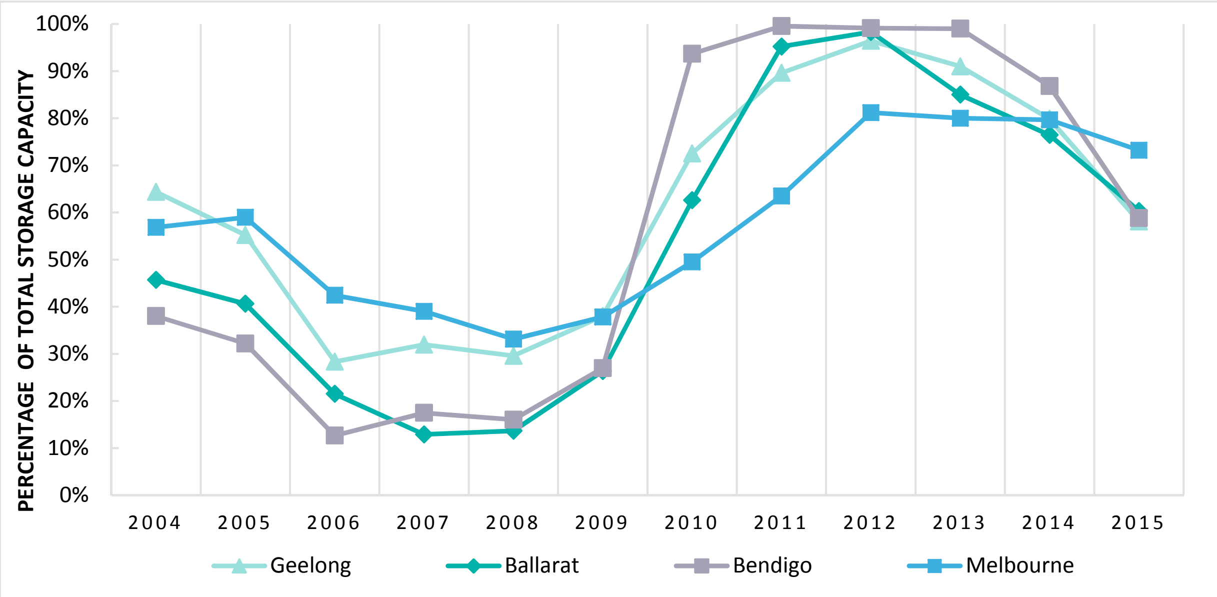
(2) The Y axis percentage relates to the current storage capacity (i.e. after the addition of Tarago's 37,580 ML).

The total volume of water stored in Victoria's major reservoirs has historically been at its highest following winter and spring inflows, so storage levels at the end of October are traditionally used as a good indication of water availability for the remainder of that year.

Figure 2-10 presents October storage levels as a percentage of storage capacity for Melbourne and selected major regional centres from October 2004 to October 2015.

During the Millennium Drought, October storage levels generally declined from 2003–07 (Figure 2-10) as inflows were not sufficient for systems to recover. A significant drop in levels occurred between 2005–06 and 2006–07, when winter and spring rainfall was extremely low across the state (Figure 2-10). By October 2010, storage levels had recovered significantly, with further recovery in 2011–12 across all major centres (Figure 2-10). At the end of October 2015, storages in Melbourne and the selected regional centres were between 58% and 99%. The regional storages were between 58% and 99%, which was on-average lower than the previous year when all regional storages were above 76%. Melbourne storages in October 2015 were at 73% of capacity, lower than the previous year of 80% (Figure 2-10).

Figure 2-10 Water in reservoirs for major urban centres at the end of October, each year 2004–15, as a percentage of total storage capacity



2.4 Groundwater

Groundwater is found in the spaces and fractures in rock and sediment beneath the ground's surface. Groundwater forms part of Earth's water cycle, when water from rainfall, surface water or snowmelt seeps from the surface into the groundwater. Groundwater flows (although only very slowly) and may eventually return to the surface either as springs, as baseflows to surface rivers and streams, lakes and wetlands, as evaporation or into the ocean. Groundwater supports groundwater-dependent ecosystems, human consumption and agricultural, commercial and industrial uses and contributes to environmental flows in streams.

Trends in groundwater levels reflect changes in aquifer storage resulting from differences between the amount of water flowing into (recharge) and out of (discharge) an aquifer. Groundwater level trends in shallow aquifers are more likely to reflect changes in recharge from either rainfall or irrigation, whereas deeper aquifer trends may show a greater influence from pumping.

Groundwater in Victoria is managed through groundwater management units (GMUs). A GMU may be classified as either as a water supply protection area (WSPA) — for which a statutory management plan approved by the Minister for Water is prepared — or a groundwater management area (GMA) — which may have a management plan approved by the relevant rural water corporation. There were several changes to GMUs in 2015–16 (chapter 3.2).

The State Observation Bore Network (SOBN) is the collection of bores used for monitoring the movement, availability and quality of Victorian groundwater as well as the linkages between groundwater and surface water systems throughout the state. The SOBN comprises about 1,400 bores that are monitored on a routine basis. Short-term groundwater level trends for GMUs have been determined based on five years' consistent monitoring data from key bores in the SOBN. Trend determinations are made quarterly, when each reading is compared with previous readings in the same season (that is, a summer record is compared with previous summer records) to account for seasonality. The bores for each GMU are selected on the basis of a number of factors including the length and quality of records available, the geographic distribution of bores and the maximum possible distance from irrigation bores (to minimise the influence of pumping on the groundwater levels recorded).

In 2015–16, groundwater level trends in many WSPAs and GMAs had changed from 2014–15. In most GMUs, groundwater level trends changed during the year from stable or rising in July 2015 to declining for the majority of systems in June 2016. Four of the state's WSPAs were categorised as stable, compared to seven in 2014–15 and eight were categorised as declining, compared to one in 2014–15 (Table 2-2 and Figure 2-11). In the state's GMAs, five were categorised as stable in 2015–16, compared to 12 in 2014–15, two areas were categorised as rising, compared with nine in 2014–15 and 21 were categorised as declining, compared to 5 in 2014–15 (Table 2-3 and Figure 2-12). Some key bores remained within historical limits, while others ended the year at historical lows. Management plans operate or are being developed for all areas of intensive use.

Table 2-2 Groundwater level trends in water supply protection areas

Water supply protection area [1]	Groundwater level trend 2015–16				Groundwater level trend June 2015
	September 2015	December 2015	March 2016	June 2016	
Condah	Declining	Declining	Declining	Declining	Declining
Glenelg	Stable	Stable	Stable	Declining	Stable
Katunga	Rising	Declining	Declining	Declining	Rising
Koo Wee Rup	Rising	Rising	Stable	Declining	Rising
Loddon Highlands	Rising	Stable	Declining	Declining	Rising
Lower Campaspe Valley	Stable	Declining	Declining	Declining	Stable
Murrayville	Stable	Stable	Stable	Stable	Stable
Sale	Stable	Stable	Stable	Stable	Stable
Upper Ovens	Declining	Declining	Declining	Stable	Stable
Warrion	Declining	Declining	Declining	Declining	Rising
Wy Yung	Rising	Stable	Stable	Stable	Rising
Yarram [2]	Declining	Declining	Declining	Declining	Stable

Notes:
(1) Nullawarre, Shepparton Irrigation Region and Yangery WSPAs were abolished in 2014–15.
(2) Yarram WSPA water levels are influenced by off-shore oil and gas extraction.

Figure 2-11 Groundwater trends in water supply protection areas

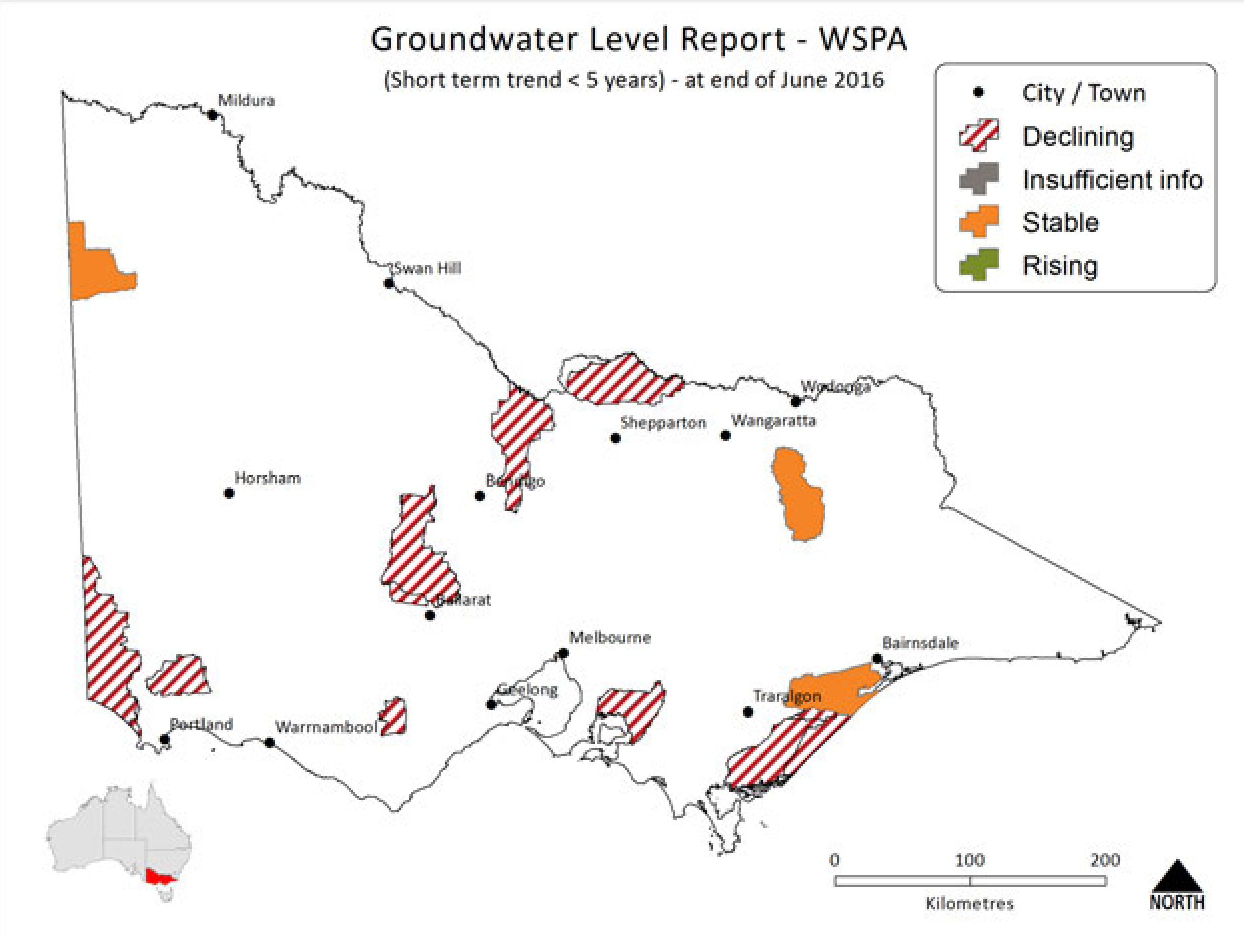


Table 2-3 Groundwater level trends in groundwater management areas

Groundwater management area (1)	Groundwater level trend 2015–16				Groundwater level trend June 2015
	Sep-15	Dec-15	Mar-16	Jun-16	
Bungaree (2)	Declining	Declining	Declining	**Declining**	Stable
Cardigan	Declining	Stable	Declining	**Declining**	Rising
Corinella	Stable	Rising	Stable	**Declining**	Rising
Deutgam (3)	Declining	Declining	Declining	**Declining**	-
Frankston	Rising	Stable	Stable	**Declining**	Rising
Gellibrand	Declining	Stable	Stable	**Declining**	Declining
Gerangamete	Rising	Rising	Rising	**Declining**	Stable
Giffard	Declining	Stable	Declining	**Declining**	Stable
Jan Juc	Declining	Declining	Declining	**Declining**	Declining
Lancefield	Declining	Stable	Declining	**Declining**	Rising
Leongatha	Declining	Stable	Declining	**Declining**	Declining
Lower Ovens	Declining	Declining	Declining	**Declining**	Stable
Merrimu	Declining	Declining	Declining	**Declining**	Stable
Mid-Goulburn (4)	Declining	Stable	Stable	**Declining**	Rising
Mid-Loddon	Declining	Declining	Declining	**Declining**	Rising
Moe	Declining	Declining	Declining	**Declining**	Declining
Mullindolingong	Declining	Stable	Declining	**Declining**	Rising
Nepean	Stable	Stable	Stable	**Declining**	Stable
Newlingrook	Stable	Stable	Stable	**Declining**	Stable
Orbost	Stable	Rising	Stable	**Declining**	Rising
Paaratte	Declining	Stable	Stable	**Rising**	Stable
Rosedale (5)	Declining	Declining	Declining	**Rising**	Stable
Shepparton Irrigation (6)	Declining	Rising	Declining	**Stable**	-
Stratford (5)	Declining	Declining	Declining	**Stable**	Declining
Tarwin	Declining	Stable	Stable	**Stable**	Stable
Wa De Lock	Declining	Stable	Rising	**Stable**	Rising
Wandin Yallock (2)	Declining	Declining	Declining	**Declining**	Rising
West Wimmera	Stable	Stable	Stable	**Stable**	Stable

Notes:

(1) The following groundwater management areas have been omitted from this table due to insufficient state observation bores to adequately define the groundwater resource or changes to the resource over time: Alexandra, Barnawartha, Colongulac, Cut Paw Paw, Glenormiston, Heywood, Kiewa, Kinglake, Moorabbin, Portland, South West Limestone and Upper Murray. Hawkesdale and Heywood GMAs were incorporated into the South West Limestone GMA.

(2) The WSPA status of Bungaree and Wandin Yallock were revoked in December 2016.

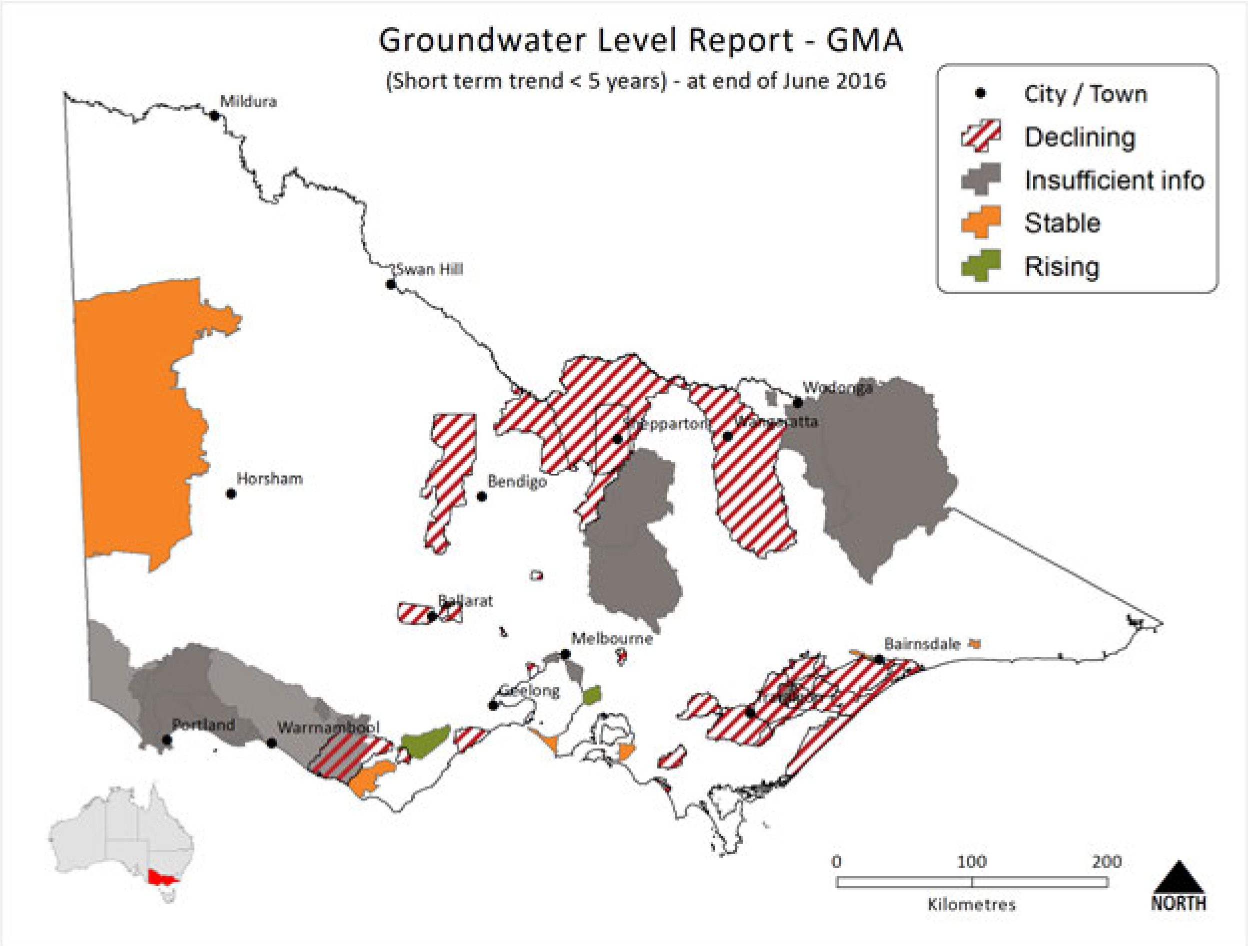
(3) The Deutgam GMA LMP was approved on 7 May 2015.

(4) The Mid-Goulburn GMA LMP was approved on 13 November 2014.

(5) Rosedale and Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.

(6) The Shepparton Irrigation Region GMA LMP was approved on 3 June 2015.

Figure 2-12 Groundwater trends in groundwater management areas

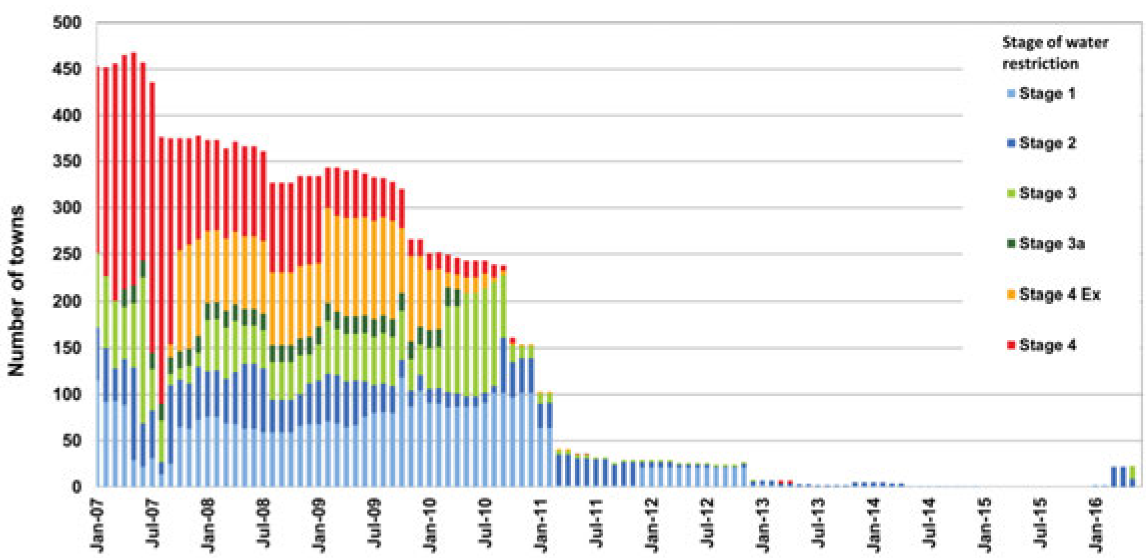


2.5 Response to water availability

2.5.1 Urban water restrictions

From July to December 2015, there were no Victorian towns on water restrictions. Between January and June 2016, 35 towns were on restrictions. The restrictions were applied by Barwon Water, South Gippsland Water and Grampians Wimmera Mallee Water. For all towns restrictions were removed by the end of June 2016. More than 450 towns were subject to restrictions at the peak of the Millennium Drought in 2007 (Figure 2-13).

Figure 2-13 Number of towns and severity of water restrictions, Victoria, February 2007 to June 2016



* The restriction policy outlined in 1.5.1 was implemented in 2011 to standardise the application of water restrictions throughout the state, prior to this water corporations could use other restriction levels Stage 3a and Stage 4ex.

Central region and Melbourne metropolitan area

During March 2016, Barwon Water applied urban water restrictions on the Colac supply system (which supplies 11 towns) and the Lorne supply system (which supplies one town). On 1 May 2016, Barwon Water raised the level of restrictions on its Lorne and Colac supply systems and applied restrictions for the Apollo Bay supply system (which supplies three towns) to stage 3. Later in the month, the restrictions on Lorne were removed as above-average rain caused storage levels to recover. On 10 June 2016, Barwon Water removed the stage 3 restrictions on its Colac and Apollo Bay supply systems.

Metropolitan Melbourne and all other towns in the Central region remained on permanent water saving rules.

Northern region

All towns in the Northern region were subject to permanent water saving rules throughout 2015–16, but no water restrictions were applied.

Western region

In March 2016, Grampians Wimmera Mallee Water applied stage 4 restrictions in 10 towns to control demand due to water quality issues resulting from a blue-green algal bloom in the Murray River. Stage 4 restrictions were in place for two weeks so do not show up on the figure 2-13 which shows restrictions in place at the end of the month. Also in March, Grampians Wimmera Mallee Water placed Stawell and four towns supplied from the Willaura supply system on stage 2 restrictions. Restrictions due to blue green algae were lifted in late March and the other restrictions were lifted in June 2016. All other towns remained on permanent water saving rules.

Gippsland region

On 14 January 2016, South Gippsland Water implemented stage 1 restrictions for Korumburra and Fish Creek, due to low reservoir levels and high demand. These restrictions were changed to stage 2 in March. At the same time, stage 2 restrictions were introduced in the Little Bass supply system, which supplies three towns. Restrictions were in place until the end of June 2016, when restrictions in all five towns were removed.

The remaining Gippsland region towns were subject to permanent water saving rules throughout 2015–16.

Table 2-4 Urban water restrictions in 2015–16

Water corporation	Water system and towns	Level of water restrictions in 2015–16
Central region		
Barwon Water	15 towns	Stage 2 – 3 restrictions
	All other towns	PWSR applied all year, all other towns
Central Highlands Water	All towns	PWSR applied all year
Melbourne metropolitan retailers (Yarra Valley Water, South East Water, City West Water)	Metropolitan Melbourne	PWSR applied all year
Southern Rural Water (Werribee and Bacchus Marsh systems)	All towns	PWSR applied all year
Westernport Water	All towns	PWSR applied all year
Western Water	All towns	PWSR applied all year
Northern region		
Coliban Water	All towns	PWSR applied all year
Goulburn Murray Water	All towns	PWSR applied all year
Goulburn Valley Water	All towns	PWSR applied all year
Lower Murray Water	All towns	PWSR applied all year
North East Water	All towns	PWSR applied all year
Western region		
Grampians Wimmera Mallee Water	15 towns	Stage 2 – 4 restrictions
	All other towns	PWSR applied all year
Wannon Water	All towns	PWSR applied all year
Gippsland region		
East Gippsland	All towns	PWSR applied all year
South Gippsland Water	5 towns	Stage 1 – 2 restrictions
	All towns	PWSR applied all year
Gippsland Water	All towns	PWSR applied all year
Southern Rural Water (Macalister system)	All towns	PWSR applied all year

Note:
PWSR: permanent water saving rules.

2.5.2 Seasonal allocations in regulated systems

In the declared systems of northern Victoria, only the Murray system reached 100% allocation for high-reliability entitlement in 2015–16, compared to the previous year when all system reached 100% allocation for high-reliability entitlement. The 2015–16 year was much drier (Table 2-5). None of the systems in northern Victoria received low-reliability allocation in 2015–16.

In southern Victoria the Thomson–Macalister irrigation system reached 100% for high-reliability entitlement and 20% low-reliability entitlement. The Werribee and Bacchus Marsh system was much drier and allocations only reached 15% high-reliability entitlement. There was no allocation made available for low-reliability entitlement in the Werribee and Bacchus Marsh system.

Table 2-5 Seasonal water allocations in regulated water systems

Water system	Water shares	2015–16			2014–15
		Initial allocation (1) (% of entitlement)	Mid-season allocation (2) (% of entitlement)	Final allocation (3) (% of entitlement)	Final allocation (% of entitlement)
Northern declared systems					
Murray	High reliability	50	100	**100**	**100**
	Low reliability	0	0	**0**	**0**
Goulburn	High reliability	58	90	**90**	**100**
	Low reliability	0	0	**0**	**0**
Broken	High reliability	0	26	**26**	**100**
	Low reliability	0	0	**0**	**100**
Campaspe	High reliability	50	64	**66**	**100**
	Low reliability	0	0	**0**	**0**
Loddon	High reliability	44	80	**84**	**100**
	Low reliability	0	0	**0**	**0**
Bullarook	High reliability	0	8	**8**	**100**
	Low reliability	0	0	**0**	**100**
Southern declared systems					
Thomson–Macalister	High reliability	100	100	**100**	**100**
	Low reliability	0	10	**20**	**20**
Werribee and Bacchus Marsh	High reliability	10	15	**15**	**70**
	Low reliability	0	0	**0**	**0**
Non-declared systems					
Wimmera-Mallee	Pipeline product	0	15	**16**	**48**
Coliban Rural	Rural licences	100	100	**100**	**100**

Notes:

(1) Allocations in August are provided as an indication of the initial allocation for the season.

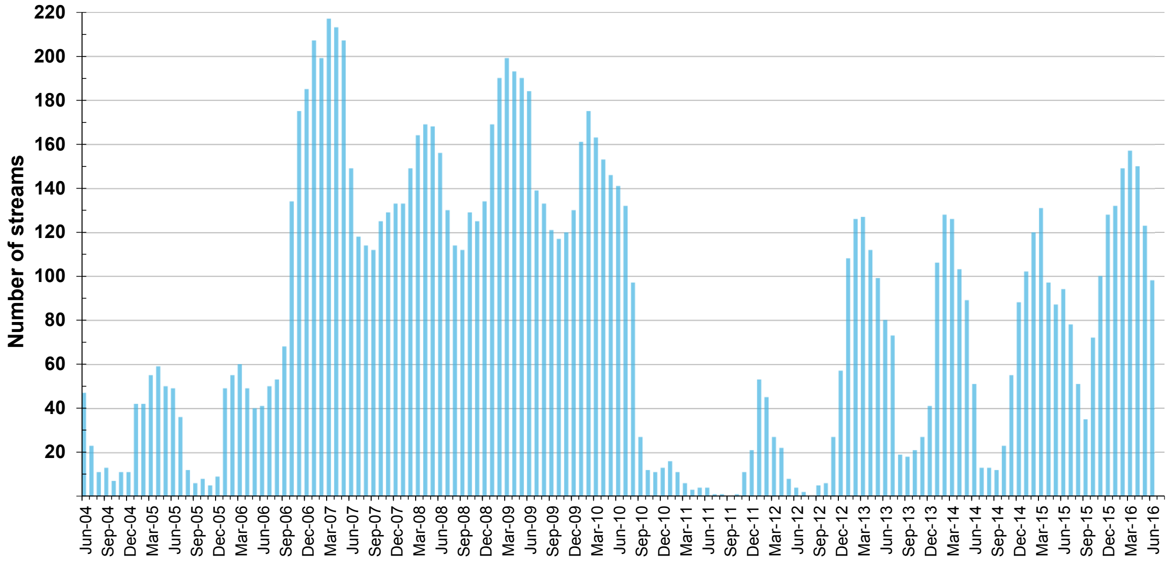
(2) Allocations in February are provided as an indication of mid-season allocations.

(3) GMW (Northern Victoria Resource Manager) announces final allocations in April while Southern Rural Water and the Wimmera-Mallee Storage Manager announce final allocations in June.

2.5.3 Restrictions on diversions from unregulated streams

The number of streams on restrictions and bans reached 157 in March 2016, compared to 131 in the previous year. Victoria had its warmest autumn on record, and this was reflected in the higher number of restrictions. There were still 123 streams subject to restrictions in May 2016, compared to 87 at the same time in the previous season. There were 98 streams on restrictions at the end of 2015–16.

Figure 2-14 Number of Victorian unregulated streams on restrictions, June 2004 – June 2016



2.5.4 Groundwater management and seasonal allocations

In 2015–16, four groundwater management units were subject to restrictions on groundwater use. As in the previous year, Katunga WSPA received a seasonal allocation of 70% in all zones, while Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) received an 80% seasonal allocation for 2015–16, compared to 84% in 2014–15. Newlyn, a trading zone of the Loddon Highlands WSPA, was restricted to 75% for 2015–16, while Deutgam WSPA received a seasonal allocation of 50% during 2015-16.

2.5.5 Water carting

Water carting is an option which water corporations use to augment town supplies when local sources cannot meet demand. Doing so can be a time-consuming and expensive exercise and is usually only a last resort to supply smaller towns. In recent years, water carting has been required to address water scarcity, particularly during drought periods. In 2015–16, water carting was used by four water corporations:

- Barwon Water (provided to Wye River and Separation Creek for drinking water)
- Central Highlands Water (the Amphitheatre system [Avoca basin] received 1 ML as a drought response)
- Gippsland Water (demand in Thorpdale was met by water carting and this is now the regular supply option)
- Grampians Wimmera Mallee Water (reverse pumping and water carting helped to maintain supply to Berriwillock, Chinkapook, Chillingollah, Culgoa, Lalbert, Mangangatang, Mnullawil, Sea Lake, Ultima and Waichie when a blue-green algae event in the Murray River affected the northern Mallee supply operations).

2.5.6 Temporary qualification of rights to water

The Minister for Water did not qualify any rights to water in 2015–16.

3 Water for consumptive use

Water for consumptive use in Victoria is taken from reservoirs, streams and aquifers under entitlements issued and authorised under the *Water Act 1989*, as explained in chapter 1.

Generally, water for consumptive use is allocated to either water corporations (which are granted bulk entitlements) or to individuals (who are issued a water share or a take and use licence).

In addition to formally issued entitlements, the Act enables individuals to take water for domestic and stock use from a range of surface water and groundwater sources without a licence (for example, from a small catchment dam). These domestic and stock rights are defined in section 8 of the Act and are not formally licensed.

Small catchment dams can be either registered and licensed or unlicensed, depending on the use and capacity. Where the capacity is small and use is restricted to domestic household and stock watering, then this is unlicensed consistent with section 8 of the Act. Where the capacity is larger and/or use is for commercial purposes including irrigation then the dam must be registered and licensed.

As well as consumptive uses, the Act provides for water to be used for environmental purposes (chapter 4).

Table 3-1 shows the volume of water defined in entitlements for consumptive use in Victoria in 2015–16 and 2014–15. This report does not include an estimate of the volume of domestic and stock use pumped from a waterway. The total volume of consumptive entitlements changes each year as new entitlements are issued or existing entitlements are modified. All basins in the state have a cap which limits the volume of water which can be allocated. Most basins have reached the cap and allocated all available water within the limit and thus only a minor change in the total number of entitlements will occur from one year to the next. In catchments which have reached the cap, no new entitlements are created unless water savings are made. In a system which has reached its cap the only way for a customer to get more entitlement is to purchase it from someone selling unwanted or unused entitlement. The cap and trade system ensures no net increase in entitlements in a catchment which has reached the cap.

Table 3-1 Consumptive water entitlements in Victoria, 2015–16 and 2014–15

Entitlement type	Volume 2015–16 (ML)	Volume 2014–15 (ML)
Surface water		
Bulk entitlements (1)	5,578,347	5,575,502
Licences (2)	275,756	305,573
Small catchment dams (3)	434,974	522,949
Total surface water entitlements	**6,289,077**	**6,404,024**
Groundwater		
Licences	958,647	947,323
Bulk entitlements	10,000	10,000
Total groundwater entitlements	**968,647**	**957,323**
Total entitlements	**7,257,724**	**7,361,347**

Notes:

(1) Bulk entitlement volumes are represented as the volume that can be taken in a one-year period. They are not adjusted to reflect trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the Victorian Environmental Water Holder are not included as water taken under these entitlements is not considered to be for consumptive purposes.

(2) Includes licences issued for unregulated rivers only. The volume of licences within regulated water supply systems is not included as these licences are included under rural water businesses' bulk entitlements.

(3) This includes small catchment dams required to be licensed or registered under the *Water Act 1989* as well as the volume estimated for domestic and stock use however excluding domestic and stock use pumped from a waterway. The total entitlement volume is assumed to be equal to the estimate of total water taken by small catchment dams for the year.

The availability and use of Victoria's water resources for 2015–16 is summarised in Table 3-2.

The volume of water taken or the water use data presented in this overview and in the Victorian water accounts is reported as the volume of water diverted from a water source. It is the bulk volume of water extracted from a stream or groundwater bore. It is not the use on a farm or in a town.

Overall, the total available volume of Victoria's surface water, groundwater and recycled water in 2015–16 was14,255,141 ML. Of this, 4,398,170 ML was taken for consumptive purposes.

The volume of surface water taken in 2015–16 was 61% of the total entitlement volume.

Table 3-2 Victoria's water availability and water taken for consumptive use, 2015–16

Water source	Available resource (ML)	Total entitlements (ML)	Total taken (ML)
Surface water (1)	12,967,156	6,289,077	3,845,195
Groundwater (2)	837,923	968,647	457,374
Recycled water (3)	450,062	n/a	95,600
Total	**14,255,141**	**7,257,724**	**4,398,170**

Notes:

(1) The volume of available surface water resources is assumed to be the volume of catchment inflow for all Victorian basins, as determined in the surface water balance for each basin presented in chapter 6.

(2) The actual groundwater resource (that is, the volume of water in aquifers) is unknown. The total resource has been assumed to be the sum of the allocation limit of each GMU.

(3) The volume of available recycled water is assumed to be the volume of wastewater produced at treatment plants.

n/a: not applicable

3.1 Surface water entitlements and use

The following provides an overview of surface water taken under consumptive entitlements across Victoria.

Table 3-3 summarises the volume of water taken under bulk entitlements, licences and small catchment dams in each basin in 2015–16. Part 2 has more detail on diversions under surface water entitlements in each basin.

The difference in bulk entitlement volumes from 2014–15 to 2015–16 is attributed to changes explained above and is described in detail in chapter 6 for each basin. Environmental entitlements are outlined separately in chapter 4, as they are not consumptive use entitlements.

The volume of water taken under bulk entitlements in 2015–16 was 60% of the total volume of bulk entitlements, and the volume of water taken under take and use licences was 26% of the total volume of licences.

Table 3-3 Volume of surface water entitlements and volume and percentage taken for consumptive use, 2015–16

Basin	Bulk entitlements [1]			Licences [2]			Small catchment dams [3]
	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Entitlement volume (ML)	Volume taken (ML)	Proportion of entitlement taken (%)	Volume taken (ML)
Murray	1,914,632	1,355,179	71%	16,396	3,747	23%	12,000
Kiewa	1,106	527	48%	15,632	4,571	29%	7,440
Ovens	50,426	13,667	27%	17,060	4,405	26%	23,754
Broken	25,279	10,334	41%	2,822	764	27%	16,766
Goulburn	1,892,768	1,074,257	57%	24,359	6,329	26%	47,106
Campaspe	105,648	46,549	44%	3,224	707	22%	22,032
Loddon	125,594	15,136	12%	22,215	5,036	23%	39,361
East Gippsland	622	104	17%	659	56	9%	711
Snowy	2,201	718	33%	3,962	471	12%	2,811
Tambo	342	24	7%	4,150	228	5%	3,661
Mitchell	9,208	4,104	45%	16,385	7,508	46%	4,517
Thomson [4]	395,896	417,447	105%	17,239	4,991	29%	5,475
Latrobe	221,692	85,571	39%	18,915	7,592	40%	22,802
South Gippsland [5]	168,887	7,902	5%	12,824	3,889	30%	28,387
Bunyip	36,595	18,702	51%	18,918	5,545	29%	32,837
Yarra	400,000	191,332	48%	42,793	8,356	20%	17,346
Maribyrnong	10,711	6,253	58%	2,086	288	14%	6,876
Werribee	38,262	14,255	37%	1,021	12	1%	5,484
Moorabool	40,600	9,199	23%	3,567	963	27%	13,012
Barwon	55,733	33,013	59%	5,515	1,767	32%	20,793
Corangamite	0	0	0%	1,177	98	8%	8,365
Otway Coast	19,667	13,865	70%	6,704	855	13%	15,556
Hopkins	629	206	33%	11,084	2,458	22%	21,446
Portland Coast	0	0	0%	1,078	4	0%	3,847
Glenelg	4,554	1,743	38%	1,044	74	7%	18,899
Millicent Coast	0	0	0%	4	4	100%	5,609
Wimmera	57,016	18,966	33%	2,234	387	17%	18,310
Mallee	0	0	0%	0	0	0%	8
Avoca	278	23	8%	2,689	40	1%	9,765
Total	**5,578,347**	**3,339,077**	**60%**	**275,756**	**71,144**	**26%**	**434,974**

Notes:

(1) Bulk entitlement volumes are represented as the volume that can be taken in a one-year period. They are not adjusted to reflect trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the Victorian Environmental Water Holder are not included as water taken under these entitlements as they are not considered to be for consumptive purposes.

(2) Includes only take and use licences issued for unregulated rivers. Licences within regulated water supply systems are not included as they are part of rural water corporations' bulk entitlements.

(3) Not all small catchment dams are required to be licensed or registered under the Act (for example, farm dams for domestic and stock use); the estimated volume of water used is presented.

(4) While the volume taken in the Thomson basin exceeded the annual entitlement volume, it did not exceed the average annual volume of diversions over the relevant long-term rolling average. See Table 6-79 for further details.

(5) The bulk entitlement volume for the South Gippsland basin includes 150,000 ML of entitlement from the desalination plant. The volume is reported in this basin as the plant is physically located in the South Gippsland basin.

During 2015–16 some bulk entitlements were amended to change the volume of water available or to change the operating rules. All changes to bulk entitlements are administered under Part 4, Division 1 of the Act and require consultation and consideration of matters including impact on existing users and the environment.

During 2015–16, the bulk entitlements and the environmental entitlement in the Latrobe regulated system were amended. Southern Rural Water surveyed the capacity of Blue Rock Reservoir and confirmed its current capacity was 198,280 ML, less than the 208,188 ML previously recorded. The reduced storage capacity slightly decreased the reliability of the eight Latrobe bulk and environmental entitlements. The entitlement holders collectively agreed to increase their entitlement shares to retain their original reliability and offset this by reducing the share set aside in the reservoir for the Latrobe drought reserve.

Minor amendments were made to Lower Murray Water's River Murray irrigation bulk entitlement, the changes were required to enable 1,053 ML of high-reliability water shares to be transferred to the Commonwealth Environmental Water Holder in line with funding arrangements and works programs for the Sunraysia Modernisation Project. This was enabled by reducing the Lower Murray Water loss allowance.

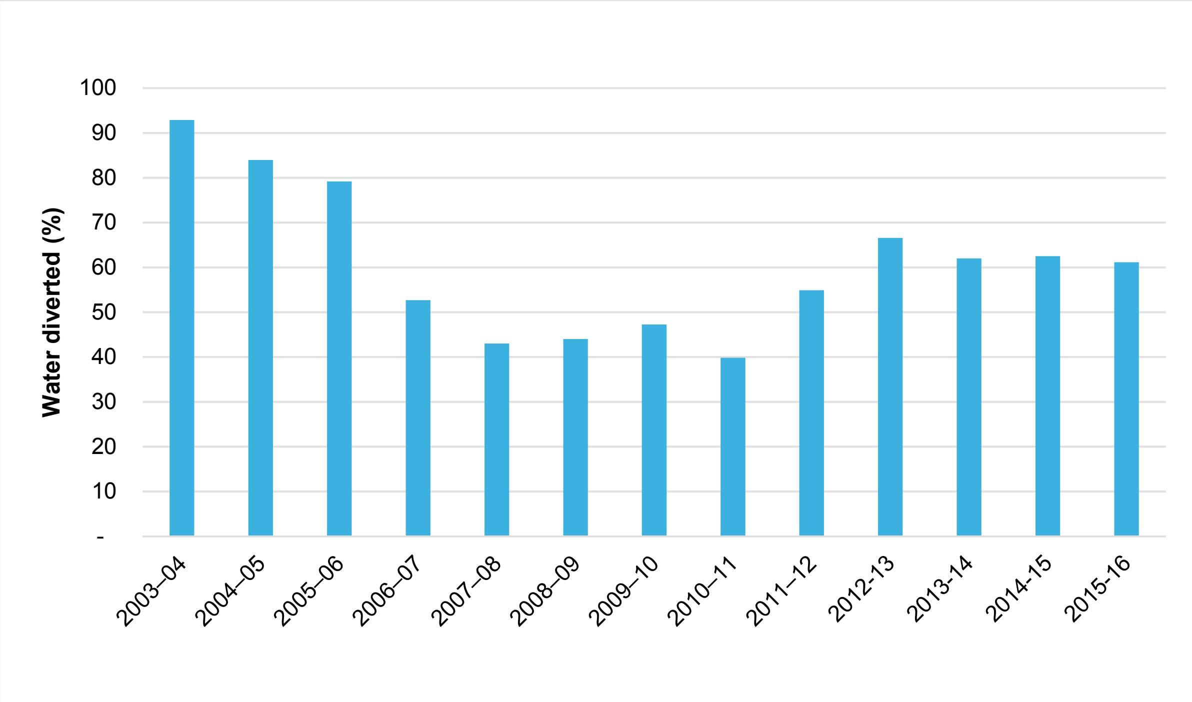
An amendment to Westernport Water's Candowie reservoir bulk entitlement was required to give Westernport Water some operational tolerance and flexibility in delivering environmental releases and to require Westernport Water and the Melbourne Water to agree to operating arrangements. Figure 3-1 shows the volume of water taken under surface water entitlements in the past 10 years.

In any given year, there is typically a gap between the total volume of entitlements — water that can be legally used — and the actual volume of water taken. This is due to a range of reasons including:

- dry climatic conditions (so there is not enough water available to take the total volume of entitlements)
- wet climatic conditions (so there is reduced need to take the total volume of entitlements)
- individual entitlement holders choosing not to take all the water they have a right to use.

The lower water use over the period 2006–07 to 2009–10 is a reflection of the extremely dry climatic conditions and limited water availability during the Millennium Drought. During this period, restrictions on water use by urban customers, low seasonal allocations in the irrigation districts and rosters and restrictions on licensed diversions from unregulated streams were widespread. In contrast, the low water use recorded in 2010–11 and 2011–12 is a reflection of suppressed demand for water due to the wet conditions experienced during these years. The proportion of water taken relative to the total volume of entitlements was 61% in 2015–16, a decrease from 62% in 2014–15.

Figure 3-1 Percentage of entitlement volume diverted for consumptive use



Surface water entitlements are used for many different purposes, but they can broadly be classified according to the following end uses of water:

- irrigation (agriculture)
- domestic and stock (rural household use and stock watering)
- urban (town water supply for households and businesses) and commercial (major non-agricultural water use)
- power generation (a separate category, due to the water-intensive nature of its operations).

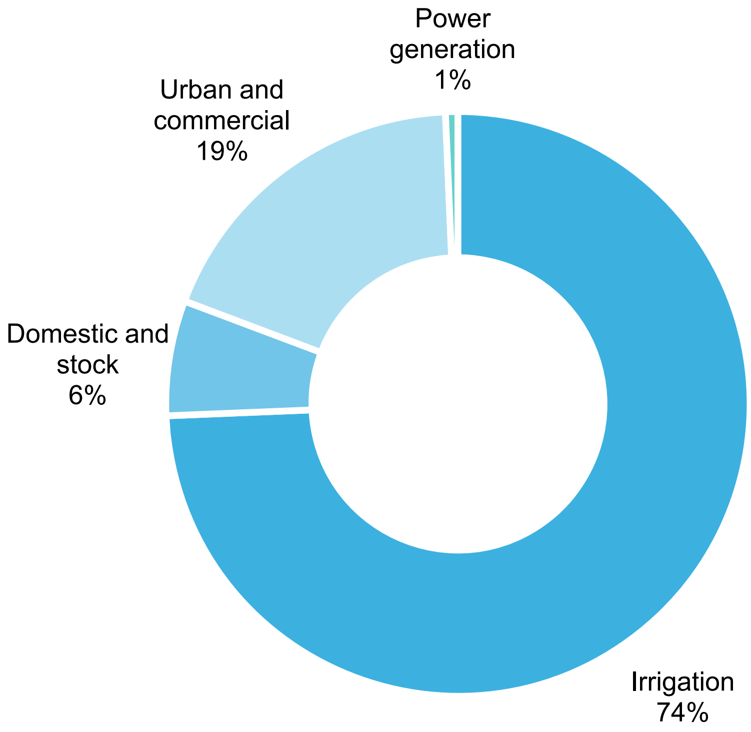
As shown in Table 3-4, the volume of water taken for consumptive use under surface water entitlements in 2015–16 was less than in 2014–15. Part of the difference is due to updated data for small catchment dam capacity values, the volume reported as diverted from small catchment dams increased by 87,974 ML. The updated small catchment dam information changed total volumes for domestic and stock dams and irrigation dams. This explains most of the differences in irrigation versus domestic and stock across the two years (Table 3-4). For more information, see Appendix E. The remaining 12,752 ML of difference is a more comparable indication of the difference in water usage from 2014–15 to 2015–16.

Irrigation continues to be the largest consumptive use of surface water in the state, comprising 74% of all water taken, as shown in Figure 3-2.

Table 3-4 Volume of water taken for consumptive use under surface water entitlements

Consumptive end use	2015–16		2014–15	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation	2,858,727	74%	3,148,568	80%
Domestic and stock	245,238	6%	164,762	4%
Urban and commercial	715,074	19%	606,833	15%
Power generation	26,157	1%	25,759	1%
Total	**3,845,196**	**100%**	**3,945,922**	**100%**

Figure 3-2 Percentage of water taken for different consumptive uses under surface water entitlements, Victoria, 2015–16



3.2 Groundwater entitlements and use

In 2015–16, some groundwater management units (GMUs) had their status revoked and some were approved. The Wandin Yallock and Bungaree WSPAs were revoked, while the Deutgam and mid-Goulburn local management plans were approved. The *South West Limestone GMA Management Plan* was also introduced by Southern Rural Water, replacing the four GMUs that were abolished in 2014–15 (Nullawarre and Yangery WSPAs and Hawkesdale and Heywood GMAs). The South West Limestone GMA is based on the broader aquifer system (of the sedimentary plain in the Otway-Torquay groundwater basin) and provides a more consistent approach to the management of groundwater resources.

Full details of water entitlements and use from each GMA and WSPA in 2015–16 are in Appendix C.

In 2015–16, total groundwater licensed entitlement was 968,647 ML across the state. The total groundwater use across the state including domestic and stock use was about 457,374 ML, which was more than the volume used in 2014–15 (404,974 ML).

There are 29,789 stock and domestic bores in Victoria. Domestic and stock use (48,349 ML) was estimated to account for about 11% of total groundwater use.

In Victoria's GMAs, licensed groundwater entitlements totalled 616,704 ML with total use of 275,862 ML. Licensed groundwater entitlements in WSPAs totalled 252,206 ML with total use of 150,636 ML of metered extractions.

The volume of groundwater entitlements outside defined a GMU (that is, in unincorporated areas) was 99,737 ML with 30,876 ML extracted.

The total volume of groundwater extracted for urban use in 2015–16 was 11,125 ML, which was about 2% of the total groundwater extracted.

A total of 73 cities and towns have a groundwater entitlement for primary or supplementary water supply. In 2015–16, 57 of these cities and towns recorded some level of groundwater extraction. The largest urban users were Portland, Sale and Geelong each with extraction of between 1,800 ML and 1,900 ML.

Figure 3-3 shows the location of towns where groundwater is used for urban water supply.

Figure 3-3 Location of towns where groundwater is extracted for urban supply

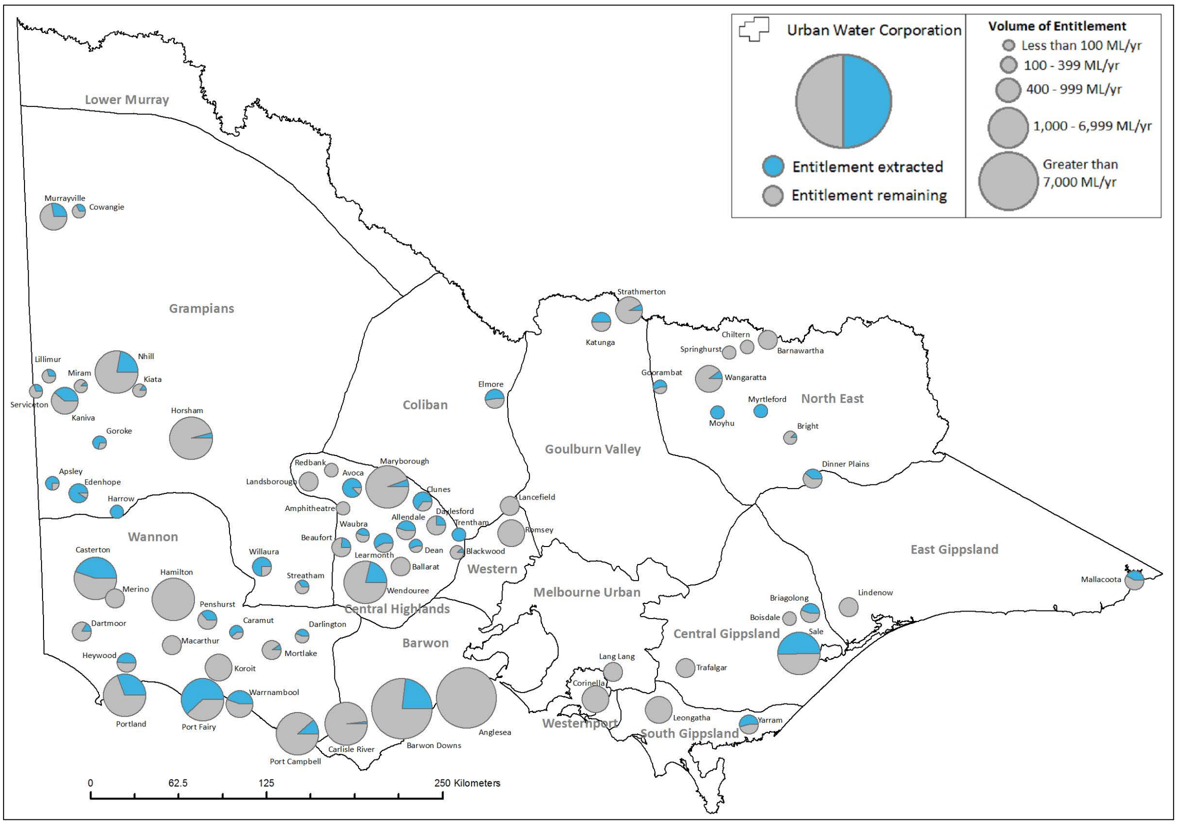
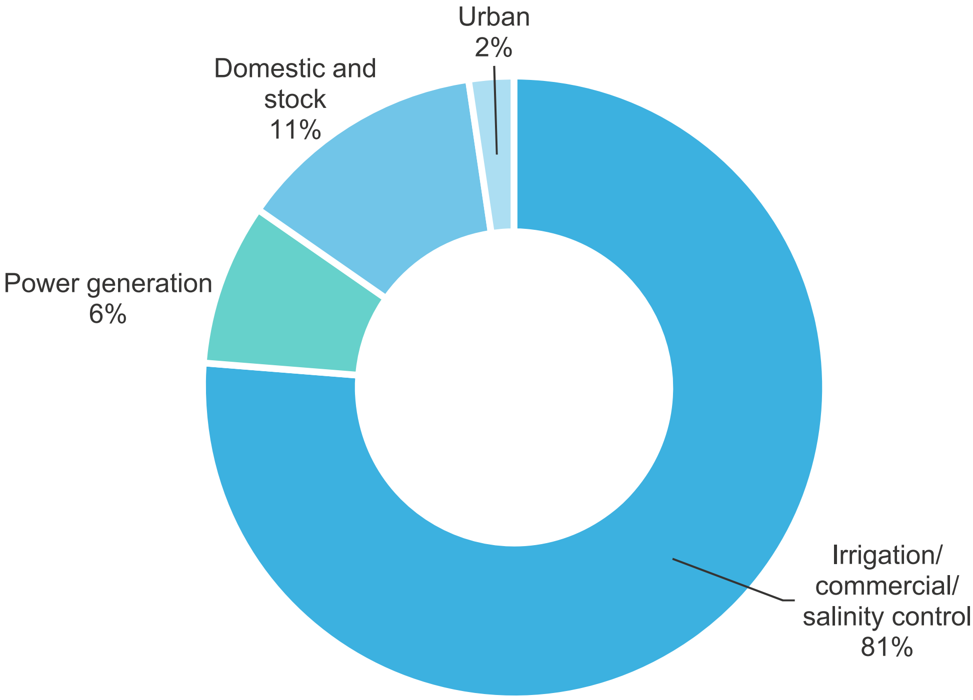


Table 3-5 and Figure 3-4 show the groundwater extraction by type of use in 2015–16.

Table 3-5 Groundwater extraction by type of end use, 2015–16

Consumptive end use	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation / commercial / salinity control	370,896	81
Domestic and stock	48,349	11
Urban	11,125	2
Power generation	27,004	6
Total consumptive diversions 2015–16	**457,374**	**100**
Total consumptive diversions 2014–15	**404,974**	**100**

Figure 3-4 Groundwater extraction by type of end use, 2015–16



3.3 Recycled water production

The total volume of 450,062 ML of wastewater produced in 2015–16 was higher than the 423,024 ML produced in 2014–15 (Table 3-6). The volume of water recycled by Victoria's water corporations increased marginally from the previous year, however use external to treatment plants was slightly lower than the in 2014–15. In 2015–16 use external to treatment plans was 76,615 ML, which was less than 76,896 ML recycled for external uses in 2014–15. An additional 18,985 ML was recycled for use within wastewater treatment process. The volumes and percentages only refer to recycled water supplied for use external to the wastewater treatment plants.

The volume of water recycled in Melbourne, which is defined as water treated in the Bunyip, Werribee and Yarra basins, was 39,583 ML or 12%. The percentage of recycled water was higher outside Melbourne where weather conditions, the availability of land and access to potential purchasers (that is, agricultural producers) are more favourable. Excluding the wastewater recycled in Melbourne, the remainder of the state recycled 31% (or 37,032 ML) of the wastewater available for reuse. This was slightly higher than in 2014–15, when it was 34,273 ML.

A significant portion of recycled water production occurs at two treatment plants: the Eastern Treatment Plant in the Bunyip basin and the Western Treatment Plant in the Werribee basin. In 2015–16, the volume of water recycled by the Eastern Treatment Plant was 17,132 ML, which was an increase on the 13,713 ML recycled in 2014–15. This increase is attributable largely to the provision of recycled water to the Melbourne urban water retailers South East Water and the private sector operator TopAq, who then sold it to end users for urban and commercial purposes. This volume increased from 5,531 in 2014–15 to 7,623 in 2015–16. Under the Eastern Irrigation Scheme, Melbourne Water sells Class C recycled water to private sector operator TopAq, which further treats the water to Class A standard and delivers the water to horticultural, recreational and industrial users.

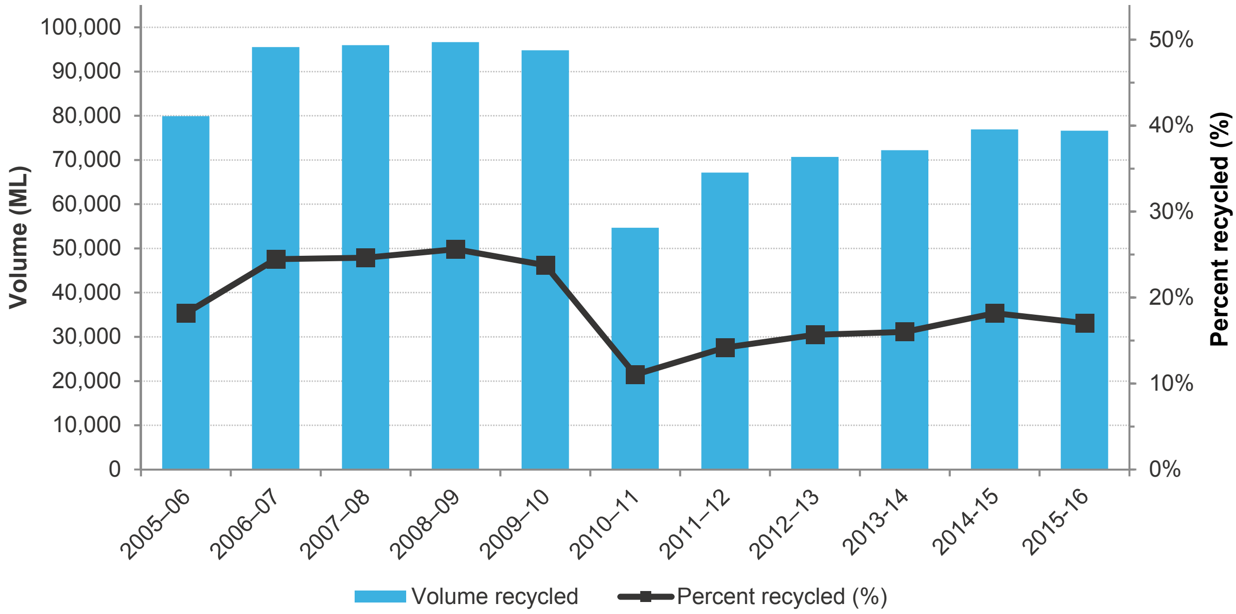
The volume of water recycled by the Western Treatment Plant decreased from 32,996 ML in 2014–15 to 25,753 ML in 2015–16. The reduction was mainly due to a drop of 14,259 ML in the volume of water used for conservation flows on-site due to changes in processes at the Western Treatment Plant. This was somewhat offset by an increase of 7,083 ML of recycled water used by Southern Rural Water, and agriculture on site.

Table 3-6 Volume of wastewater recycled, 2015–16

Basin	Wastewater produced (ML)	Volume of wastewater recycled (ML)	Percentage of wastewater recycled (%)	End uses of recycled water					Volume discharged to the environment (ML)	Released to ocean/Other (ML)
				To retailers	Urban and industrial	Agriculture	Beneficial allocation [1]	Within process [2]		
Avoca	133	133	100%	0	47	85	0	0	0	0
Barwon	31,486	5,218	10%	0	949	1,822	335	2,112	8,206	18,063
Broken	436	436	100%	0	0	436	0	0	0	0
Bunyip	145,687	21,214	15%	7,623	2,466	837	0	10,289	858	123,616
Campaspe	2,159	1,774	82%	0	314	1,459	0	1	385	0
Corangamite	1,709	256	15%	0	17	239	0	0	1,453	0
East Gippsland	100	100	100%	0	0	100	0	0	0	0
Glenelg	746	746	100%	0	154	592	0	0	0	0
Goulburn	7,737	6,893	89%	0	589	6,305	0	0	844	0
Hopkins	6,028	1,016	14%	0	207	657	0	153	0	5,012
Kiewa	321	132	41%	0	8	124	0	0	189	0
Latrobe	21,276	690	3%	0	46	61	583	0	3,450	17,136
Loddon	8,110	2,790	34%	0	1,460	1,330	0	0	4,944	377
Mallee	0	0	0%	0	0	0	0	0	0	0
Maribyrnong	5,671	4,073	20%	0	513	631	0	2,929	1,597	0
Millicent Coast	36	36	100%	0	36	0	0	0	0	0
Mitchell	1,710	1,640	96%	0	0	355	1,286	0	71	0
Moorabool	1,467	1,467	96%	0	1,411	0	0	57	0	0
Murray	10,097	4,026	39%	0	178	3,733	0	114	3,691	2,379
Otway Coast	1,260	392	20%	0	0	248	0	144	28	839
Ovens	2,861	1,172	41%	0	93	1,079	0	0	1,689	0
Portland Coast	2,285	120	5%	0	0	120	0	0	98	2,067
Snowy	394	394	100%	0	0	394	0	0	0	0
South Gippsland	4,769	521	11%	0	83	423	0	14	1,079	3,171
Tambo	954	954	100%	0	0	954	0	0	0	0
Thomson	1,131	1,105	98%	0	6	1,099	0	0	26	0
Werribee	177,167	32,939	16%	6,222	2,685	19,363	3,870	799	168	144,060
Wimmera	1,457	1,457	100%	0	470	985	0	0	0	0
Yarra	12,875	3,906	12%	0	786	747	0	2,373	8,104	863
Total 2015–16	**450,062**	**95,600**	**17%**	**13,845**	**12,518**	**44,178**	**6,074**	**18,985**	**36,880**	**317,583**
Total 2014-15	423,024	91,277	18%	9,868	9,019	37,452	20,578	14,358	43,174	288,597

Figure 3-5 shows the trend in recycled water over the 10 years to 2015–16. In 2005–06, the volume of water recycled was slightly less than 80,000 ML. Over the next year, as demand for recycled water increased due to the Millennium Drought and more recycling schemes came online, the volume of water recycled grew substantially, as did the percentage recycled. The volume and percentage recycled in 2010–11 and 2011–12 were less than during the preceding five years, due to reduced demand for recycled water as a result of higher rainfall. Over the last four years to 2014–15, the volume and percentage of wastewater recycled has been slowly increasing. The volume recycled 2015–16 was only slightly less than the year before (281 ML).

Figure 3-5 Recycled water volume and percentage, 2005–06 to 2015–16 (1)

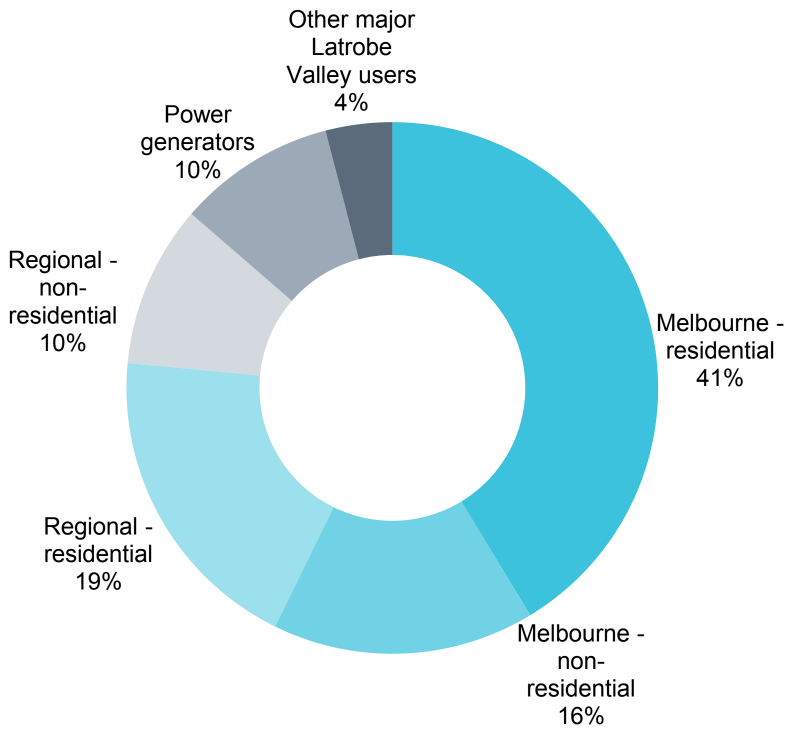


Note:
(1) This figure excludes recycled water used 'within process'.

3.4 Metered urban and commercial consumptive use

Consumption in urban areas is typically measured by the metered volume of water delivered to customers – both households (residential use) and businesses (commercial use). This figure differs from the bulk water diversion figures in Table 3-4 because water is lost in the distribution network through evaporation and leakage between the points of diversion and delivery. Therefore, the metered consumption volumes in Figure 3-6 are less than the urban diversion volumes in Table 3-4 and Figure 3-2. Chapter 8 has information about urban distribution systems.

Figure 3-6 Metered urban and commercial consumption of water, Victoria



4 Water for the environment

Water for the environment is set aside in Victoria's water allocation framework to preserve the environmental values and health of water ecosystems. It is used to improve or maintain the health of wetlands and rivers and the plants and animals that depend on them. Water for the environment is provided in three ways:

- **Water entitlements**: volumes of water held in perpetuity. Most of the water entitlements held for the environment are specified as a share of the water available in storages that can be released to meet particular environmental needs. Carryover, trade and seasonal allocation provisions are typically the same as water entitlements held for consumptive purposes. When actively managed, water available under water entitlements can be targeted so that the right amount of water is in the right place at the right time so that when fish, birds, turtles and other animals need water to trigger feeding, breeding, fledging or migration, that water is available for them. For this reason, water entitlements held for the environment are often called **'managed environmental water'**.
- **Obligations on consumptive entitlements**: volumes of water which water corporations or licensed diverters are obliged to provide out of storages or past diversion points before water can be taken for consumptive use.
- **Above cap water**: water available above the total volume allocated for consumptive use.

The Victorian Environmental Water Holder (VEWH) is responsible for the use of managed environmental water across the state. This year was the VEWH's fifth year managing water for the environment in Victoria. The Commonwealth Environmental Water Holder (CEWH) holds and manages water entitlements in line with the *Water Act 2007 (Commonwealth)* and Murray-Darling Basin Plan. The Murray-Darling Basin Authority (MDBA) also holds and manages water entitlements specifically for the Living Murray Program.

Further information about the VEWH's planning processes for use of the environmental water holdings, the program achievements and outcomes of environmental watering in 2015–16 is available in the VEWH's annual report and annual watering booklet (*Reflections*), available at www.vewh.vic.gov.au (search 'VEWH Reflections').

4.1 Managed environmental watering in 2015–16

4.1.1 Annual overview

The volume of total managed environmental water available in 2015–16 was 1,805,751 ML, which was slightly more than the year before. Of this total available, 689,532 ML of environmental water was delivered during the year to priority river reaches and wetlands in Victoria and 688,478 ML was delivered via the Murray River to the South Australian border. Table 4-1 summarises Victoria's managed environmental watering in 2015–16.

Table 4-1 Summary of managed environmental watering, 2015–16

	2015–16	2014–15
Managed environmental water availability		
Total available during the year (ML) (1)	1,805,751	1,727,646
Managed environmental water deliveries		
Volume delivered to off-stream wetlands (ML)	73,181	131,546
Volume delivered in-stream (ML)	616,350	514,221
Total volume delivered (ML)	**689,532**	**645,767**
Managed environmental water – other actions		
Volume of return flows (ML) (2)	591,199	314,141
Volume delivered via the Murray River to South Australia (ML)	688,478	570,709
Volume transferred to the Snowy Scheme (ML) (3)	75,807	83,508
Net volume traded to non-environmental users (ML)	22,336	1,996

Notes:

(1) Total available includes the volume carried over from the previous year plus seasonal allocations in the current year, plus any 'return flows' credited during the year. It does not include any water traded to the environmental water holders from another party

(2) 'Return flows' means the volume of water released in-stream by the VEWH and made available for further re-use by the environment at a downstream location.

(3) The volume of allocation transferred from the Victorian Murray, Goulburn and Loddon systems to the Snowy Hydro-electric Scheme for increasing environmental flows in the Snowy and Murray Rivers.

4.1.2 Water entitlements, availability and use

Managed environmental water is held in 15 Victorian river basins. Table 4-2 presents for each river basin the volume of entitlements at 30 June 2016 and the volumes made available and used during 2015–16.

Table 4-2 Environmental water availability and use, 2015–16 (ML)

	Basin	Entitlement type/ reliability (1)	Entitlement volume at 30 June 2016	Net carryover at July 2016 (a)	Seasonal allocation / Share of inflows (b)	Return flows (2) (c)	Total available (pre trade) (d) = (a)+(b)+(c)	Net trade in (3) (e)	Volume used (f)	Closing balance at 30 June 2016 (g) = (d)+(e)-(f)
North	Murray (4)	High	438,910	229,742	431,113	590,987	1,251,842	-730,836	375,481	145,525
		Low	137,656							
		Provisional	75,000							
		Unregulated	74,300							
	Ovens	High	70	0	70	0	70	0	70	0
	Broken	High	253	2	66	0	68	500	500	68
		Low	4							
	Goulburn	High	401,392	58,370	356,681	0	415,051	-59,441	242,591	113,019
		Low	215,563							
	Campaspe	High	27,295	2,598	19,232	0	21,830	8,000	14,484	15,346
		Low	8,409							
	Loddon	High	7,406	2,000	13,760	0	15,760	-1,588	7,372	6,801
		Low	2,551							
		Provisional	7,490							
	Total			**292,712**	**820,922**	**590,987**	**1,704,621**	**-783,365**	**640,498**	**280,759**
West	Wimmera & Glenelg	High - pipeline	40,560	9,883	6,490	0	16,373	0	8,112	8,261
		Wetland	1,000							
		Low	28,000							
	Total			**9,883**	**6,490**	**0**	**16,373**	**0**	**8,112**	**8,261**
Central	Tarago	Share of inflows	10.3%	3,000	765	0	3,765	0	2,117	1,648
	Yarra	High	17,000	18,065	17,000	0	33,095	-1,970	8,817	24,278
	Werribee (5)	Share of inflows	10%	579	25	212	816	1,234	651	1,399
	Maribyrnong (6)	n/a	n/a	0	0	0	0	302	300	2
	Moorabool	Share of inflows	11.9%	970	0	0	970	0	240	730
	Barwon (7)	Unregulated	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total			**22,614**	**17,790**	**212**	**38,646**	**-434**	**12,125**	**28,058**
Gippsland	Latrobe (7)(8)	Unregulated	n/a	18,731	800	0	19,530	0	3,750	15,780
		Share of inflows	9%							
	Thomson	High	22,461	4,610	21,971	0	26,581	1,970	25,047	3,504
		Low	6,230							
	Total			**23,340**	**22,771**	**0**	**46,111**	**1,970**	**28,797**	**19,284**
Total				**348,549**	**867,972**	**591,199**	**1,805,751**	**-781,828**	**689,532**	**336,361**

Notes:

(1) Entitlement reliability defines the likelihood of the full entitlement volume being available. High reliability entitlements receive allocations before low reliability entitlements. Access to unregulated entitlements is only permitted when water in river flows are above a certain height or rate. Some entitlements are specified as a share of inflows into storage, rather than a volumetric limit. Provisional entitlements provide access to water based on conditions specified in the bulk entitlement.

(2) 'Return flows' means the volume of water released in-stream under an entitlement and made available for further re-use by the environment at a downstream location.

(3) 'Net trade in' means the net trade to all environmental water holders into the river basin.

(4) The Barmah Millewa Environmental Water Allocation is not included in the carryover and allocation volumes for the Murray basin because these represent accounting transactions and the water could not be used during the year.

(5) The net carryover reported for Werribee includes 135.5 ML of adjustments made during the year for release corrections and evaporation, this volume decreased the water available during the year.

(6) There are no Maribyrnong entitlements held for the environment, but the VEWH purchased 302 ML allocation from other entitlement holders.

(7) There are unregulated environmental entitlements in these basins where availability depends on river heights so are not quantified in volumes.

(8) The seasonal allocation / share of inflows reported for Latrobe includes 407.7 ML of adjustments made under the Blue Rock Environmental Entitlement (inflows share) for inflows, internal spills, evaporation losses and release corrections, this volume decreased the water available during the year.

4.1.3 Snowy Water Initiative

The Snowy Water Initiative was formally established in 2002 to increase flows in the Snowy River in response to the impacts the Snowy Hydro-electric Scheme (Snowy Scheme) was having on the river's health by regulating and diverting large volumes of water west into the Murray-Darling Basin. As part of this initiative the Victorian, NSW and Commonwealth governments committed to recovering water from the Murray-Darling basin to increase flows in the Snowy and Murray rivers.

The Victorian government met its commitment by recovering water from the Murray, Goulburn and Loddon systems by 2012. This resulted in the creation of entitlements which are now held by the VEWH. Each year the water allocated to these entitlements at 31 January is transferred to the Snowy Scheme where it is made available for release into the Snowy and Murray rivers. These transfers effectively reduce the amount of water required to be delivered from the Snowy Scheme to the Murray River. This then offsets the volume of water that must be supplied from the Snowy system to the Murray and Murrumbidgee rivers, thereby freeing up water for environmental flows in the Snowy, while ensuring the equivalent amount of consumptive water is still available in the Murray River.

In 2015–16, the VEWH transferred a total of 75,807 ML to the Snowy Scheme. This is less than the volumes made available in 2014-15 (83,509 ML) due to lower seasonal allocations in the Murray, Goulburn and Loddon at 31 January 2016 compared to 31 January 2015. Including contributions from NSW, a total of 186,856 ML was transferred to the Snowy Scheme in 2015–16, see Table 4-3. Of this volume, 124,571 ML was available for release to the Snowy River and 62,285 ML to the Murray River.

Table 4-3 Water available under Snowy Water Initiative 2015–16 (ML) (1)

Entitlement source	Entitlement volume (ML)	Volume made available for release in 2015–16 (ML)
Victoria (2)	115,939	75,807
New South Wales (3)	192,219	111,050
Total	**308,158**	**186,856**
Volume apportioned to Snowy River increased flows		*124,571*
Volume apportioned to River Murray increased flows		*62,285*

Notes:

(1) The information about the Snowy River entitlements was sourced from the New South Wales Office of Water.

(2) Includes 83,508 ML high-reliability entitlements and 32,431 ML of low-reliability entitlements.

(3) Includes 52,635 ML high-security entitlements, 115,084 ML general-security entitlements and 24,500 ML conveyance entitlements.

4.2 Obligations on consumptive water entitlements

Obligations on consumptive water entitlements are an important component of water for the environment. Obligations set out arrangements for sustainably managing available water resources to balance the needs of all consumptive users and the environment. Obligations are typically described as flows that must be maintained at a point, a passing flow, and ensure equitable sharing of resources for consumptive users downstream.

4.2.1 Passing flows on bulk entitlements

Most consumptive bulk entitlements include obligations expressed as 'passing flow requirements', which are the flows that a water corporation must pass at its weirs or reservoirs before it can take water for other uses. Passing flow requirements are specified as obligations in bulk entitlements, and the holders must report on their compliance with these requirements.

No major breach of passing flows compliance was reported in 2015–16. However, five minor failures to meet passing flows requirements occurred, as reported below.

Barwon Water had two instances where passing flows requirements were not met:

- Two days of non-compliance were recorded in Aireys Inlet where the passing flows measured were slightly less than required. An issue with the flow meter was identified and a recalibration performed to correct it.
- In Colac, passing flows were suspended for 50 days between April to June 2016 due to poor water quality (a colour change, increased turbidity, iron and manganese levels, and reduced dissolved oxygen levels) caused by low water levels in West Gellibrand reservoir. This action was supported by the Corangamite Catchment Management Authority (CMA) as the poor-quality water would have had an adverse impact on the environment. The volume of water which should have been passed was released at a later date agreed with the CMA, for maximum environmental benefits.

Goulburn–Murray Water was unable to meet the minimum required passing flows in the Campaspe River downstream of Lake Eppalock for four days. A volume of water equal to the shortfall in passing flows was subsequently made available for release at the discretion of the VEWH.

Western Water was unable to meet the minimum passing flows requirements twice:

- A shortfall of water supply failed to be released as instantaneous passing flows in Willimigongon Creek as it requires manual operation to meet passing flows requirements. To improve the manual operation process, an extra meter was added to the monitoring network during 2014–15 however this did not resolve the issue.

Therefore, telemetry and alarm systems were added in 2016–17 to ensure compliance with passing flows requirements.

- A shortfall of water supply also failed to be released as instantaneous passing flows for Main Creek as it requires manual operation to meet passing flows requirements. However average passing flows over the year exceeded the shortfall. Telemetry and alarming was added in 2015-16 to ensure compliance with passing flows requirements.

4.2.2 Management plans in unregulated river systems

Obligations on consumptive entitlements are outlined in management plans in unregulated river systems, which set out arrangements for sustainably managing available water resources to balance the needs of all users including the environment.

The types of management plans are:

- **statutory management plans:** follow a legislated process to determine how water in a waterway will be shared between consumptive users and the environment in unregulated systems and is documented as a streamflow management plan.
- **local management plans:** are developed by water corporations to capture and formalise existing rules in unregulated systems. These plans explain to licensees and the broader community the specific management arrangements for the water resource from which they extract and the rules that apply to them as users of that resource. They also explain how water will be shared in times of shortage. These typically apply in areas where there are no statutory management plans.

Management plans will include flow thresholds at which rosters, restrictions and bans on the water taken from streams by licensed diverters. Rosters and restrictions set out the order in which licence holders are allowed to take water and the quantity allowed to be taken (for example, 75% of licensed volume). When water is particularly scarce, bans on diversions from waterways are imposed.

Seven streamflow management plans (SFMPs) were in place in the Yarra basin. There is also a management plan for the Upper Ovens River. The Upper Ovens management plan provides for integrated management of surface water and groundwater. It is the only integrated management plan developed in Victoria so far.

Table 4-4 Status of streamflow management plans

Basin	Stream(s)	Status
Kiewa	Kiewa River	Local management plan in place as recommended under the Northern Region Sustainable Water Strategy
Ovens	Upper Ovens River above Myrtleford	Integrated surface water and groundwater management plan approved and operational. Review commenced
Goulburn	King Parrot Creek, Yea River, Seven Creeks	Local management plans in place as recommended under the Northern Region Sustainable Water Strategy
Thomson	Avon River	Local management plan in place as recommended under the Gippsland Region Sustainable Water Strategy:
Latrobe	Latrobe River (upper)	Local management plan in place as recommended under the Gippsland Region Sustainable Water Strategy
South Gippsland	Tarra River	Local management plan in place as recommended under the Gippsland Region Sustainable Water Strategy
Yarra	Diamond Creek, Hoddles Creek, Plenty River, Pauls / Steels / Dixons creeks, Olinda Creek, Stringybark Creek, Woori Yallock Creek and Little Yarra and Don rivers	Streamflow management plans approved and operational Following review and consultation, the Diamond Creek SFMP was revoked and a local management plan developed
Maribyrnong	Upper Maribyrnong River (Deep Creek)	The Review of the Central Region Sustainable Water Strategy will review streamflow management plan arrangements
Barwon	Barwon River main stem and tributaries to the south including Leigh River	The WSPA was abolished in November 2016 as the resource was considered sustainable and a streamflow management plan was not required
Otway Coast	Gellibrand River	Local management plan in place as recommended under the Western Region Sustainable Water Strategy
Hopkins	Merri River	Reviewed under the Western Region Sustainable Water Strategy, which recommended a local management plan be developed instead of a SFMP
Wimmera	Upper Wimmera River	Reviewed under the Western Region Sustainable Water Strategy, which recommended a local management plan be developed instead of a SFMP

Compliance with each approved SFMP is reported annually by the relevant water corporation to the Minister for Water and the relevant CMA. Melbourne Water is responsible for managing and implementing the seven SFMPs that are in effect, and information about compliance is available on the Melbourne Water streamflow management website page.

Goulburn–Murray Water is responsible for the management and implementation of the integrated *Upper Ovens River Water Management Plan*, and information about compliance is reported in the Upper Ovens River WMP annual report available on the Goulburn–Murray Water website.

4.3 Above cap water

Above cap water is the volume of water available above the volume allocated to water entitlements. For the Victorian Water Accounts this is calculated as the difference between the total inflow to a river basin and the total volume flowing out of the basin.

Figure 4-1 shows the proportion of inflows to all Victorian river basins volume flowing out of Victoria for the last 12 years. The proportion of flows leaving Victorian river basins is not in itself a reliable indicator of river health due to the complex interaction of ecological processes and seasonal variability of streamflow.

Figure 4-1 Volume leaving Victorian river basins, as proportion of total flows. 2004–05 to 2015–16

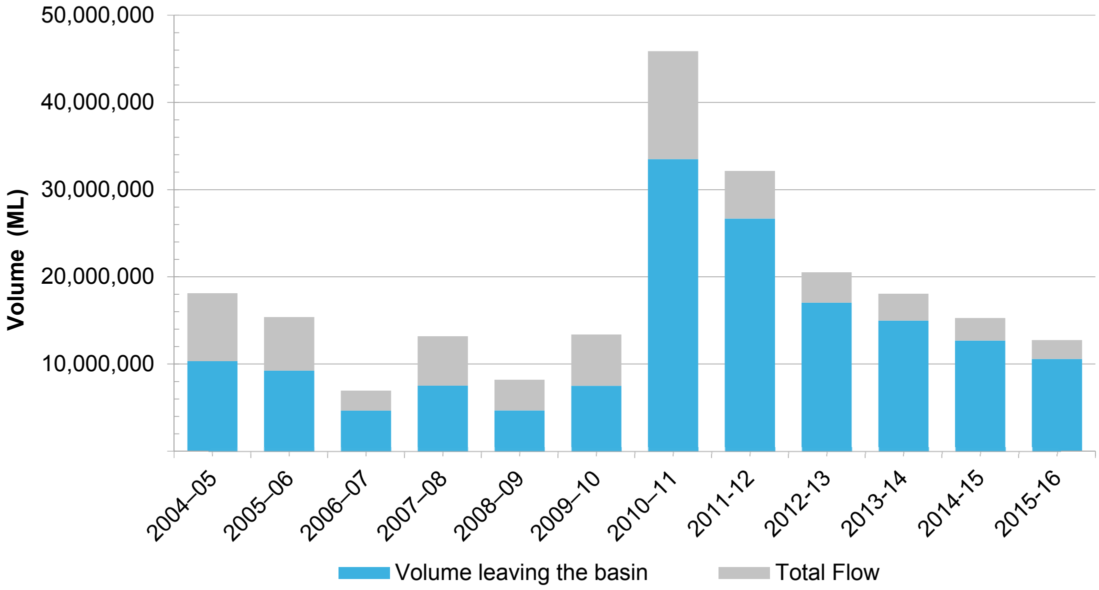


Table 4-5 shows the above cap water for each basin by reporting the total amount of water in each basin together with the amount of water that leaves the basin after water is extracted for consumptive use. The above cap water is expressed as a proportion of the annual flows of water that could have left the basin if there were no diversions. The below-average rainfall and lower river flows experienced across much of the state in 2015–16 meant that the above cap water as a total volume of water leaving Victoria's river basins was lower than in the previous year (10,577,069 ML, compared to 12,678,383 ML in 2014–15). However, as a percentage of total inflow volume, the water reaching the basin outlets was higher, with 82% reaching the basin outlets in 2015–16, compared to 80% in 2014–15 (Table 4-5).

In 2015–16, the proportion of total flows leaving the basin decreased in about half of the basins and increased in the rest, when compared to the previous year (Table 4-5). The basins that experienced the lowest proportions of water leaving the basin as a percentage of total flows in 2015–16 were the Avoca (0%), Wimmera (7%), Moorabool (14%), Werribee (25%), Loddon (29%), and Maribyrnong (30%) basins. The proportion of annual flows leaving the basin was above 90% in 8 basins, predominantly in the south of the state, similar to 2014–15. The East Gippsland and Snowy basins recorded the highest proportion of total flows leaving the basin in 2015–16.

Table 4-5 Volume leaving Victorian river basins, 2015–16

Basin	Outflows to	2015–16			2014–15		
		Total flows if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flows leaving the basin (%)	Total flows if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flows leaving the basin (%)
Murray (1)	South Australia	2,840,189	1,580,000	56%	3,436,013	1,891,600	55%
Kiewa (2)	Murray River	473,861	426,526	90%	482,119	438,423	91%
Ovens	Murray River	713,835	648,968	91%	943,000	887,438	94%
Broken	Murray River	77,457	39,959	52%	139,328	106,062	76%
Goulburn	Murray River	1,041,566	471,160	45%	1,581,734	954,910	60%
Campaspe	Murray River	54,467	26,416	48%	88,951	70,371	79%
Loddon	Murray River	79,107	22,691	29%	117,053	30,067	26%
East Gippsland	Bass Strait	1,161,495	1,160,397	100%	1,359,269	1,357,912	100%
Snowy (VIC only) (3)	Bass Strait	1,927,323	2,589,593	134%	1,544,877	2,049,928	133%
Tambo	Gippsland Lakes	435,656	429,564	99%	337,832	331,755	98%
Mitchell	Gippsland Lakes	514,485	497,308	97%	660,176	642,629	97%
Thomson	Gippsland Lakes	559,677	319,934	57%	740,389	425,876	58%
Latrobe	Gippsland Lakes	552,528	473,132	86%	703,081	586,940	83%
South Gippsland	Bass Strait, Western Port	579,308	532,603	92%	729,705	692,117	95%
Bunyip	Bass Strait, Western Port, Port Phillip Bay	466,417	409,964	88%	505,591	469,843	93%
Yarra (4)	Port Phillip Bay	495,720	275,730	56%	597,406	370,448	62%
Maribyrnong	Port Phillip Bay	19,806	5,858	30%	22,282	9,553	43%
Werribee	Port Phillip Bay	21,233	5,344	25%	23,922	4,872	20%
Moorabool	Port Phillip Bay	23,457	3,202	14%	50,588	5,272	10%
Barwon	Port Phillip Bay, Bass Strait	104,820	52,158	50%	125,208	60,106	48%
Corangamite (4)	Corangamite lakes	40,645	27,244	67%	147,448	130,182	88%
Otway Coast	Bass Strait	419,384	384,801	92%	574,874	545,599	95%
Hopkins	Bass Strait	80,845	38,985	48%	222,928	125,075	56%
Portland Coast	Bass Strait	104,323	97,297	93%	273,021	252,584	93%
Glenelg	Bass Strait	116,794	55,089	47%	349,324	225,540	65%
Millicent Coast (6)	South Australia	4	-	-	4	-	-
Wimmera (4)	Lakes Hindmarsh and Albacutya	44,378	3,146	7%	44,990	13,280	30%
Mallee (6)	Murray River	-	-	-	-	-	-
Avoca (5)	Lake Bael Bael and the Marshes	18,377	0	0%	22,507	0	0%
Total		**12,967,156**	**10,577,069**	**82%**	**15,823,619**	**12,678,383**	**80%**

Notes:

(1) This table includes only the Victorian component of Murray basin streamflows and Victoria's contribution to the environment's share of total flows. In this case, the environment's share is taken to be Victoria's contribution to flows at the Victorian-South Australian border.

(2) Includes the NSW share of Kiewa River flows under the Murray–Darling Basin Agreement.

(3) The total flow volume relates to the flows from the Victorian tributaries of the Snowy River only. Volume leaving the basin relates to all water flowing from the Snowy River into Bass Strait, which includes water originating from the NSW portion of the Snowy River.

(4) Transfers of water into this basin are not included in the total flows.

(5) For the purpose of this table, flows leaving the basin are taken as flows entering the terminal lakes.

(6) There are no significant streams in this basin.

5 Water trade

Water trading is the process of buying, selling or exchanging rights to water. Water trade has long been used as a tool in Victoria to facilitate the efficient use of water resources. While unofficial trade was likely occurring as early as the 1940s, official temporary trades first occurred in 1987 and official permanent trades first occurred in 1991–92.

The ability to report on trade allows the examination of how availability and demand for water influences its movement and efficient use in Victoria. This chapter reports on trade activity during the 2015–16 water year, and the volume of water traded and the geographical movements of water in those trades.

Further information about water trading in Victoria is provided in the *Victorian Water Trading 2015–16 Annual Report*, available at waterregister.vic.gov.au (search 'Trade reports Victorian water register').

5.1 Victoria's water trade framework

Trade of water in Victoria is governed by trading rules and policies set by the Minister for Water. The rules and policies aim to facilitate trade wherever possible, while minimising negative impacts on other users and the environment.

Trade can be a permanent transfer of ownership of a water entitlement (the ongoing right to water), or trade of seasonal water allocation (the physical water available in a given year). There are four main avenues for trading water in Victoria. For declared systems, there is trade of seasonal allocation and trade (or transfer) of water shares. In non-declared systems, trade may involve 'entitlement volume trade' between licences or the 'change of ownership' of a licence due to land ownership change.

5.1.1 Allocation trade

Allocation is water available each season under water entitlements. Water is allocated based on the available resource in any given year (see chapter 2.2.2 for information about allocations in 2015–16).

The allocation made against a water entitlement may be traded separately from the water entitlement and from the land title. Allocation trade can either occur within a trading zone or between trading zones in line with the trading rules for declared water systems.

Allocation trade includes trade of allocation made available under water shares and bulk entitlements. Most allocation trade occurs in declared water systems. In northern Victoria, these are the Broken, Bullarook, Campaspe, Goulburn, Loddon, Murray and Ovens systems; and in southern Victoria, the Thomson–Macalister and Werribee systems. In other parts of the state, trade of allocation available under bulk entitlements may also occur.

Environmental water holders also use allocation trade to move water between different environmental water accounts.

5.1.2 Trade of water shares

As explained in chapter 1, a water share is a legally recognised, secure entitlement to a share of the water available for use in a declared water system. Trade of water shares can mean a transfer of ownership from one person to another, a change of the location where the water share is used, or both. This chapter provides summary information about transfers of ownership of water shares.

More detailed reporting on the movement of water shares into or out of different water delivery systems in Victoria is provided in the Victorian water trading annual report. 'Movement' occurs with:

- a change of ownership (when the new owner wishes the water share to be used at a new location)
- an association or variation of the water share (when an existing owner wishes to shift the water share to another location).

5.1.3 Trade of take and use licences

Outside declared water systems, take and use licences allow water to be taken from either unregulated surface water systems or from groundwater and be used on the land defined in the licence. Trading of take and use licences is subject to the requirements of the *Water Act 1989*, the ministerial policies for managing take and use licences and any approved local management rules or plans.

Transfer of entitlement volume for a take and use licence can be either a 'permanent volume transfer' or a 'temporary volume transfer' to transfer part or all of the volume from one licence to another. These generally include a change in location. The other type of transfer is 'change of ownership', which changes the ownership of a licence due to a land ownership change without affecting the volume and location of the licence.

In this chapter, unregulated surface water trades and groundwater trades are reported separately.

5.2 Overview of trade in 2015–16

5.2.1 Allocation trade

A total of 2,737 GL of allocation was traded in Victoria in 2015–16, an increase on 2014–15 when 2,694 GL was traded. Most of this occurred in northern Victoria (2,702 GL) with small volumes in southern Victoria (31 GL) and western Victoria (4 GL).

The continued high level of trade resulted from a combination of high volumes of allocation available and hot and dry conditions. Trade volumes were also boosted by the volume of allocation traded by environmental water holders moving water between their environmental water accounts.

As in previous years, environmental trades made up a significant portion of the volume traded in 2015–16: there was 1,385 GL of within-environment allocation trade (Table 5-1) which equates to 51% of the total volume traded. For information about the assumptions made to distinguish between environmental and consumptive trading, see the *Victorian Water Trading 2015–16 Annual Report*.

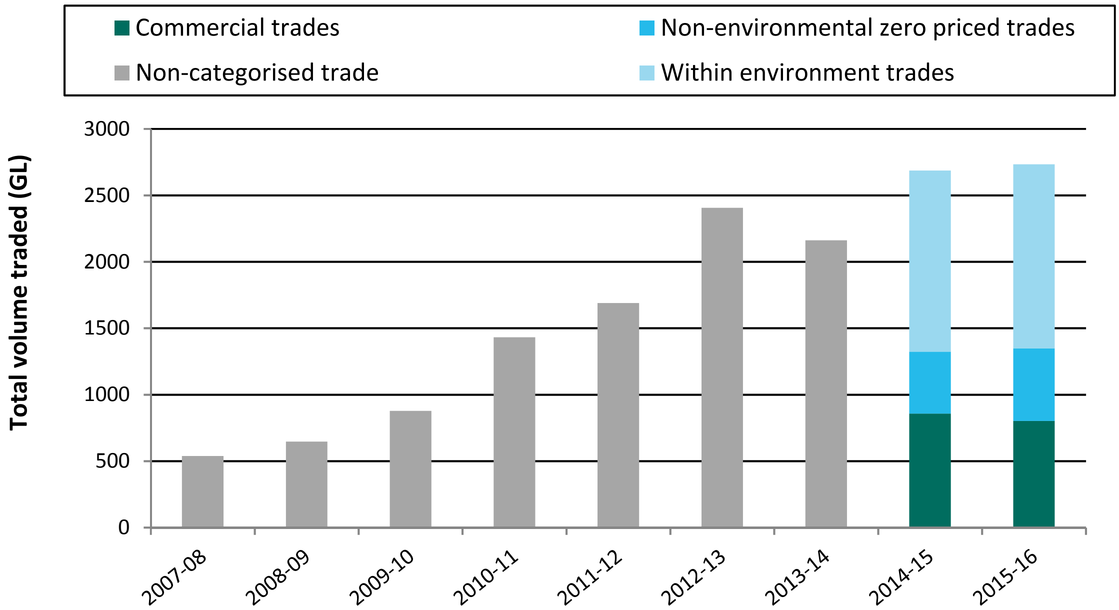
Table 5-1 Summary of trade of seasonal allocation trade in Victoria, 2015–16

Trade type	Number of trades	Volume (ML)
Commercial trades	9,922	805,437
Zero-priced allocation trades	5,453	546,740
Within environment trades	92	1,385,059
Total	**15,467**	**2,737,236**

Across the state, trades of environmental water represented a large proportion of the volume traded. The VEWH uses trade to move water between areas across Victoria, depending on its environmental watering plan.

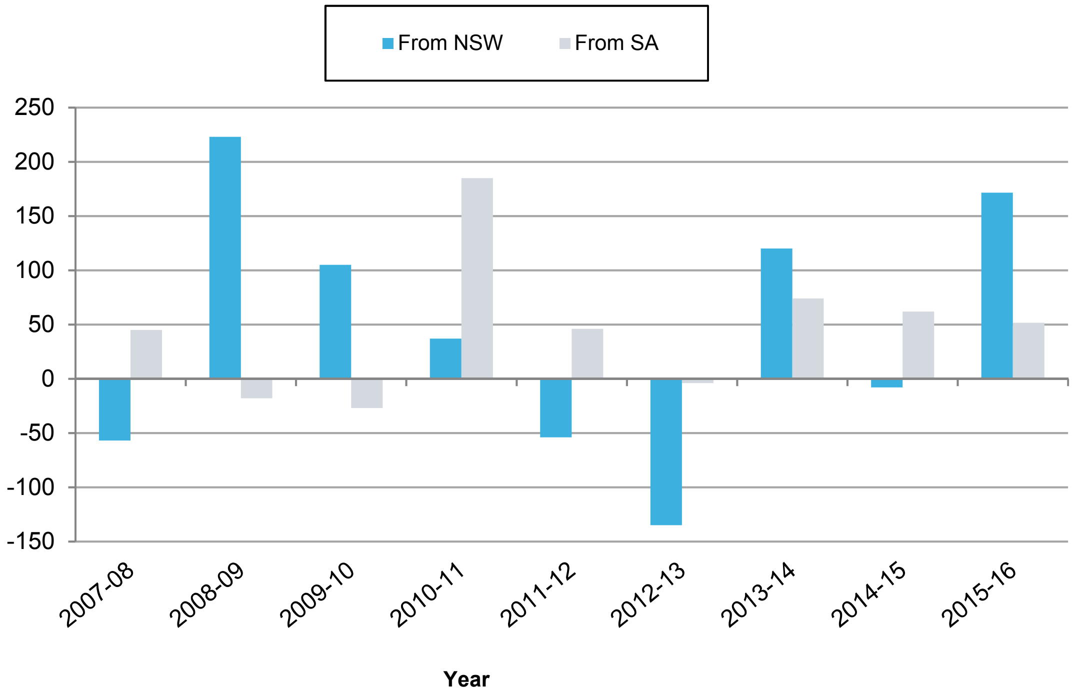
Commercial trades, where allocation is sold for a specified price, represented 805 GL of the total volume of allocation water traded. Zero-priced trades, where water is traded from one account to another without payment, represented about 20% of the total volume traded (Figure 5-1). These trades may include trades between accounts owned by the same person or between related parties. The proportion of trade applications received without price information has reduced in recent years, enabling greater confidence in this type of more detailed market analysis.

Figure 5-1 Volume of allocation trade in Victoria



Water trade between Victoria, New South Wales and South Australia is permitted, subject to trading rules. Excluding seasonal allocation traded within environmental accounts, there was a total of 294 GL traded into Victoria (168 GL commercially) in 2015–16 and 71 GL traded out of Victoria (37 GL commercially), resulting in an overall net trade into Victoria of 223 GL (Figure 5-2).

Figure 5-2 Net volume of allocation trade into Victoria from New South Wales and South Australia (excluding trade within environment)



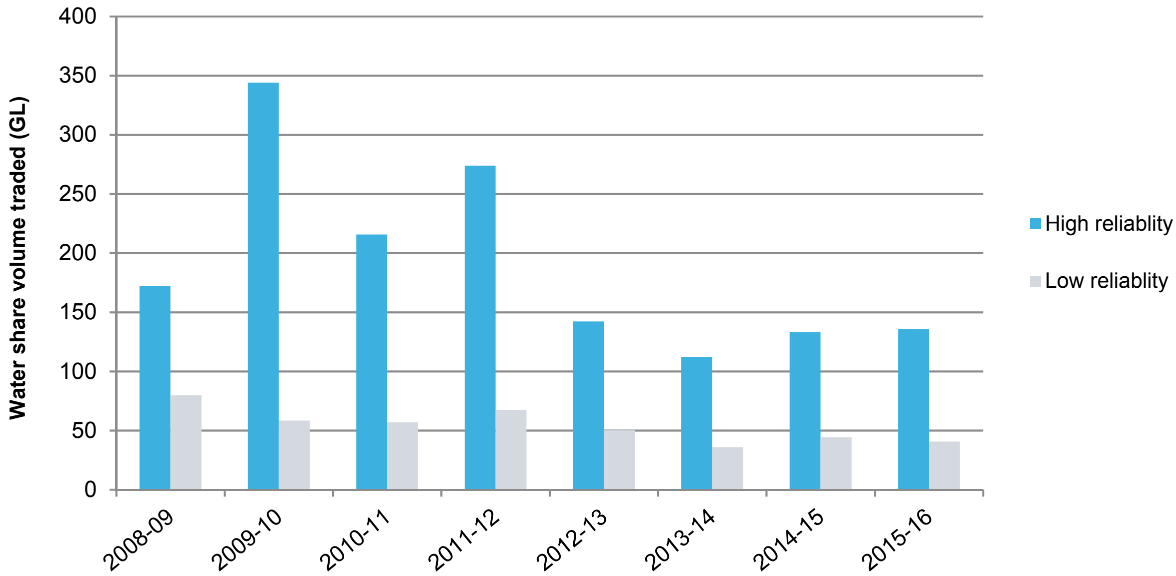
5.2.2 Water share transfers

Water share trade across Victoria in 2015–16 included 136 GL of high-reliability and 41 GL of low-reliability water shares transferring ownership (Table 5-2 and Figure 5-3). As with allocation trade, most of this occurred in northern Victoria, with a small amount in southern Victoria.

Table 5-2 Water share transfers in Victoria

Water share type	Number of trades	Volume (ML)
High reliability	2,283	135,805
Low reliability	688	40,649

Figure 5-3 Transfer of ownership of water shares in Victoria



5.2.3 Unregulated surface water

Surface water take and use licence trading during 2015–16 resulted in 1.7 GL of water permanently traded and 5.8 GL of water temporarily traded. Unlike allocation and water share trading, most of the surface water take and use licence trading occurred in southern Victoria, with 0.9 GL of permanent trade and 4 GL of temporary trade. Slightly lower volumes were traded in northern Victoria, and almost no take and use licence volume was traded in western Victoria, except as part of land transfers.

As shown in Table 5-3, trade in surface water take and use licences was much lower than the trade in groundwater take and use licences. Trades as part of land transfers (take and use licence change of ownership) are the dominant trade type, by volume of water in surface water trades.

Table 5-3 Trade of surface water take and use licences in Victoria (1)

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	78	1,727	68	793	411	6,532
South	135	4,030	34	922	195	4,727
West	0	0	0	0	15	126
Total	**213**	**5,757**	**102**	**1,715**	**621**	**11,385**

5.2.4 Groundwater

The volume of groundwater take and use licence trading was higher in 2015–16 than in the previous year, with 25 GL of temporary trade (compared to 17,437 ML in 2014–15) and 10 GL of permanent trade (compared to 9 GL in 2014–15).

Table 5-4 shows that in 2015–16, trades of groundwater take and use licences were mostly part of land transfers (take and use licence change of ownership) with 361 trades amounting to about 54 GL.

Table 5-4 Trade of groundwater take and use licences in Victorian groundwater management units (1)

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	124	15,945	36	6,301	185	30,157
South	122	5,799	50	3,083	165	17,832
West	16	3,619	4	906	11	5,514
Total	**262**	**25,363**	**90**	**10,290**	**361**	**53,503**

Part 2: Water accounts 2015–16

Part 2 of the *Victorian Water Accounts 2015–16* presents an account of surface water, groundwater and distribution systems in Victoria for 2015–16.

Chapter 6 provides the water accounts for each of Victoria's 29 river basins and includes:

- a map of each river basin
- a basin overview, including summaries of information presented in each basin, management responsibilities in the basin and, where applicable, information about water for the environment
- the total water resources in each basin
- detailed information about surface water entitlements in the basin
- detailed information about the use of surface water and recycled water in the basin.

The basin water accounts presented in chapter 6 track surface water from the time it appears as inflows to a waterway to the time it is diverted from the surface streams of the basin, or flows from the basin to another basin or to the sea.

Chapter 7 provides the water accounts for each of Victoria's 20 groundwater catchments and includes:

- a map of each groundwater catchment
- an overview of groundwater resources and management responsibilities in each catchment
- detailed information about licensed entitlements and unlicensed stock and domestic bores (private rights to water) as well as groundwater use in the catchment.

The groundwater catchment accounts presented in chapter 7 help to describe Victoria's groundwater resource and track groundwater extracted for irrigation, urban and domestic and stock use.

Chapter 8 provides the accounts for all of Victoria's rural and urban distribution systems. While chapter 6 and chapter 7 describe the entitlements and use of water taken from river basins and groundwater catchments, chapter 8 describes the movement of this water through the constructed distribution systems that deliver water to users. These accounts track the water from the time it moves from a waterway, an aquifer or other source to the time it is delivered to a customer or another destination.

Distribution systems typically supply users within irrigation districts or towns and urban areas. Some infrastructure services both of these end uses. On occasion, environmental entitlements are supplied using the distribution systems. Providing water accounts for distribution systems enable water corporations and the community to understand where delivery-efficiency improvements to reduce losses can most readily be made.

6 Basin water accounts

6.1 Overview of methodology

6.1.1 Introduction

This section outlines the basis for the information presented in the basin water accounts. It explains some important assumptions and limitations of the data in the accounts, which should be read in conjunction with the information in the basin accounts.

The basin water accounts are compiled from information obtained from:

- responses to requests for data from water corporations, catchment management authorities (CMAs), the Victorian Environmental Water Holder (VEWH), the Department of Environment, Land, Water and Planning (DELWP), major users of water and the Murray–Darling Basin Authority (MDBA)
- water consumption and recycled water data collected from water corporations by the Essential Services Commission (ESC)
- hydrologic information from selected streamflow monitoring sites
- climate information from selected rainfall and evaporation monitoring sites provided by the Australian Bureau of Meteorology and water corporations
- estimated relationships between water use and climate or hydrologic data, which is produced by water supply system modelling, held by DELWP
- water corporations' annual reports and related documents.

All information for each of the 29 basins is provided for the period 1 July 2015 to 30 June 2016. Responsibilities for water management are reported in the accounts as they were in 2015–16. Any changes to responsibilities since the end of June 2016 will be reported in future water accounts.

Surface water data generally aligns well with river basin boundaries, except where water is diverted from a waterway in one river basin and is then used in another. For the purposes of the basin water accounts, water is accounted for at the point of diversion from the waterway and not at the point of use. For example, information about diversions to supply the Rochester Irrigation Area, located at the downstream end of the Campaspe basin, is accounted for in the Goulburn basin where the source of supply is located.

Towns with wastewater treatment plants have been assigned to river basins according to the point of discharge from the plant into the receiving waters. If all water is reused and none is discharged into waterways, the treatment plant is assigned to a basin according to the location of the plant.

Continuous improvement of the Victorian water accounts

After 10 years, Victoria now has improved data with which to derive an estimation of the total volume of small catchment dams. In these water accounts, the GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. Due to this improved measure of small catchment dam capacity values, the estimation of water harvested, used and lost through small catchment dams has changed from previous years. Changes in reported values are likely to be the result of the improved identification of those small catchment dams with very small capacities (less than 5 ML) and an improved ability to differentiate small catchment dams from other small water bodies (such as natural lakes and wetlands). Where the change has been significant, an explanatory note has been included in the water balance for the particular basin. More information on this new method can be found in Appendix E.

6.1.4 Surface water resources

Information about surface water in 2015–16 is presented in this section for each of the 29 river basins. There are three subsections: water balance, storages and flows, and entitlement volumes and diversions.

6.1.5 Surface water balance

The surface water balance is the principal water accounting tool in the Victorian water accounts. The water balance provides a statement of the water flows in a basin for a specified year, in which the sum of the outflows from the area equals the sum of the inflows less the water accumulated in the area (that is, water in storages).

A surface water balance is presented for all the basins except the Mallee basin and Millicent Coast basin. A lack of significant surface water resources in these basins means there is insufficient data available to prepare a water balance.

The three components of the water balance — major on-stream storages, inflows, outflows — are further explained below.

Major on-stream storages

The overall change in storage volume in a basin for the year is provided as the difference between the volume in storage at the start of the year and the end of the year. In general, only on-stream storages with a total capacity larger than 1,000 ML are included in this component of the water balance. While storages that are less than 1,000 ML are important locally, they are generally an insignificant proportion of total storage at a basin and statewide level. Note that the volume of water in off-stream storages is not reported in the surface water balance because this would in some instances result in double counting water that has been diverted from rivers or extracted from groundwater.

Inflows

Inflows contribute to the volume of streamflows in waterways within a basin. The inflow components included in the water balance are as follows.

- **Catchment inflow:** this item represents the total volume of surface run-off from rainfall that becomes streamflow into the basin or is captured by small catchment dams. This is generally the unaccounted-for item in each water balance, that is it is calculated as a balancing item. Catchment inflows are determined to be the difference between the total outflows and the known inflows plus accumulated storage volume. The only exception to this is the Murray basin. In the Murray basin, this item represents known inflows, which include Victoria's share of inflows to Lake Dartmouth, Lake Hume and the Menindee Lakes, Victoria's share of inflows from the Kiewa River and inflows from other Victorian basins (Ovens, Goulburn, Broken, Campaspe and Loddon) into the Murray River. It also includes estimated inflows to small catchment dams in the Murray basin.
- **Rainfall on major storages:** this represents inflows from rain falling directly on major on-stream storages. Estimates are based on rainfall data and the surface area of storages.
- **Transfers from other basins:** transfers from other basins are included in a basin's water balance only where these transfers are known to affect streamflows in the receiving basin. These transfers (for example, to rivers or on-stream storages) are included principally because the volume may contribute to the in-stream loss and/or outflow components of the water balance. If water transferred across basin boundaries is supplied directly into a distribution/reticulation system and does not affect streamflows, it is considered as a diversion to an end use (for example, urban and irrigation district diversions) and is not accounted for as a transfer in the water balance.
- **Return flows from irrigation:** return flows from irrigation are the outfalls from an irrigation system that return to waterways. These outfalls arise as part of the normal operation of systems that rely on delivering water by gravity. Return flows from power stations and major industry are also included in the water balance for the Latrobe basin.
- **Treated wastewater discharged back to river:** this component represents the volume of water discharged from wastewater treatment plants back into waterways and is further described in chapter 6.1.10.

Outflows

This term represents water that has left a waterway, whether by natural processes (such as evaporation and seepage) or through being diverted by water corporations and individuals. The outflow components included in the water balance are as follows.

Diversions include water that is deliberately diverted from a waterway to meet a specific use and include:

- *Urban diversions*: this item represents the total volume of water diverted from waterways by water corporations to supply urban customers.
- *Irrigation district diversions*: this component represents the bulk volume of water diverted from waterways by rural water corporations to supply customers in declared irrigation districts.
- *Licensed diversions from regulated or unregulated streams*: licensed diversions occur where the extraction and delivery of water to a property from a watercourse is the responsibility of the licence holder. Information about licensed diversions is reported separately for regulated and unregulated water sources. Domestic and stock water users are assumed to divert their full entitlement volume, unless otherwise reported by water corporations. The water balance excludes diversions under private rights for domestic and stock use (under section 8 of the *Water Act 1989*), which do not require a licence. The volume associated with these rights is relatively small.
- *Transfers to other basins*: transfers to other basins represent the transfer of water to another basin where it is either used or contributes to the in-stream loss in the other basin. The corresponding transaction is reported as inflows in the receiving basin.
- *Environmental water diversions to wetlands*: environmental water is often used to support streamflows within a waterway and this contributes to the volume leaving a basin outlet. In some instances, environmental water is diverted from a waterway to off-stream wetlands. Metered diversions to off-stream wetlands under environmental entitlements are accounted for in this component of the water balance.
- *Small catchment dams*: this item represents the estimated volume of extractions from small catchment dams within a basin. Chapter 6.1.9 has more information about how the volume of extractions is determined.

Losses refer to catchment inflows that are lost from the waterway via natural processes. Losses represent a volume that is unable to be diverted for use and that does not contribute to the flows at a basin outlet.

- *Evaporation losses from major storages*: this represents direct evaporation from major on-stream storages. It is estimated, based on evaporation rates and the surface area of the storage.

- *Losses from small catchment dams*: this item represents the estimated volume of evaporation losses from small catchment dams within a basin. Chapter 6.1.9 has more information about how evaporation losses from small catchment dams is determined.
- *In-stream infiltration to groundwater, flows to floodplain and evaporation (also referred to as in-stream losses)*: this item represents the volume of water that is lost from the waterway via natural processes and is not directly measurable. In the Murray basin, in-stream losses for the year are considered to be the unaccounted-for item in the water balance and are used as balancing items. In this instance, in-stream losses are determined to be the difference between the known outflows and the total inflows plus the net change in storage volume.
  In most other basins, in-stream losses for the year are estimated based on loss functions used in water resource models (such as REALM). Where suitable models are available, in-stream losses are derived by applying measured streamflow data for the year into the loss functions included in the model. The basins with suitable models are documented in Table 6-1. In-stream losses have not been estimated for basins where a suitable model is not available: these are the East Gippsland, Snowy, Tambo, Latrobe, South Gippsland, Yarra, Corangamite, Otway Coast, Hopkins and Portland Coast basins.

Water passed at outlet of basin represents the total volume of flows that leaves the end of the basin. The outlets vary from basin to basin and include:

- *outflows to ocean*: common in southern Victoria, where most rivers flow to the sea
- *outflows to other rivers*: common in northern Victoria, where most rivers flow north and join the Murray River
- *outflows to terminal lakes*: several rivers in western Victoria outflow to lakes that are referred to 'terminal lakes' as they are not connected to the ocean or to other rivers
- *outflows to another state*: the outlet of the Murray River is considered to be the boundary with South Australia for accounting purposes. Flows across the boundary into South Australia from Victoria's share of the Murray River resources are considered to be water passed at the outlet of the basin.

The volume of water passed at basin outlets is estimated by using gauged streamflow data at a point as close to the basin outlet as possible and then extrapolating the gauged data to ungauged basin area.

Table 6-1 Models used to derive in-stream losses for 2015–16

Basin(s)	Model(s)
Kiewa	Kiewa River REALM [1]
Ovens	Ovens River REALM (the volume derived using the model represents the average annual in-stream loss over the period 1891–2006)
Broken, Goulburn, Campaspe, Loddon	Goulburn Simulation Model (this model covers the Goulburn, Broken, Campaspe and Loddon systems)
Avoca	Avon River REALM
Wimmera	Wimmera–Glenelg REALM
Mitchell	Mitchell River REALM, Mitchell River Streamflow Management Plan REALM
Thomson	Thomson Macalister REALM
Bunyip	Tarago and Bunyip River REALM
Maribyrnong	Maribyrnong REALM
Werribee	Werribee REALM
Moorabool, Barwon	Barwon Moorabool REALM
Glenelg	Glenelg River REALM, Wimmera–Glenelg REALM

Notes:
(1) REALM = REsource ALlocation Model

6.1.6 Storages and flows

A chart is presented in each basin that plots catchment inflows from the water balance and the total capacity and volume of water held in major storages (including both off- and on-stream storages) in the basin for the past 10 years. Information about storages in each basin is presented, including the capacity, starting and ending volume in store, rainfall and evaporation. An amount representing catchment inflows less regulated releases is also provided. This volume is the balancing item for each storage and represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

6.1.7 Entitlement volumes and diversions

An overview of the entitlements held by individuals or corporations in the basin is provided. The diversions by water corporations under bulk entitlements, diversions to off-stream wetlands under environmental entitlements, licensed diversions from unregulated streams by private diverters, and diversions and losses from small catchment dams are also reported.

6.1.7.1 Entitlement volumes

Details of all entitlements to water in each basin are reported. Entitlements can include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Bulk entitlements specify a maximum volume of water that may be diverted over a given number of years. The ‘Annual entitlement volume’ column provides the maximum volume that may be diverted in any one year. Where the entitlement volume is an amount specified over more than one year, the total volume that may be taken over the period of the entitlement is shown in the notes. For example, the Gisborne–Barringo Creek bulk entitlement in the Maribyrnong basin specifies that up to 585 ML can be diverted in any one year, while the maximum volume that can be taken over any five-year period is 1,600 ML (320 ML annual average).

In the large, regulated systems, bulk entitlements are normally specified in one of two ways.

- *Source bulk entitlement*: This is an entitlement to harvest water directly from a water source. Source entitlements typically cover multiple storages operated in an integrated way within a river basin. They also include obligations to divert or release water to supply primary entitlement holders (such as customers within irrigation districts, licensed diverters in regulated streams, water corporations that hold delivery bulk entitlements and environmental entitlements held by the VEWH).
- *Delivery bulk entitlement*: this is an entitlement to be supplied with water from another water corporation’s dam or within a water supply system which is regulated by the works of another water corporation.

The bulk entitlement volume for a source bulk entitlement will include the volumes supplied to delivery entitlement holders and other primary entitlement holders specified in the source bulk entitlement. To account for this, primary entitlements are presented inset as a part of the source bulk entitlement. Appendix D lists all Victoria’s bulk entitlements and their entitlement holders.

6.1.8 Allocation account balance

Allocation available under bulk entitlements and licences is presented. Allocation represents the actual water that was available for use and trade in the 2015–16 water year. Individuals or authorities that held water entitlements in Victoria were allocated water based on the size of their entitlement and the available resource. For example, in 2015–16, entitlement holders with high-reliability water shares in the Werribee system were allocated 20% of their entitlement. That is, for every 100 ML of high-reliability entitlement they owned, they were allocated 20 ML of water that could be used or traded.

The tables in this section summarise the water transactions for each basin by entitlement holder or by entitlement holder type (that is, the total water transactions for all water share holders in a particular basin). Where a source bulk entitlement exists, a total diversion is reported. This represents the volume of water diverted from the waterway to supply the primary entitlements that are specified in the bulk entitlement. Where there is a difference between the total diversion from the waterway and the amount supplied to primary entitlement holders, an amount is allocated to an operating provision line item. This allows for any known or unknown loss and/or any unaccounted-for gain in the system.

6.1.9 Estimated small catchment dam information

Small catchment dams are dams that are not located on a defined watercourse but harvest water from their local catchment. The presence of small catchment dams changes the hydrology in a basin by reducing the rate of overland flows (surface run-off), and by altering evaporation and groundwater seepage. Small catchment dams reduce the volume of surface run-off that might otherwise become streamflows in a basin.

In prior Victorian water accounts, the total volume of water harvested by small catchment dams was determined based on estimates of the total volume of small catchment dams in a basin obtained from DELWP’s Sustainable Diversions Limits project in 2002 and Flow Stressed Ranking Procedure project in 2005, and from computer-based simulation modelling of the impact of small catchment dams on mean annual streamflows.

In these Victorian water accounts for 2015–16, the GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. Due to this improved measure of small catchment dam capacity values, our estimation of water harvested, used and lost through small catchment dams has changed from previous years. Changes in reported values are likely to be the result of the improved identification of those small catchment dams with very small capacities (less than 5 ML) and an improved ability to differentiate small catchment dams from other small water bodies such as natural lakes or wetlands. Where the change has resulted in a significant change to the water harvested, an explanatory note has been included in the water balance for the particular basin. More information on this new method can be found in Appendix E.

Estimations of small catchment dam impacts are represented in the river basin water balances (chapter 6) as three separate components.

- The estimated volume harvested by small catchment dams in each basin appears as catchment inflow in the water balance. This is calculating by multiplying the estimated total capacity by an impact factor. This makes an estimate of how much water is harvested by small catchments over the course of a year.
- The estimated volume that owners extract from dams to supply their needs is accounted for as a diversion in the surface water balance. The volume extracted (volume used in each basin) is calculated by multiplying the estimated total capacity by an extraction factor.
- The estimated volume of evaporation from small catchment dams is accounted for as a loss in the surface water balance. This volume is determined to be the difference between the amount harvested and the amount used.

All volumes presented for small catchment dams are annual average figures. In extremely dry years, these annual average figures are factored down to reflect the reduced water availability from lower rainfall. As 2015–16 was not an extremely dry year for any of Victoria’s 29 basins, the average annual volumes have been applied.

6.1.10 Recycled water

Recycled water from towns with wastewater treatment plants has been assigned to basins according to the point of discharge to the receiving waters. If all water from a treatment plant is reused and none is discharged to rivers or lakes, the volume is reported in the basin where the plant is located.

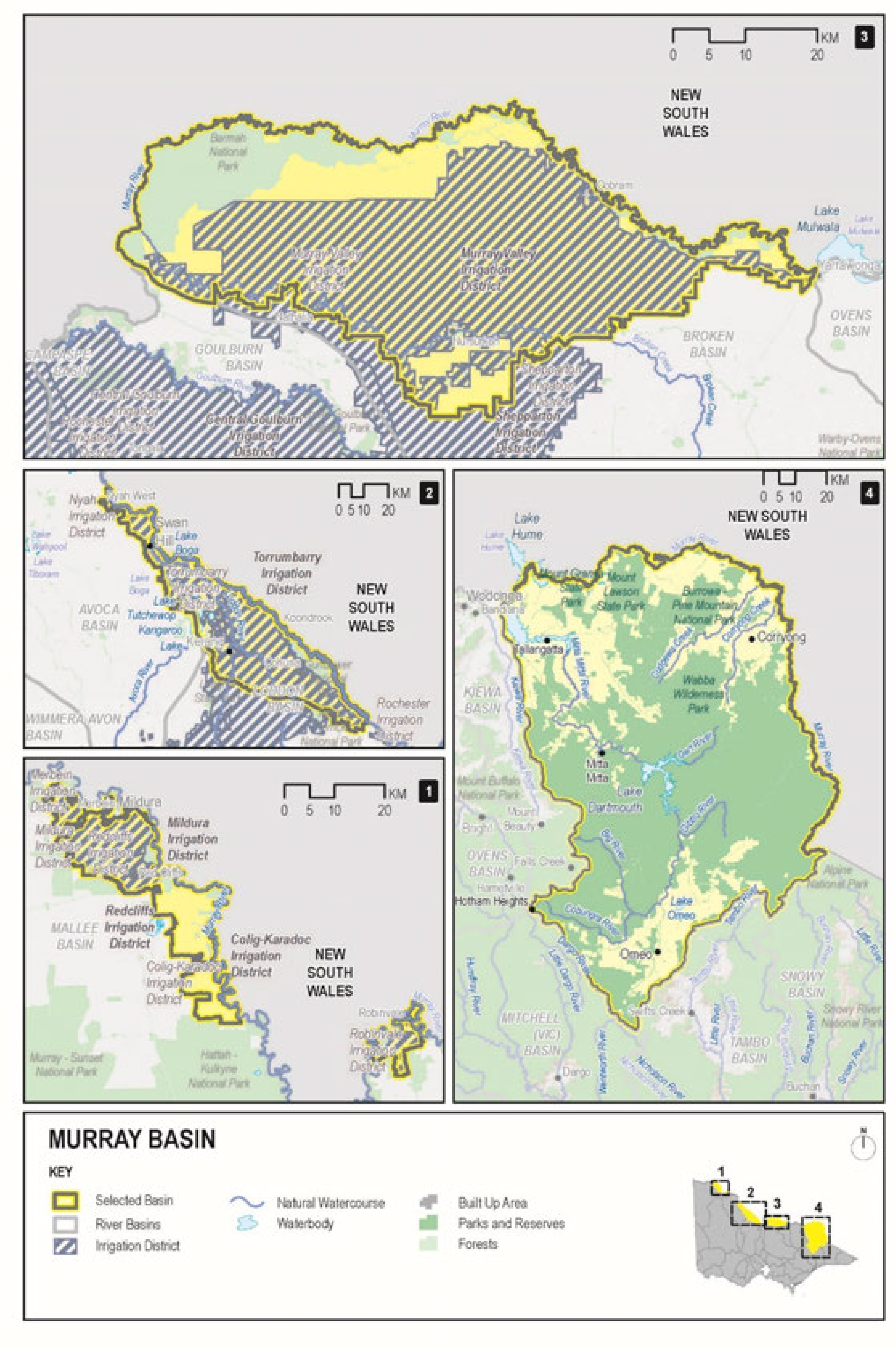
A table in each basin chapter provides information about the following items.

- Volume of wastewater produced (excluding evaporation)
- Total volume recycled
- Percent recycled: excludes 'within plant process' which refers to water reused in sewage treatment processes (for example, to back-flush filters). This value is not included in the total percentage recycled, consistent with its treatment in the Essential Service Commission's performance report.
- A breakdown into the following end-use categories:
  - volume recycled for urban and industrial uses
  - volume recycled for agricultural uses
  - volume recycled for beneficial allocations: refers to the volume used to deliver specific environmental flows benefits
  - volume recycled within plant process: refers to water reused in wastewater treatment processes (for example, to maintain biological processes or back-flush filters). This value is not included in the total 'Percent recycled', consistent with its treatment in the Essential Services Commission's performance report
  - volume discharged to the environment (ocean outfalls or inland water discharges)
  - volume of other discharges: refers to a change in on-site effluent storage or other minor items affecting the annual water balance for recycled water that are not otherwise accounted-for.

6.2 Murray basin (Victoria)

The Murray River forms the border with New South Wales. Victoria shares the volume of water held in the Murray–Darling basin's storages with New South Wales under the Murray–Darling Basin Agreement. For the purposes of this report, the Murray basin includes the Upper Murray basin and areas in Victoria supplied from the Murray River downstream of Lake Hume (Figure 6-1).

Figure 6-1 Map of the Murray basin (Victoria)



6.2.1 Water resources overview

In the eastern part of the Murray basin in 2015–16, rainfall was between 80% and 125% of the long-term average, with a small pocket experiencing between just 40% and 60%. Further west, rainfall ranged from 60% to 125% of the long-term average.

Catchment inflows to the Murray basin in 2015–16 were 37% of the long-term average, lower than in 2014–15 when inflows were 45% of the long-term average.

The volume held in Victoria's share of the major Murray system storages started at 55% of capacity at the beginning of July and was at 38% of capacity at the end of June 2016.

Seasonal allocations in the regulated Murray system began the year at 35%. The seasonal allocation for high-reliability water shares reached 100% by February 2016. There was no seasonal allocation for low-reliability water shares in 2015–16.

Irrigation bans were put in place on the Indigo Creek from December 2015 to May 2016 and Black Dog Creek Upper from October 2015 to July 2016. Licensed diversions were also banned on Waterfall, Sandy and Lockharts creeks during summer until May 2016. Nariel Creek was placed on stage 2 urban use restrictions from early March until mid-May 2016.

In March 2016, Grampians Wimmera Mallee Water applied stage 4 urban use restrictions for two weeks to ten towns (Berriwillock, Chinkapook, Chillingollah, Culgoa, Lalbert, Mangangatang, Mnullawil, Sea Lake, Ultima and Waichie) to restrict demand due to water quality issues related to a blue-green algae bloom on the Murray River. All other towns in the Murray basin remained on permanent water savings rules throughout the year.

The MDBA is responsible under the Commonwealth *Water Act 2007* for the planning and management of Murray–Darling basin water resources on behalf of Victoria, New South Wales, Queensland, the Australian Capital Territory and South Australia. Under the Murray–Darling Basin Agreement, Victoria shares the waters of the Murray River with New South Wales and South Australia. Under normal conditions, Victoria is entitled to a 50% share of all flows upstream of Doctors Point near Albury–Wodonga (that is, flows to Hume and Dartmouth reservoirs and from the Kiewa River), a 50% share of inflows to the Menindee Lakes storage and all flows entering the Murray from the Ovens, Goulburn, Broken and Campaspe rivers. Victoria is also required under the agreement to supply half of South Australia's monthly entitlement flows from the water available to it.

Goulburn–Murray Water in its role as resource manager is responsible for allocating water to bulk entitlement and water share holders from Victoria's share of the water supply storages in the Murray basin.

Table 6-2 shows the responsibilities of the authorities in the Victorian-controlled parts of the Murray basin.

Table 6-2 Responsibilities for water resources management in the Murray basin (Victoria)

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Murray Darling Basin Authority				Jointly coordinates waterway management along the Murray River and operates the Murray supply system
Department of Environment, Land, Water and Planning (Victoria)				Coordinates Victoria's input to resource management associated with the Murray River
State Water (New South Wales)				Operates Lake Hume, Euston Weir and the Menindee Lakes on behalf of the MDBA Obliged to meet passing flow requirements
South Australian Water Corporation				Operates Lake Victoria and several locks on behalf of the MDBA
Goulburn–Murray Water	Supplies Murray Valley, Torrumbarry, Woorinen, Tresco and Nyah irrigation areas	Manages private diversions on the Victorian side of the Murray basin upstream of Nyah		Operates Lake Dartmouth, Yarrawonga Weir (Lake Mulwala), Torrumbarry Weir and Mildura Weir on behalf of the MDBA Obliged to meet passing flow requirements
Lower Murray Water	Supplies Red Cliffs, Robinvale, Merbein and the First Mildura irrigation districts	Manages private diversions in the Sunraysia region	Supplies towns along the Murray River from Swan Hill to the South Australian border	
North East Water			Supplies towns upstream of Lake Mulwala	Obliged to meet passing flow requirements
Goulburn Valley Water			Supplies towns in the Murray Valley Irrigation Area	
Coliban Water			Supplies towns in the Torrumbarry Irrigation Area	

6.2 Murray basin (Victoria)

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
East Gippsland Water			Supplies Omeo and Dinner Plain	Obliged to meet passing flow requirements
Grampians Wimmera Mallee Water			Supplies domestic and stock water to towns and farms in the northern Mallee area	
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
North East Catchment Management Authority				Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west
Mallee Catchment Management Authority				Manages waterways in an area that runs along the Murray River from Nyah to the South Australian border and south to the Wimmera
Goulburn Broken Catchment Management Authority				Manages waterways in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley
North Central Catchment Management Authority				Manages waterways in the region bordered by the Murray River to the north, the Great Dividing Range and Wombat State Forest to the south and Mt Camel Range to the east.

Water for the environment

Important environmental assets depend on water in the Murray basin. The Barmah–Millewa Forest, Gunbower Forest, Hattah Lakes and Kerang Wetlands are located along the Murray River and are all internationally significant wetlands listed under the Ramsar Convention and are also Living Murray Icon sites. The Lindsay, Wallpolla and Mulcra islands Living Murray Icon sites also depend water for the environment in the Murray basin. These sites rely on the freshwater inputs from the Murray River to function ecologically.

In 2015–16, the Murray basin (Victoria) water for the environment comprised the following components:

- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999*, comprising 29,783 ML of high-reliability, 3,893 ML of low-reliability and 40,000 ML of unregulated entitlements held by the VEWH
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Living Murray, comprising 9,589 ML of high-reliability, 101,850 ML of low-reliability and 34,300 ML of unregulated entitlements held by the VEWH on behalf of the MDBA
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Barmah–Millewa Environmental Water Allocation – a significant operational rule embedded in consumptive entitlements, comprising 50,000 ML of high-reliability and 25,000 ML of low-reliability entitlements held by the VEWH
- *Environmental Entitlement (River Murray – NVIRP Stage 1) 2012*, comprising 22,376 ML held by the VEWH, which includes mitigation water allocated for the purposes of watering specific environmental sites that have been identified through the Goulburn–Murray Water Connections Project environmental approvals processes
- *Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004*, comprising 29,794 ML of high-reliability entitlements
- 347,369 ML of high-reliability water shares and 31,913 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released by the MDBA as a condition of the Murray–Darling Basin Agreement
- water set aside for the environment through flow-sharing arrangements set out in North East Water's and East Gippsland Water's bulk entitlements from unregulated rivers
- all other water in the basin not allocated for consumptive use.

A total of 375,481 ML of environmental water was used in the Murray basin in 2015–16: 69,509 ML of this was diverted off-stream while the remaining 305,972 ML was delivered in-stream.

6.2.2 Surface water resources

6.2.2.1 Water balance

Total surface water resources include:

- Victoria's share of inflows to Lake Dartmouth, Lake Hume, Lake Victoria and the Menindee Lakes
- Victoria's share of inflows from the Kiewa River
- outflows from the Ovens, Goulburn, Campaspe and Loddon rivers and from Broken Creek into the Murray River.

The total volumes of water available and supplied from water resources in the Murray basin in 2015–16 are shown in Table 6-3. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Murray basin, the water balance shows catchment inflows in 2015–16 were 595,823 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 3,440,403 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 600,214 ML less (rather than 595,823 ML). For more information, see Appendix E.

Table 6-3 Balance of surface water in the Murray basin (Victoria) [3]

Water account component	2015–16 (ML) (6)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	2,380,526	3,170,910
Volume in storage at end of year	1,626,410	2,634,426
Change in storage	**(754,116)**	**(536,484)**
Inflows		
Catchment inflows (1)	2,840,190	3,436,013
Rainfall on major storages	80,987	80,987
Transfer from NSW (2)	237,200	240,030
Return flows from irrigation	296,148	269,026
Treated wastewater discharged back to river	3,690	3,788
Total inflows	**3,458,214**	**4,029,844**
Outflows		
Diversions		
Urban diversions	41,234	37,720
Irrigation district diversions	1,151,084	1,171,556
Licensed diversions from regulated streams	459,009	431,397
Licensed diversions from unregulated streams	3,747	2,318
Environmental water diversions	69,509	128,101
Transfer to NSW (3)	117,840	115,830
Usage from small catchment dams (4)	12,000	6,445
Total diversions	***1,854,422***	***1,893,367***
Losses		
Evaporation losses from major storages	194,668	194,668
Losses from small catchment dams (4)	0	1,164
In-stream infiltration to groundwater, flows to floodplain and evaporation (5)	583,240	585,530
Total losses	***777,908***	***781,362***
Water passed at outlet of basin		
Murray River flows to South Australia from Victoria's allocation	1,580,000	1,891,600
Total water passed at outlet of basin	***1,580,000***	***1,891,600***
Total outflows	**4,208,381**	**4,566,329**

Notes:

(1) Inflows calculated based on estimates of inflows to major on-stream storages plus inflows from tributaries.
(2) Transfers from NSW include internal spills from NSW to Victoria.
(3) Transfers to NSW include internal spills and volumes ceded from Victoria to NSW.
(4) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.
(5) This is the balancing item in this water balance. It is the difference between Victoria's share of the total outflows, total inflows and net change in storage volume.
(6) The volumes in this table may not be consistent with the MDBA's cap compliance reporting due to different accounting entities and methods.

6.2.2.2 Storages and flows

The volume held in major storages in the Murray basin began 2015–16 at 3,170,910 ML (66% of capacity) and ended the year at 2,634,426 (55% of capacity) (Table 6-4). This includes Victoria's share of Lake Cullulleraine, Lake Dartmouth, Lake Hume, Lake Victoria and the Menindee Lakes. Victoria had a zero share of Menindee Lakes during 2015–16 due to storage levels being below the trigger level specified in the Murray-Darling Basin Agreement. When storages levels are low, the available water is reserved for NSW to supply local needs.

The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-4 is the balancing item for each storage. It primarily represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

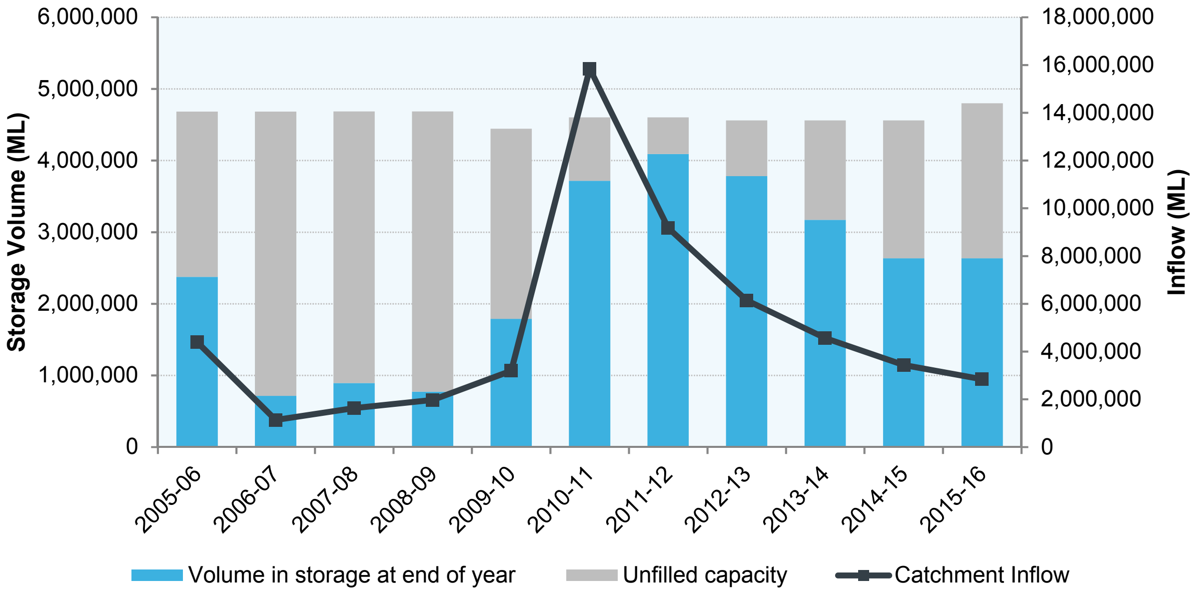
Table 6-4 Storage volumes in the Murray basin (Victoria)

Storage	Total Capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Cullulleraine	5,270	4,326	358	4,257	3,984	4,410
Lake Dartmouth (VIC share)	1,928,116	1,891,300	4,710	7,010	(852,000)	1,037,000
Lake Hume (VIC share)	1,502,579	484,900	10,360	46,960	136,700	585,000
Lake Victoria (VIC share)	338,500	250,900	6,500	69,000	30,000	218,400
Menindee Lakes (VIC share)	1,025,000	0	0	0	0	0
Total storage volumes	**4,799,465**	**2,631,426**	**21,928**	**127,227**	**(681,316)**	**1,844,810**

Victoria's share of catchment inflows was 37% of the long-term average of 7,618,000 ML, lower than in 2014–15 when catchment inflows were 45% of the long-term average (Figure 6-2).

The Victorian component of water flowing from the Murray basin to South Australia was 1,580,000 ML in 2015–16. This represented 56% of the catchment inflows into the basin, compared to 55% in 2014–15.

Figure 6-2 Storage volumes and catchment inflows in the Murray basin (Victoria)



6.2.2.3 Entitlement volumes and diversions

East Gippsland Water, Coliban Water, Goulburn Valley Water, North East Water, Grampians Wimmera Mallee Water, Goulburn–Murray Water, Lower Murray Water, and the Melbourne metropolitan retail water corporations (City West Water, South East Water and Yarra Valley Water) all hold bulk entitlements in the Murray basin. Surface water is also diverted by licensed diverters, and is harvested in small catchment dams.

Entitlements in the Murray basin include rights granted to individuals (water shares and take and use licences) and rights granted to authorities (bulk entitlements granted to water corporations or the VEWH). Rights to water in the Murray basin are outlined in Table 6-5.

Table 6-5 Entitlement volumes in the Murray basin (Victoria)

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999	
High-reliability water shares	921,938
Low-reliability water shares	303,727
High-reliability supply by agreements	1,433
Low-reliability supply by agreements	595
Loss provisions – irrigation district (1)	231,443
Mid Murray Storages - Loss provision	47,371
Sub-total: Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	**1,506,506**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	
High-reliability water shares	322,670
Low-reliability water shares	7,746
High-reliability supply by agreements	0
Waterworks districts	714
Provision for unlicensed domestic and stock use	532
Loss provisions – irrigation district (1)	15,981
Subtotal: Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	**347,643**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Urban) Conversion Order 1999	**30,971**
Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Conversion Order 1999	**3,492**
Bulk Entitlement (River Murray – North East Water) Conversion Order 1999	**13,236**
Bulk Entitlement (River Murray – Goulburn Valley Water) Conversion Order 1999	**5,593**
Bulk Entitlement (River Murray – Coliban Water) Conversion Order 1999	**6,285**
Bulk Entitlement (River Murray – South East Water) Order 2012 (2)	**n/a**
Bulk Entitlement (River Murray – City West Water) Order 2012 (2)	**n/a**
Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012 (2)	**n/a**
Bulk Entitlement (Corryong) Conversion Order 2000	**680**
Bulk Entitlement (Cudgewa) Conversion Order 2000	**29**
Bulk Entitlement (Dartmouth) Conversion Order 2000	**60**
Bulk Entitlement (Omeo) Conversion Order 2008	**77**
Bulk Entitlement (Walwa) Conversion Order 2000	**61**
Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	
High-reliability entitlement	39,371
Low-reliability entitlement	105,744
Unregulated entitlement	74,300
Subtotal: Bulk Entitlement (River Murray - Flora and Fauna) Conversion Order 1999	**219,415**
Environmental Entitlement (River Murray – NVIRP Stage 1) 2012 (3)	**n/a**
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	**29,794**
Take and use licences – unregulated surface water	**16,396**
Total volume of water entitlements in the Murray basin	**2,180,237**

Notes:

(1) The volumes specified are the loss entitlement volumes recorded in the *Victorian Water [Trade] Register*.

(2) These entitlements provide City West Water, South East Water and Yarra Valley Water with a total annual allocation of water equal to one-third of the phase 3 Murray water savings achieved in the previous year under the Goulburn–Murray Water Connections Project Stage 1.

(3) This entitlement provides VEWH with a total annual allocation of water equal to one-third of the phase 3 Murray water savings achieved in the previous year under the Goulburn–Murray Water Connections Project stage 1.

n/a: Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-6. Entitlements to water in regulated systems in the Murray basin provide for the right to carry over unused allocation to the next season. In the Murray basin these entitlement holders can carry over unused water up to 100% of their entitlement volume; any unused water above this amount is written off as an end-of-season forfeiture.

Water held above entitlement volume is also subject to a risk of spill from major storages: no water was written off due to spill events in 2015–16. Water corporations' diversions under bulk entitlements for 2015–16 are presented in Table 6-6. Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report*.

The VEWH diverted 69,509 ML to off-stream wetlands from water available under Victorian environmental entitlements.

Table 6-6 Allocation account balance summary for the Murray basin (Victoria)

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
River Murray – Goulburn Murray Water						
Water shares	292,283	906,652	(443,838)	496,340	7,405	251,353
Supply by agreements	608	1,443	50	1,311	46	744
Loss provision - irrigation district	-	-	-	215,575	-	-
Operating provisions (whole of system) (1)	-	-	-	57,519	-	-
Net diversion: River Murray – Goulburn Murray Water (2)				**770,745**		
River Murray – Lower Murray Urban and Rural Water – Irrigation						
Water shares	76,556	338,270	233,630	526,407	(14,415)	136,463
Supply by agreements	19	(19)	2	0	2	0
Loss provision - irrigation district	-	-	-	13,005	-	-
Diversion: River Murray – Lower Murray Water (3)				**539,412**		
River Murray – Lower Murray Water (Urban)	3,896	30,971	(4,146)	21,942	439	8,339
River Murray – Grampians Wimmera Mallee Water	130	3,486	1,080	3,788	45	863
River Murray – North East Water (4)	1,986	15,075	(2,676)	9,536	491	4,359
River Murray – Goulburn Valley Water	1,151	5,593	15	4,762	100	1,897
River Murray – Coliban Water	827	6,285	2,645	4,647	255	4,855
River Murray – Melbourne retail water corporation (5)	12,218	15,166	(14,063)	0	666	12,654
Corryong	0	680	0	247	433	0
Cudgewa	0	29	0	0	29	0
Dartmouth	0	60	0	25	35	0
Omeo	0	77	0	56	21	0
Walwa	0	61	0	20	41	0
River Murray – Flora and Fauna						
High-reliability entitlement (6)	33,025	593,376	(513,145)	90,428	859	21,968
Low-reliability entitlement (6)	3,752	36,983	246,643	283,507	192	3,679
Unregulated entitlement	0	0	0	0	0	0
Subtotal: River Murray – Flora and Fauna (7)				**373,935**		
River Murray – NVIRP stage 1 (8)	19,089	16,024	(21,575)	1,546	600	11,392
River Murray – Snowy Environmental Reserve	0	29,794	(28,602)	0		1,192
Take and use licences – unregulated surface water	-	16,396	0	4,059	12,337	-

Notes:

(1) Operating provisions include primarily the change in storage and other effects of the Victorian Mid-Murray Storages (Kow Swamp, Lake Charm, Kangaroo Lake and Lake Boga).

(2) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Goulburn–Murray Water Murray system source bulk entitlement (net of return flows from irrigation).

(3) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Lower Murray Urban and Rural Water – Irrigation Murray system source bulk entitlements.

(4) Allocation includes return flows of 1,839 ML credited to North East Water from Wodonga recycled water treatment.

(5) Melbourne retail water corporations' entitlements are held in one account as they each own equal shares of the available allocation.

(6) Allocation includes return flows of 590,987 ML credited to the VEWH from deliveries of environmental water.

(7) Water use reported under this entitlement represents both in-stream use and actual diversions from the waterway. Of the 373,935 ML reported, 67,963 ML represents diversions from the waterway.

(8) Water use reported under the Snowy Environmental Reserve entitlement was all diverted from the waterway. There was no in-stream use in 2015–16.

The estimated total capacity of and total water harvested from small catchment dams in the Murray basin is small, compared with other basins (Table 6-7).

The capacity of small catchment dams for the Murray basin is estimated using GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 6,098 ML more for small catchment dam capacity and an increase of 5,554 ML usage. For more information, see Appendix E.

Table 6-7 Estimated small catchment dam information for the Murray basin (Victoria)

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,287	1,680	n/a
Registered commercial and irrigation	14,379	10,320	n/a
Total	**16,666**	**12,000**	**12,000 (1)**

Notes:
(1) Usage and total water harvested are assumed to be equal due to the model outputting a zero loss.
n/a: information not available.

6.2.3 Recycled water

North East Water, Goulburn Valley Water, Coliban Water, Lower Murray Water and East Gippsland Water run wastewater treatment plants in the Murray basin. About 39% of wastewater passing through the treatment plants in 2015–16 was recycled, a slight decrease from 41% from 2014–15.

Table 6-8 shows the volumes and uses of water recycled in the Murray basin in 2015–16.

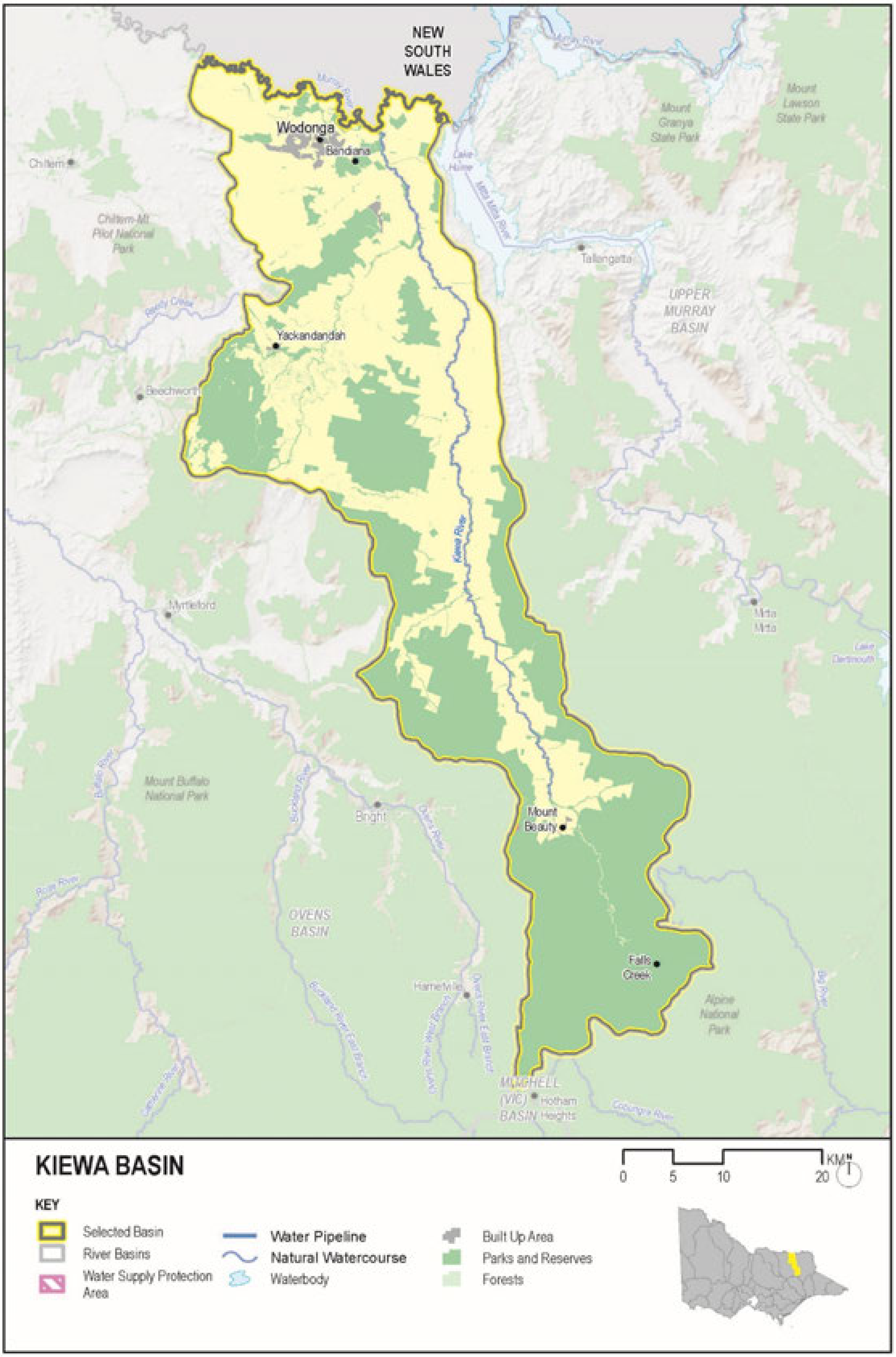
Table 6-8 Volume and use of recycled water in the Murray basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bellbridge	67	67	100%	0	67	0	0	0	0
Bundalong	0	0	0%	0	0	0	0	0	0
Cobram	108	108	100%	0	108	0	0	0	0
Cohuna	0	0	0%	0	0	0	0	0	0
Corryong	72	72	100%	0	72	0	0	0	0
Dartmouth	3	0	0%	0	0	0	0	3	0
Gunbower / Leitchville	0	0	0%	0	0	0	0	0	0
Koondrook	74	0	0%	0	0	0	0	0	74
Koorlong	2,111	1,925	91%	0	1,925	0	0	0	185
Lake Boga	51	0	0%	0	0	0	0	0	51
Merbein	147	0	0%	0	0	0	0	0	147
Mildura	1,365	558	41%	0	558	0	0	0	806
Murrabit	6	0	0%	0	0	0	0	0	6
Nathalia	110	110	100%	0	110	0	0	0	0
Numurkah	83	83	100%	0	83	0	0	0	0
Nyah / Nyah West	63	0	0%	0	0	0	0	0	63
Omeo	33	33	100%	0	33	0	0	0	0
Robinvale	233	307	132%	0	307	0	0	0	(74)
Strathmerton	0	0	0%	0	0	0	0	0	0
Swan Hill	1,121	0	0%	0	0	0	0	0	1,121
Tallangatta	143	143	100%	0	143	0	0	0	0
Walwa	3	3	100%	3	0	0	0	0	0
Wodonga	3,977	290	4%	175	0	0	114	3,688	0
Yarrawonga	327	327	100%	0	327	0	0	0	0
Total 2015–16	**10,097**	**4,026**	**39%**	**178**	**3,733**	**0**	**114**	**3,691**	**2,379**
Total 2014–15	10,232	4,271	41%	161	4,012	0	98	3,788	2,173

6.3 Kiewa basin

The Kiewa basin (Figure 6-3) is located in northern Victoria and drains to the Murray River. The Kiewa River is about 100 km long, extending from the Bogong High Plains, draining northward to the Murray River.

Figure 6-3 Map of the Kiewa basin



6.3.1 Water resources overview

In 2015–16, rainfall in the Kiewa basin was generally between 80% and 100% of the long-term average, though a small area in the north-west of the basin received between 100% and 125% of the long-term average.

Catchment inflows were 69% of the long-term average, compared to 70% in 2014–15. The volume of water flowing out of the Kiewa River into the Murray basin represented 90% of the Kiewa basin's total inflows.

The major water storages in the Kiewa basin finished the year at 62% of capacity, compared to 53% of capacity at the start of the year.

Restrictions to irrigation use were applied in December 2015, when 10 creeks were subject to restrictions. These systems had also been subject to restrictions in the prior year. During the 2015–16 year, irrigation use was restricted in a total of 16 unregulated streams by March 2016 and these restrictions remained in place until late May 2016, when restrictions were removed for nine of the creeks. By the end of June 2016 irrigation use remained restricted in seven creeks.

No urban water use restrictions applied in the Kiewa basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-9 shows the responsibilities of the authorities in the Kiewa basin.

Table 6-9 Responsibilities for water resources management in the Kiewa basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Manages private diversions		Obliged to meet passing flow requirements
North East Water		Supplies towns across the basin including Wodonga and Mount Beauty	Obliged to meet passing flow requirements
AGL Hydro			Operates reservoirs in the Kiewa basin for hydropower generation Obliged to meet passing flow requirements
North East Catchment Management Authority			Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west

Water for the environment

Important environmental assets (such as threatened remnant vegetation and the Murray cod) exist in the reaches of the West Kiewa River and lower Kiewa River and depend on water in the Kiewa basin. Water from the Kiewa basin also flows into the Murray River, helping to protect environmental assets in the Murray basin.

In 2015–16, water for the environment in the Kiewa basin comprised:

- water set aside for the environment through flow-sharing arrangements, and the operation of passing flows released as a condition of bulk entitlements held by North East Water and AGL Hydro Ltd
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.3.2 Surface water resources

6.3.2.1 Water balance

The total volumes of water available and supplied from water resources in the Kiewa basin in 2015–16 are shown in Table 6-10. Outflows from the Kiewa basin are shared on a 50-50 basis between Victoria and New South Wales in the Murray system.

Outflows from the Kiewa basin were lower in 2015–16 (Table 6-10) than those reported in the *Victorian Water Accounts 2014–15*. Only a small proportion of the surface water resources in the Kiewa basin (2.2%) was extracted for consumptive use, which is slightly higher than 2014–15 (1.5%).

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Kiewa basin, the water balance shows catchment inflows in 2015–16 were 8,259 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 486,496 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 12,636 ML less (rather than 8,259 ML). For more information, see Appendix E.

6.3 Kiewa basin

Table 6-10 Balance of surface water in the Kiewa basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	15,548	11,828
Volume in storage at end of year	18,473	15,548
Change in storage	**2,925**	**3,720**
Inflows		
Catchment inflow (1)	473,860	482,119
Rainfall on major storages	3,815	3,561
Treated wastewater discharged back to river (2)	310	304
Total inflows	**477,985**	**485,984**
Outflows		
Diversions		
Urban diversions	527	628
Licensed diversions from unregulated streams	4,571	2,894
Usage from small catchment dams (3)	7,440	3,927
Total diversions	***12,538***	***7,449***
Losses		
Evaporation losses from major storages	2,895	2,738
Losses from small catchment dams (3)	1,963	1,099
In-stream infiltration to groundwater, flows to floodplain and evaporation	31,138	32,554
Total losses	***35,996***	***36,391***
Water passed at outlet of basin		
Kiewa basin outflow to Murray River - Victoria share	213,263	219,212
Kiewa basin outflow to Murray River - NSW share	213,263	219,212
Total water passed at outlet of basin	***426,526***	***438,424***
Total outflows	**475,060**	**482,264**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows and net change in storage volume.

(2) Includes returns from the Falls Creek Alpine Resort to Rocky Valley Creek.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.3.2.2 Storages and flows

Storage levels for all major on-stream and off-stream storages in the basin were 18,888 ML (62% of capacity) by the end of June 2016, compared to 16,113 ML (53% of capacity) at the start of July 2015 (Table 6-11). The volume reported in the 'Catchment inflows less regulated releases' column is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

Table 6-11 Storage volumes in the Kiewa basin

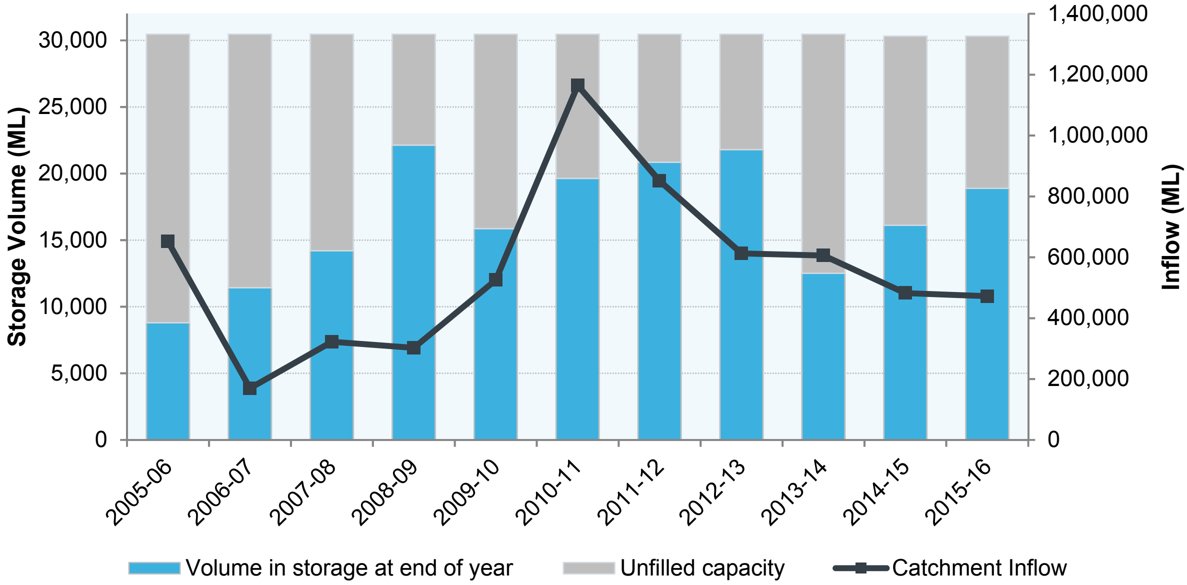
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Guy	1,416	445	206	156	(135)	359
Rocky Valley	28,294	15,103	3,609	2,738	2,140	18,114
Total on-stream storages	**29,710**	**15,548**	**3,815**	**2,894**	**2,005**	**18,473**
Off-stream storages						
Clover Pondage	255	210	n/a	n/a	(150)	60
Pretty Valley basin	355	355	n/a	n/a	0	355
Total off-stream storages	**610**	**565**	**n/a**	**n/a**	**(150)**	**415**
Total storage volumes	**30,320**	**16,113**	**3,815**	**2,894**	**1,855**	**18,888**

n/a: Information not available.

The catchment inflow volume for 2015–16 was 472,183 ML, representing 69% of the long-term average of 689,000 ML. The volume of water flowing from the Kiewa basin into the Murray River decreased to 426,526 ML in 2015–16 (including the New South Wales share of Kiewa River flows under the Murray–Darling Basin Agreement). This volume was about 11,898 ML less than the 2014–15 outflow volume of 438,424 ML. The volume of water flowing from the Kiewa basin into the Murray River in 2015–16 represented 90% of the total inflows into the Kiewa basin, which is similar to the percentage of inflows in the previous year.

Figure 6-4 illustrates total storage volume and catchment inflows for 2015–16, compared to the previous 10 years.

Figure 6-4 Storage volumes and catchment inflows



6.3.2.3 Entitlement volumes and diversions

In the Kiewa basin, surface water is diverted by North East Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements include rights granted to individuals (water shares and take and use licences) and rights granted to authorities (bulk entitlements granted to water corporations or the VEWH). Rights to water in the Kiewa basin are in Table 6-12.

Table 6-12 Entitlement volumes in the Kiewa basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Kiewa – Hydro) Conversion Order 1997 (1)	n/a
Bulk Entitlement (Kiewa – Tangambalanga) Conversion Order 2000	179
Bulk Entitlement (Mount Beauty – Tawonga) Conversion Order 1997	718
Bulk Entitlement (Yackandandah) Conversion Order 2001	209
Take and use licences – unregulated surface water	15,632
Total volume of water entitlements in the Kiewa basin	**16,738**

Note:

(1) This bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes. All water diverted under this entitlement must be returned to the waterway.

n/a: Specified volume is not applicable.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-13. Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.* Because the system is unregulated, carryover provisions are not available for entitlement holders. All unused seasonal allocation water is therefore forfeited at the end of the season.

6.3 Kiewa basin

Table 6-13 Allocation account balance summary for the Kiewa basin

Water entitlement	Allocation issued (ML)	Net trade In / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Kiewa – Hydro [(1)]	0	0	0	0
Kiewa – Tangambalanga	179	0	0	179
Mount Beauty – Tawonga	718	0	362	356
Yackandandah	209	0	166	43
Take and use licences – unregulated surface water	15,632	20	4,571	11,081

Note:

(1) This bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes. All water diverted under this entitlement must be returned to the waterway, therefore no volumes are reported as diversions for the purposes of this table.

The estimated volume of water harvested from small catchment dams in the Kiewa basin is provided in Table 6-14. The capacity of small catchment dams for Kiewa basin is estimated using GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 5,471 ML more for small catchment dam capacity and an increase of 3,513 ML usage. For more information, see Appendix E.

Table 6-14 Estimated small catchment dam information for the Kiewa basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	7,157	3,579	n/a
Registered commercial and irrigation	4,597	3,861	n/a
Total	**11,754**	**7,440**	**9,403**

n/a: Information not available.

6.3.3 Recycled water

North East Water and East Gippsland Water operate wastewater treatment plants in the Kiewa basin. About 41% of wastewater was recycled in 2015–16, the same percentage as estimated in 2014–15. In addition, 121 ML was returned from the Falls Creek Alpine Resort to Rocky Valley Creek during the water year.

Table 6-15 highlights the volumes and uses of water recycled in the Kiewa basin in 2015–16.

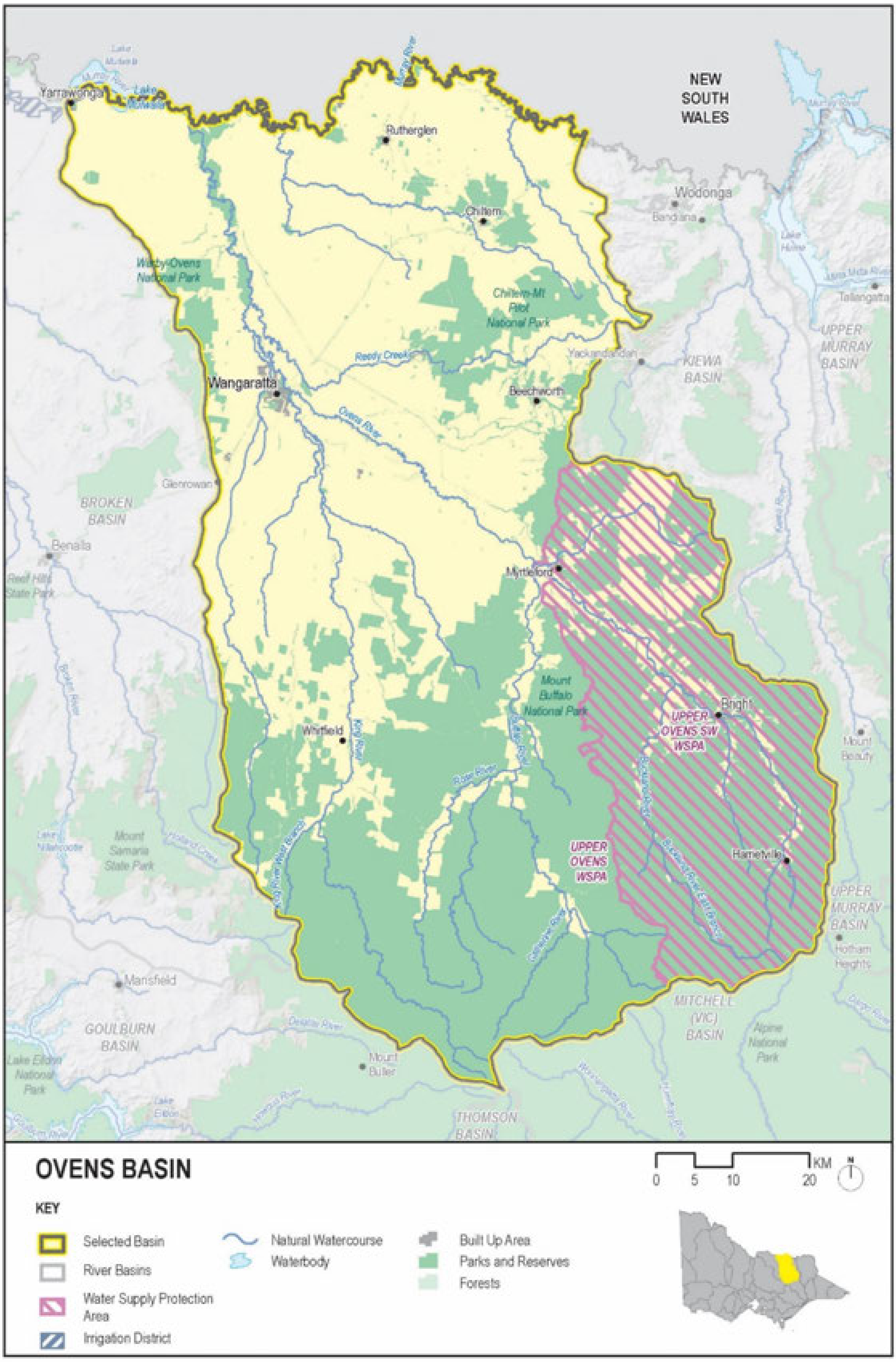
Table 6-15 Volume and use of recycled water in the Kiewa basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Baranduda	0	0	0%	0	0	0	0	0	0
Dinner Plain	51	51	100%	0	51	0	0	0	0
Mount Beauty	197	8	4%	8	0	0	0	189	0
Yackandandah	73	73	100%	0	73	0	0	0	0
Total 2015–16	**321**	**132**	**41%**	**8**	**124**	**0**	**0**	**189**	**0**
Total 2014–15	314	129	41%	6	123	0	0	185	0

6.4 Ovens basin

The Ovens basin (Figure 6-5) is located in north-east Victoria and covers an area of 7,985 km^2. It covers an area that extends from the Murray River in the north to the Great Dividing Range in the south and is bordered by the Broken basin in the west and the Kiewa basin in the east.

Figure 6-5 Map of the Ovens basin



6.4.1 Water resources overview

In 2015–16, rainfall across most of the Ovens basin was 80% to 100% of the long-term average, with the northern part of the basin receiving 100% to 125%.

Catchment inflows in 2015–16 were 41% of the long-term average annual volume: a decrease from the previous year. The volume of water flowing out of the Ovens basin into the Murray River represented 90% of the Ovens basin's total inflows.

The total volume of water held in major storages in the Ovens basin finished the year at 77% of capacity, similar to 76% at the start of the year.

Licensed diversions on unregulated streams were mostly unrestricted in late 2015, but a hot, dry summer led to irrigation restrictions being imposed on 23 streams by March 2016. By June 2016, Roberts Creek was the only stream with an irrigation ban still in place in the basin.

No urban water use restrictions were applied in the Ovens basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-16 shows the responsibilities of the authorities in the Ovens basin.

Table 6-16 Responsibilities for water resources management in the Ovens basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies primary entitlements on the regulated Ovens and King system	Manages licensed diversions		Operates Lake Buffalo and Lake William Hovell Obliged to meet passing flow requirements
North East Water			Supplies towns including Wangaratta, Bright, Myrtleford, Beechworth and Chiltern	Obliged to meet passing flow requirements
North East Catchment Management Authority				Manages waterways in the region bounded by the Murray River in the north, the Victorian Alps in the south, the NSW border in the east and the Warby Ranges in the west

Water for the environment

The Lower Ovens River, which contains heritage and iconic reaches, is an important environmental asset that depends on water in the Ovens basin. Water from the Ovens basin also feeds into the Murray basin, helping to maintain the Murray basin's environmental assets.

In 2015–16, water for the environment in the Ovens basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Goulburn–Murray Water on the regulated rivers
- water set aside for the environment through flow-sharing arrangements set out in North East Water's bulk entitlements in the unregulated rivers
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, including those set out in the *Upper Ovens River Water Management Plan*
- 70 ML of high-reliability water shares held for the environment
- all other water in the basin not allocated for consumptive use.

In 2015–16, 70 ML of environmental water was diverted off-stream in the Ovens basin.

6.4.2 Surface water resources

6.4.2.1 Water balance

The total volumes of water available and supplied from water resources in the Ovens basin in 2015–16 are shown in Table 6-17. The volume of surface water resources in 2015–16 decreased to 719,258 ML, compared to 947,280 ML in 2014–15. Total water use was less than the previous year, with total use of 41,897 ML in 2015–16, compared to 39,097 ML in 2014–15.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Ovens basin, the water balance shows catchment inflows in 2015–16 were 228,980 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 955,536 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 241,516 ML less (rather than 228,980 ML). For more information, see Appendix E.

Table 6-17 Balance of surface water in the Ovens basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	28,035	30,522
Volume in storage at end of year	28,512	28,035
Change in storage	**477**	**(2,487)**
Inflows		
Catchment inflow (1)	713,835	943,000
Rainfall on major storages	3,663	2,864
Treated wastewater discharged back to river	1,690	1,416
Total inflows	**719,188**	**947,280**
Outflows		
Diversions		
Urban diversions	5,582	5,428
Licensed diversions from regulated streams	8,086	7,462
Licensed diversions from unregulated streams (2)	4,405	10,319
Small catchment dams (3)	23,754	15,888
Total diversions	***41,827***	***39,097***
Losses		
Evaporation losses from major storages	3,796	3,781
Evaporation from small catchment dams (3)	9,184	4,514
In-stream infiltration to groundwater, flows to floodplain and evaporation	14,936	14,936
Total losses	***27,916***	***23,231***
Water passed at outlet of basin		
Ovens basin outflow to Murray River	648,968	887,438
Total water passed at outlet of basin	***648,968***	***887,438***
Total outflows	**718,711**	**949,766**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The 2014–15 licensed diversions from unregulated streams value was incorrectly published in the *Victorian Water Accounts 2014–15* as 15,751 ML.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.4.2.2 Storages and flows

The total volume of water held in major storages in the Ovens basin was 28,035 ML (or 76% of capacity) at 1 July 2015 and 28,512 ML (or 77% of capacity) by the end of June 2016 (Table 6-18). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-18 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and it may include other minor components influencing the change in the volume in storage during the year.

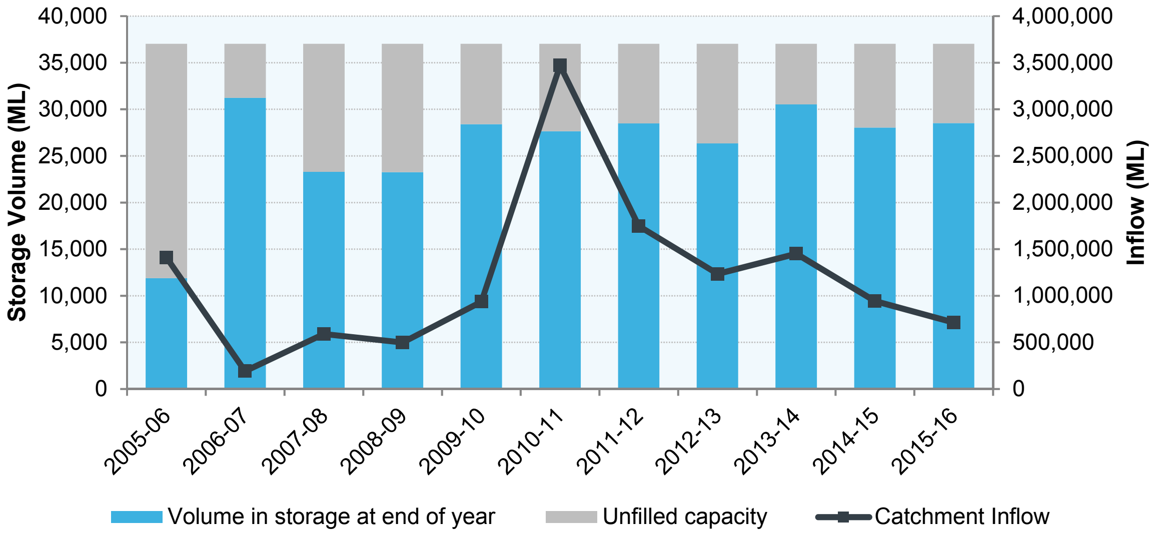
Table 6-18 Storage volumes in the Ovens basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Buffalo	23,340	14,610	2,553	2,994	488	14,657
Lake William Hovell	13,690	13,425	1,110	802	122	13,855
Total storage volumes	**37,030**	**28,035**	**3,663**	**3,796**	**610**	**28,512**

Catchment inflows in 2015–16 were 41% of the long-term annual average (1,758,000 ML), compared to 54% in 2014–15. The volume of water flowing from the Ovens basin into the Murray River was 648,968 ML in 2015–16. This represented 90% of the total inflows into the basin, compared to 93% in 2014–15.

Figure 6-6 shows the storage levels and inflow volumes in the Ovens basin from 2005–06 to 2015–16.

Figure 6-6 Storage volumes and catchment inflows in the Ovens basin



6.4.2.3 Entitlement volumes and diversions

In the Ovens basin, water is diverted by Goulburn–Murray Water, North East Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Ovens basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Ovens basin are outlined in Table 6-19.

Table 6-19 Entitlement volumes in the Ovens basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Ovens System – Goulburn Murray Water) Conversion Order 2004 (1)	
High-reliability water shares	26,203
Spill reliability water shares	12,520
Bulk Entitlement (Ovens System – Moyhu, Oxley and Wangaratta – North East Water) Conversion Order 2004	7,832
Subtotal: Bulk Entitlement (Ovens System – Goulburn Murray Water) Conversion Order 2004	**46,555**
Bulk Entitlement (Beechworth) Conversion Order 2001	**1,100**
Bulk Entitlement (Bright) Conversion Order 2000 (2)	**870**
Bulk Entitlement (Chiltern) Conversion Order 2000	**180**
Bulk Entitlement (Glenrowan) Conversion Order 1999	**90**
Bulk Entitlement (Harrietville) Conversion Order 1999	**91**
Bulk Entitlement (Myrtleford) Conversion Order 2001 (3)	**1,470**
Bulk Entitlement (Springhurst) Conversion Order 1999	**36**
Bulk Entitlement (Whitfield) Conversion Order 1999	**34**
Take and use licences – unregulated surface water	**17,060**
Total volume of water entitlements in the Ovens basin	**67,487**

Notes:

(1) Under this bulk entitlement, Goulburn–Murray Water operates Lake Buffalo and Lake William Hovell to supply to water share holders in the regulated part of the Ovens system and to supply water to North East Water's Ovens system bulk entitlement for Wangaratta, Oxley and Moyhu.

(2) On 16 October 2014, the *Bulk Entitlement (Bright) Conversion Order 2000* was amended and the *Bulk Entitlement (Porepunkah) Conversion Order 1999* was repealed to reflect infrastructure changes in the system (the construction of an off-river storage at Freeburgh). As part of this amendment, the water entitlement previously held under the Porepunkah bulk entitlement was transferred to the Bright bulk entitlement.

(3) This entitlement specifies that up to 1,470 ML can be diverted in any one year. The maximum volume that can be taken over any two-year period is 2,424 ML (1,212 ML annual average).

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-20. Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Murray–Kiewa–Ovens valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-20 Allocation account balance summary for the Ovens basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Ovens system – Goulburn-Murray Water				
Water shares (1)	28,730	0	8,156	20,575
Ovens system – Moyhu, Oxley and Wangaratta	7,832	0	3,500	4,332
Diversion: Ovens system – Goulburn-Murray Water (2)			**11,586**	
Beechworth	1,100	0	589	511
Bright	870	0	869	1
Chiltern (3)	180	0	0	180
Glenrowan	90	(40)	0	50
Harrietville	91	0	67	24
Myrtleford	1,212	0	557	655
Springhurst	36	0	0	36
Whitfield	34	0	0	34
Take and use licences – unregulated surface water (4)	16,879	551	4,405	13,025

Notes:

(1) Water use reported includes 70 ML of environmental in-stream use. This amount is not reflected in the water balance in Table 6-17 as it does not reflect an actual diversion from the waterway.

(2) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Ovens system source bulk entitlement. It does not include water delivered in-stream for environmental purposes.

(3) North East Water has not diverted any water under this bulk entitlement since February 2008 when Chiltern was connected to the Wodonga supply system.

(4) Net trade encompasses temporary and permanent trades in and out of the Ovens basin. The net value of 551 ML represents water traded in from the Upper Ovens GMU.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Ovens basin (Table 6-21).

The capacity of small catchment dams for the Ovens basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 15,288 ML more for small catchment dam capacity and an increase of 7,866 ML usage. For more information, see Appendix E.

Table 6-21 Estimated small catchment dam information for the Ovens basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,375	14,688	n/a
Registered commercial and irrigation	10,793	9,066	n/a
Total	**40,168**	**23,754**	**32,938**

n/a: information not available.

6.4.3 Recycled water

North East Water operates all wastewater treatment plants in the Ovens basin. About 41% of the wastewater was recycled in 2015–16, similar to the estimated 42% in 2014–15.

Table 6-22 highlights the volumes and uses of water recycled in the Ovens basin in 2015–16.

Table 6-22 Volume and use of recycled water in the Ovens basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Barnawartha	0	0	0%	0	0	0	0	0	0
Beechworth	338	111	33%	0	111	0	0	227	0
Bright / Porepunkah	341	27	8%	27	0	0	0	314	0
Chiltern	50	50	100%	0	50	0	0	0	0
Myrtleford	323	0	0%	0	0	0	0	323	0
Rutherglen / Wahgunyah	130	130	100%	61	69	0	0	0	0
Wangaratta	1,494	854	57%	5	849	0	0	640	0
Wangaratta Trade Waste	185	0	0%	0	0	0	0	185	0
Total 2015–16	**2,861**	**1,172**	**41%**	**93**	**1,079**	**0**	**0**	**1,689**	**0**
Total 2014–15	2,437	1,022	42%	89	933	0	0	1,415	0

6.5 Broken basin

The Broken basin (Figure 6-7) is located in northern Victoria. It includes the Broken River, which flows into the Goulburn River at Shepparton, and Broken Creek, which flows into the Murray River at Barmah. For the purposes of these Water Accounts, the Broken basin excludes the Murray Valley Irrigation Area.

Figure 6-7 Map of the Broken basin

6.5.1 Water resources overview

In 2015–16, rainfall across the Broken basin was 80% to 100% of the long-term average in much of the basin. A small southern area of the basin received 60% to 80% while a small northern area receiving 100% to 125% of the average rainfall. Total catchment inflows were 25% of the long-term average of 308,000 ML, lower than the previous year which had inflows of 45% of the long-term average.

Major storages in the Broken basin were at 32% of capacity at the end of the 2015–16, after being at 55% of capacity at the start.

The year began with a 0% seasonal allocation for high-reliability water shares for Broken system irrigators. The seasonal allocation for high-reliability water shares only reached 26% in February and went no higher.

An irrigation ban was in place on Boosey Creek from December 2015 until July 2016 and on Lima and Lima East creeks from December to end of May 2016. Hollands Creek and Ryans Creek were also subject to irrigation bans from early December to June 2016. There were no restrictions on urban water use in the Broken basin during 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-23 shows the responsibilities of the authorities within the Broken basin.

Table 6-23 Responsibilities for water resources management in the Broken basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies primary entitlements for the Broken River and the Tungamah domestic and stock supply system	Manages licensed diversions	Provides bulk water supplies to Goulburn Valley Water (1) and North East Water	Operates Lake Nillahcootie and weirs on Broken River Obliged to meet passing flow requirements
North East Water			Supplies towns across most of the Broken basin including Benalla	Operates Loombah-McCall Say Reservoir Obliged to meet passing flow requirements
Goulburn Valley Water			Supplies towns in the west of the basin including Dookie (1)	
Goulburn Broken Catchment Management Authority				Manages waterways in the region comprising of the catchments of the Goulburn and Broken rivers and part of the Murray River valley

Note:

(1) Urban water systems managed by Goulburn Valley Water in the Broken basin are supplied water from the Goulburn and Murray systems.

Water for the environment

Important environmental assets (such as the Murray cod, the trout cod and significant areas of intact riparian and floodplain vegetation) depend on the Broken basin water for the environment. Sites in Broken Creek and Lower Broken Creek are similarly dependent, and contain native fish habitat and a wetland of national significance. Water from the Broken basin also feeds into the Murray basin, helping to maintain internationally significant environmental assets within that basin.

In 2015–16, water for the environment in the Broken basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by North East Water and Goulburn–Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use
- 253 ML of high-reliability water shares and 4 ML low-reliability water shares held for the environment.

In 2015–16, 500 ML of environmental water was diverted off-stream in the Broken basin.

6.5.2 Surface water resources

6.5.2.1 Water balance

The total volumes of water available and supplied from water resources in the Broken basin in 2015–16 are shown in Table 6-24. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Broken basin, the water balance shows catchment inflows in 2015–16 were 61,871 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 141,754 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 64,297 ML less (rather than 61,871 ML). For more information, see Appendix E.

Table 6-24 Balance of surface water in the Broken basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	23,060	35,040
Volume in storage at end of year	13,562	23,060
Change in storage	**(9,498)**	**(11,980)**
Inflows		
Catchment inflows (1)	77,457	139,328
Rainfall on major storages	2,137	2,926
Total inflows	**79,594**	**142,254**
Outflows		
Diversions		
Urban diversions	1,538	1,390
Licensed diversions from regulated streams	8,296	10,338
Licensed diversions from unregulated streams (2)	764	888
Environmental water diversions	500	887
Usage from small catchment dams (3)	16,766	15,738
Total diversions	***27,864***	***29,241***
Losses		
Evaporation losses from major storages	3,459	4,366
Losses from small catchment dams (3)	8,625	7,227
In-stream infiltration to groundwater, flows to floodplain and evaporation	9,185	7,338
Total losses	***21,269***	***18,931***
Water passed at outlet of basin		
Broken River at Gowangardie to Goulburn basin	38,514	102,464
Boosey Creek at Tungamah to Murray basin	346	2,228
Broken Creek at Katamatite to Murray basin	1,099	1,370
Total water passed at outlet of basin	***39,959***	***106,062***
Total outflows	**89,092**	**154,234**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume. The 2014–15 report incorrectly reported a volume of 2,960 ML as volume diverted from unregulated streams.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.5.2.2 Storages and flows

The volume of water held in major storages in the Broken basin was 13,562 ML at the end of June 2016, almost half of the storage volume at the start of the year (Table 6-25). The volume reported in the 'Catchment inflows less regulated releases' column in the table is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and it may include other minor components influencing the change in storage during the year.

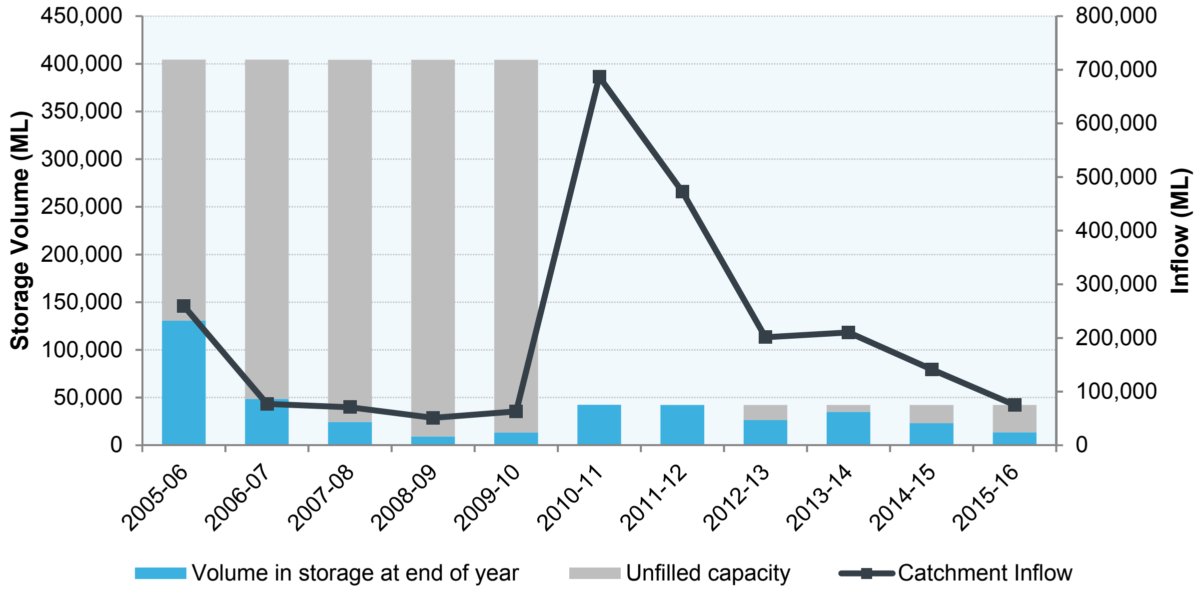
Table 6-25 Storage volumes in the Broken basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Nillahcootie	40,400	21,434	1,832	2,643	(8,808)	11,815
Loombah – McCall Say	1,747	1,626	305	816	632	1,747
Total storage volumes	**42,147**	**23,060**	**2,137**	**3,459**	**(8,176)**	**13,562**

Catchment inflows were 25% of the long-term average of 308,000 ML, lower than the 46% recorded in 2014–15 (Figure 6-8).

The amount of water flowing from the Broken basin into the Goulburn and Murray rivers decreased to 39,959 ML in 2015–16. This represented 53% of the Broken basin's total inflows, compared to 68% in 2014–15.

Figure 6-8 Storage volumes and catchment inflows in the Broken basin



Note:

(1) Before 2010–11, Lake Mokoan was included as a storage in the Broken basin. Lake Mokoan was decommissioned in 2010 and water supply from this storage ceased. It is therefore no longer included in the total storage capacity for Broken basin.

6.5.2.3 Entitlement volumes and diversions

In the Broken basin, surface water is diverted by Goulburn–Murray Water, North East Water, and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Broken basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Broken basin are outlined in Table 6-26.

Table 6-26 Entitlement volumes in the Broken basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Broken System Goulburn Murray Water) Conversion Order 2004 [(1)]	
High-reliability water shares	17,625
Low-reliability water shares	3,345
Bulk Entitlement (Broken System – Tungamah Devenish and St James – North East Water) Conversion Order 2004	135
Loss provision	1,850
Subtotal: Bulk Entitlement (Broken System Goulburn Murray Water) Conversion Order 2004	**22,955**
Bulk Entitlement (Loombah McCall – Say) Conversion Order 2001	**2,324**
Take and use licences – unregulated surface water	**2,822**
Total volume of water entitlements in the Broken basin	**28,102**

Note:

(1) Under this bulk entitlement, Goulburn–Murray Water operates Lake Nillahcootie to supply water share holders in the regulated part of the Broken system, and to supply water to North East Water's bulk entitlement for t Tungamah, Devenish and St James.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-27. Entitlements to water in regulated systems in the Broken basin provide for the right to carry over unused allocation to the next season. In the Broken basin these entitlement holders can carry over unused water up to 50% of their entitlement volume; any unused water above this amount is written-off (end-of-season forfeiture).

Diversions under bulk entitlements in the Broken basin are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-27 Allocation account balance summary for the Broken basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Broken system – Goulburn-Murray Water						
Water shares (1)	4,766	4,583	(714)	3,804	1,202	3,628
Tungamah, Devenish and St. James (2)	64	68	0	0	68	64
Loss provision	-	-	-	2,066	-	-
Diversion: Broken system – Goulburn-Murray Water (3)				**5,870**		
Loombah – McCall Say (Benalla)	-	2,324	0	1,538	786	-
Take and use licences – unregulated surface water	-	2,744	77	2,423	398	-

Notes:

(1) Water use reported includes 500 ML of environmental use, which was diverted to Moodies Swamp.

(2) North East Water transferred its offtake for this bulk entitlement to upstream of Benalla Weir in October 2009, but does not yet have infrastructure in place to supply water under this entitlement. In 2015–16, these towns continued to be supplied with water via a pipeline from Yarrawonga in the Murray system.

(3) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Broken system source bulk entitlement.

The estimated volume of water harvested from small catchment dams represented the largest diversion of surface water in the Broken basin (Table 6-28).

The capacity of small catchment dams for Broken basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 2,637 ML more for small catchment dam capacity and an increase of 1,027 ML usage. For more information, see Appendix E.

Table 6-28 Estimated small catchment dam information for the Broken basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	18,875	9,438	n/a
Registered commercial and irrigation	8,724	7,328	n/a
Total	**27,599**	**16,766**	**25,391**

n/a: information not available.

6.5.3 Recycled water

North East Water operates the sole wastewater treatment plant in the Broken basin, at Benalla. As with the previous three years, 100% of the wastewater produced in 2015–16 was recycled.

Table 6-29 highlights the volumes and uses of water recycled in the Broken basin in 2015–16.

Table 6-29 Volume and use of recycled water in the Broken basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Benalla	436	436	100%	0	436	0	0	0	0
Total 2015–16	**436**	**436**	**100%**	**0**	**436**	**0**	**0**	**0**	**0**
Total 2014–15	555	555	100%	0	555	0	0	0	0

6.6 Goulburn basin

The Goulburn basin (Figure 6-9) is located in northern Victoria and extends from the Great Dividing Range near Woods Point to the Murray River near Echuca in the north-west.

Figure 6-9 Map of the Goulburn basin

6.6.1 Water resources overview

In 2015–16, rainfall across the Goulburn basin ranged from 60% to 100% of the long-term average. Catchment inflows were 31% of the long-term average, compared to 47% in 2014–15. The amount of water flowing from the Goulburn basin into the Murray River represented 41% of the total inflows into the basin.

The volume of water in major storages in the Goulburn basin started the year at 54% of capacity and ended the year at 38% of capacity.

The seasonal allocation for high-reliability water shares started at 42% and reached 90% in February 2016. There was no seasonal allocation for low-reliability water shares in 2015–16.

September 2015 was the only month during the year when licensed diversions from Sunday Creek were not restricted for a full month. Irrigation bans were put in place in late 2015 on Hughes and Seven creeks, and the Yea River was placed on stage 3 restrictions from mid-December 2016. The Delatite River was placed on restrictions in February and these were removed in mid-May 2016. Irrigation bans were put in place on King Parrot, Strath and Wallaby creeks from late January 2016 until the start of June. By April 2016, the number of streams with irrigation restrictions had increased to eight. However, at the end of June 2016 only Sunday Creek was still restricted.

No urban water use restrictions applied in the Goulburn basin in 2015–16 with all towns remaining on permanent water savings rules throughout the year.

Table 6-30 shows the responsibilities of the authorities within the Goulburn basin.

Table 6-30 Responsibilities for water resources management in the Goulburn basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies Central Goulburn Irrigation District, Rochester Irrigation Area and Shepparton Irrigation Area	Manages surface water diversions	Delivers bulk supplies to many of Goulburn Valley Water's towns and some of Coliban Water's towns	Operates lakes Eildon and Nagambie and the Waranga basin Obliged to meet passing flow requirements
Goulburn Valley Water			Supplies towns located in the Goulburn basin including Shepparton, Alexandra and Seymour	Obliged to meet passing flow requirements for towns with supply from unregulated streams
Coliban Water			Can supply towns located in the Loddon and Campaspe basins from the Goulburn basin including Bendigo	Obliged to meet passing flow requirements
Melbourne Water			Operates the Silver–Wallaby diversion system to Melbourne	Obliged to meet passing flow requirements
Grampians Wimmera Mallee Water			Supplies Quambatook	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
Goulburn Broken Catchment Management Authority				Manages waterways in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley

Water for the environment

Important environmental assets (such as wetlands of national significance, significant areas of intact riparian and floodplains vegetation and endangered flora and fauna species including trout cod and Murray cod) depend on water for the environment in the Goulburn basin. Water from the Goulburn basin also feeds into the Murray basin, helping to maintain internationally significant environmental assets (such as Gunbower Forest and the Hattah Lakes within the Murray basin). Sites in the Goulburn basin that rely on water for the environment include:

- the lower Goulburn River (downstream of Goulburn Weir) which contains a wetland of national significance, native fish habitat and floodplain national park
- Reedy Swamp, a regionally significant wetland that is part of the Lower Goulburn National Park and which contains drought refuge and significant habitat for colonial nesting birds

In 2015–16, water for the environment in the Goulburn basin comprised:

- the *Environmental Entitlement (Goulburn System – Living Murray 2007)*, comprising 39,625 ML of high-reliability and 156,980 ML of low-reliability entitlements held by the VEWH
- the *Goulburn River Environmental Entitlement 2010*, comprising 8,851 ML of high-reliability and 3,140 ML of low-reliability entitlements held by the VEWH
- the *Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012* held by the VEWH, which includes mitigation water allocated for the purposes of watering specific environmental sites that have been identified through the Goulburn–Murray Water Connections Project environmental approvals processes

- the *Bulk Entitlement (Goulburn System – Snowy Environment Reserve) Order 2004*, comprising 30,252 ML of high-reliability and 8,156 ML of low-reliability entitlements
- 289,859 ML of high-reliability water shares and 47,287 ML of low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements (regulated and unregulated systems) held by Goulburn Valley Water and Goulburn–Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- the *Silver and Wallaby Creeks Environmental Entitlement 2006*, which provides passing flow rules on Silver and Wallaby creeks
- all other water in the basin not allocated for consumptive use.

A total of 242,591 ML of environmental water was used in the Goulburn basin in 2015–16; 2,371 ML of this was diverted off-stream while the remaining 240,220 ML was delivered in-stream.

6.6.2 Surface water resources

6.6.2.1 Water balance

The total volumes of water available and supplied from water resources in the Goulburn basin in 2015–16 are shown in Table 6-31. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin.

In the Goulburn basin, the water balance shows catchment inflows in 2015–16 were 540,168 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 1,588,505 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 546,938 ML less (rather than 540,168 ML). For more information, Appendix E.

Table 6-31 Balance of surface water in the Goulburn basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	1,879,721	2,440,563
Volume in storage at end of year	1,204,968	1,879,721
Change in storage	**(674,753)**	**(560,842)**
Inflows		
Catchment inflows (1)	1,045,733	1,581,734
Rainfall on major storages	58,894	94,707
Inflow from Broken River at Gowangardie	38,514	102,464
Inflow from Loddon via the Goulburn supplement	0	0
Return flow from irrigation	0	0
Transfer from Campaspe via Waranga Western Channel	0	0
Treated wastewater discharged back to river	976	1,471
Total inflows	**1,144,117**	**1,780,376**
Outflows		
Diversions		
Urban diversions	28,783	26,048
Irrigation district diversions	1,025,556	1,058,951
Licensed diversions from regulated streams	18,859	22,684
Licensed diversions from unregulated streams (2)	10,496	3,723
Transfer from Silver and Wallaby creeks to Yarra basin	1,059	1,454
Transfers to Melbourne via North-South pipeline (3)	0	0
Environmental water diversions	2,371	0
Usage from small catchment dams (4)	47,106	47,513
Total diversions	***1,134,230***	***1,160,372***
Losses		
Evaporation losses from major storages	83,831	75,390
Losses from small catchment dams (4)	17,243	10,065
In-stream infiltration to groundwater, flows to floodplain and evaporation	112,406	140,480
Total losses	***213,480***	***225,935***
Water passed at outlet of basin		
Goulburn River to Campaspe River via Waranga Western Channel	450	1,778
Goulburn River outflows to Murray River	440,438	929,458
Goulburn River outflows to Murray River via Broken Creek	30,271	23,674
Total water passed at outlet of basin	***471,160***	***954,910***
Total outflows	**1,818,870**	**2,341,217**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The 2014–15 licensed diversions from unregulated streams value was incorrectly reported as 6,452 ML. The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume.

(3) There were no transfers to the Yarra basin via the North-South Pipeline in the 2015–16 water year.

(4) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.6.2.2 Storages and flows

The total volume for all major storages in the basin was 1,449,598 ML at the end June 2016 (or 38% of the total storage capacity), compared to 2,053,916 ML at the start of July 2015 (Table 6-32). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-32 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

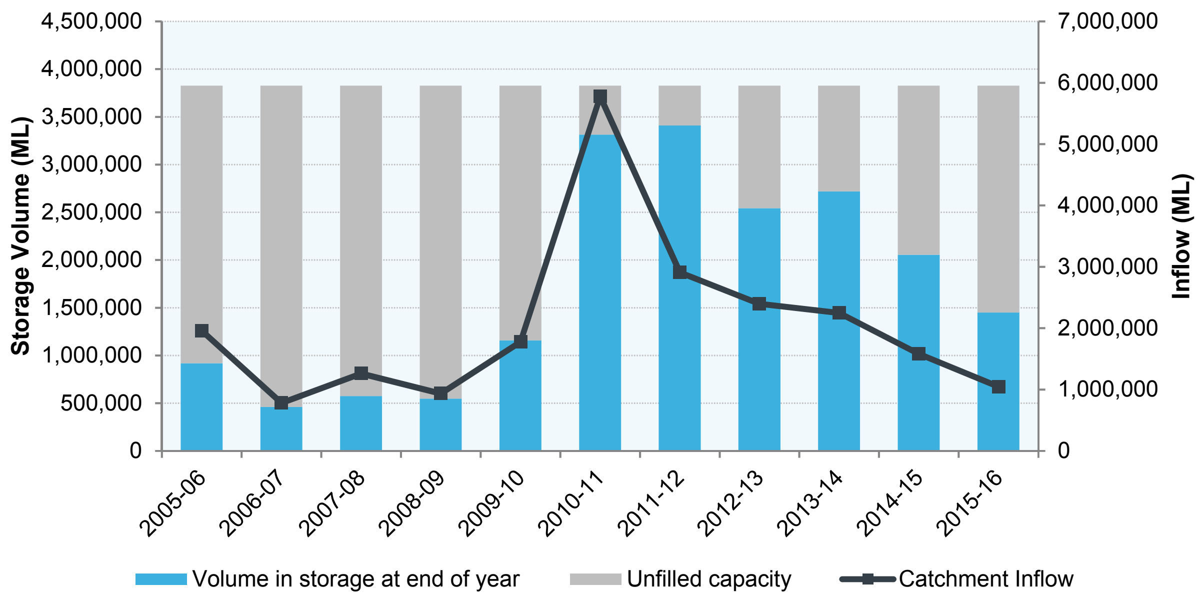
Only volumes for major on-stream storages have been included in the water balance in Table 6-32. Major off-stream storages (such as Waranga basin and Greens Lake) have not been included.

Table 6-32 Storage volumes in the Goulburn basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Goulburn Weir	25,500	25,268	5,602	12,319	1,583	20,134
Lake Eildon	3,334,158	1,853,395	53,199	71,377	(651,022)	1,184,195
Sunday Creek Reservoir	1,650	1,058	93	135	(377)	639
Total on-stream storages	**3,361,308**	**1,879,721**	**58,894**	**83,831**	**(649,816)**	**1,204,968**
Off-stream storages						
Greens Lake	32,500	22,370	2,047	5,236	(1,320)	17,862
Waranga basin	432,360	151,825	19,237	49,100	104,806	226,768
Total off-stream storages	**464,860**	**174,195**	**21,284**	**54,336**	**103,486**	**244,630**
Total storage volumes	**3,826,168**	**2,053,916**	**80,178**	**138,167**	**(546,330)**	**1,449,598**

Catchment inflows to the Goulburn basin in 2015–16 were 31% of the long-term average (Figure 6-10). The amount of water flowing from the Goulburn basin into the Murray River decreased to 470,710 ML in 2015–16. This represented 41% of the total inflows into the Goulburn basin, a decrease from 53% in 2014–15.

Figure 6-10 Storage volumes and catchment inflows in the Goulburn basin



6.6.2.3 Entitlement volumes and diversions

Goulburn-Murray Water, Coliban Water, Goulburn Valley Water, Grampians Wimmera Mallee Water, the Melbourne metropolitan retail water corporations (City West Water, South East Water and Yarra Valley Water), Melbourne Water and AGL Hydro Ltd all hold bulk entitlements in the Goulburn basin. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

Melbourne Water holds a bulk entitlement to divert surface water from the Silver and Wallaby creeks. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool which primarily supplies Melbourne and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

Entitlements in the Goulburn basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Goulburn basin are outlined in Table 6-33.

Table 6-33 Entitlement volumes in the Goulburn basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995 (1)	
High-reliability water shares	1,046,067
Low-reliability water shares	456,049
High-reliability supply by agreements	4,490
Low-reliability supply by agreements	1,851
Waterworks districts (2)	2,293
BE (Goulburn Channel System – CW) Order 2012	2,420
BE (Goulburn River – GVW) Order 2012	26,299
BE (Goulburn Channel System – GVW) Order 2012	7,191
Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006	100
Goulburn System – Melbourne metropolitan retail water corporations	
Bulk Entitlement (Goulburn System – City West Water) Order 2012 (3)	n/a
Bulk Entitlement (Goulburn System – South East Water) Order 2012 (3)	n/a
Bulk Entitlement (Goulburn System – Yarra Valley Water) Order 2012 (3)	n/a
Sub-total: Goulburn system – Melbourne metropolitan retail water corporations	**n/a**
Environmental Entitlement (Goulburn System – Living Murray) 2007	196,605
Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012 (4)	n/a
Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	38,408
Goulburn River Environmental Entitlement 2010	11,991
Loss provision -irrigation district (5)	316,210
Subtotal: Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	**2,109,974**
Bulk Entitlement (Broadford, Kilmore and Wallan) Conversion and Augmentation Order 2003 (6)	**2,875**
Bulk Entitlement (Buxton) Conversion Order 1995	**110**
Bulk Entitlement (Euroa System) Conversion Order 2001	**1,990**
Bulk Entitlement (Longwood) Conversion Order 1995	**120**
Bulk Entitlement (Mansfield) Conversion Order 1995	**1,300**
Bulk Entitlement (Marysville) Conversion Order 1995	**462**
Bulk Entitlement (Pyalong) Conversion Order 1997	**75**
Bulk Entitlement (Strathbogie) Conversion Order 2012	**23**
Bulk Entitlement (Thornton) Conversion Order 1995	**120**
Bulk Entitlement (Upper Delatite) Conversion Order 1995	**235**
Bulk Entitlement (Violet Town) Conversion Order 1997	**20**
Bulk Entitlement (Woods Point) Conversion Order 1995	**30**
Bulk Entitlement (Yea) Conversion Order 1997	**438**
Bulk Entitlement (Rubicon – Southern Hydro Ltd) Conversion Order 1997 (7)	**0**
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014 (8)	**22,000**
Silver and Wallaby Creeks Environmental Entitlement 2006	**n/a**
Take and use licences – unregulated surface water	**24,359**
Total volume of water entitlements in the Goulburn basin	**2,163,131**

Notes:

(1) Under Goulburn-Murray Water's Eildon– Goulburn Weir bulk entitlement, the water corporation operates the Goulburn system to supply Goulburn system water share holders, bulk entitlements held by Coliban Water, Goulburn Valley Water and Grampians Wimmera Mallee Water for towns supplied from irrigation districts, and entitlements held by the Melbourne metropolitan retail water corporations and the VEWH.

(2) This entitlement includes losses and excludes the volume to supply Grampians Wimmera Mallee Water's Quambatook bulk entitlement (100 ML) and Coliban Water (65 ML), as described in Goulburn-Murray Water's Eildon–Goulburn Weir bulk entitlement.

(3) These entitlements provide City West Water, South East Water and Yarra Valley Water with a total annual allocation of water equal to one-ninth of the phase 3 water savings achieved in the previous year under the Goulburn–Murray Water Connections Project stage 1.

(4) This entitlement provides the VEWH with a total annual allocation of water equal to one-ninth of the phase 3 water savings achieved in the previous year under the Goulburn–Murray Water Connections Project stage 1.
(5) The volume specified is the loss entitlement volume recorded in the *Victorian Water Register*. The volume has decreased since 2014–15 as a result of water shares issued to the Commonwealth Government for the GMW Connections Project stage 2.
(6) This entitlement specifies that up to 2,875 ML can be diverted in any one year. The maximum volume that can be taken over any 10-year period is 22,380 ML (2,238 ML annual average).
(7) The Rubicon–Hydro bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes and therefore the volume has not been included. Water diverted under this entitlement is returned to the watercourse.
(8) Melbourne Water holds a 22,000 ML bulk entitlement on the Silver and Wallaby creeks. Compliance with a three-year diversion limit of 66,000 ML is assessed using a three-year rolling total diversion. This water is used to supply primary entitlement holders (City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra System – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.
n/a: Specified volume not applicable.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-34. Entitlements (except some waterworks districts entitlements) to water in the regulated system of the Goulburn basin provide for the right to carry over unused allocation to the next season. In the Goulburn basin, these entitlement holders can carry over unused water up to 100% of their entitlement volume. Any unused water above this amount is written off as an end-of-season forfeiture. Water held above entitlement volume is also subject to a risk of spill; there were no spill events in 2015–16 affecting customers' spillable water accounts.

The VEWH holds *Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004* in trust for the Snowy River. Allocation to the entitlement is traded out of VEWH environmental accounts to supply consumptive users who would otherwise have been supplied through water diverted from the Snowy system. By reducing the demand by consumptive users for water from the Snowy system, this water can be used to maximise environmental flows in both the Snowy River and the Murray River. Table 4-3 has information about this entitlement.

Diversions under bulk entitlements for 2015–16 are presented in Table 6-34. Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-34 Allocation account balance summary for the Goulburn basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Eildon – Goulburn Weir						
Water shares	236,018	941,468	(155,276)	706,510	23,061	292,639
Supply by agreements	1,873	4,041	139	3,918	186	1,949
Waterworks districts (1)	-	2,071	0	1,744	327	-
Goulburn channel system – CW	756	2,420	0	1,999	27	1,150
Goulburn River and Eildon – GVW (2)	1,192	26,463	(3,100)	16,622	335	7,598
Goulburn channel system – GVW	399	7,191	0	5,884	(44)	1,750
Quambatook – Grampians Wimmera Mallee Water	15	100	20	133		3
Goulburn system – Melbourne retailers	22,258	24,046	(22,266)	0	1,202	22,836
Environmental Entitlement Goulburn system – Living Murray (3)	13,507	35,663	(5,461)	27,680	189	15,839
Goulburn System – NVIRP Stage 1 (3)	17,767	25,220	1,522	12,140	1,618	30,750
Goulburn system – Snowy Environmental Reserve	0	27,227	(25,714)	0	0	1,513
Goulburn River environmental entitlement (3)	2,983	7,966	203,670	202,770	593	11,255
Operating provisions (whole of system) (4)	-	-	-	178,419	-	-
Loss provision - irrigation district	-	-	-	153,824	-	-
Diversion: Eildon – Goulburn Weir (5)				**1,071,424**		
Broadford, Kilmore and Wallan	-	2,238	0	1,724	515	-
Buxton	-	110	0	0	110	-
Euroa system	-	1,990	0	842	1,148	-
Longwood	-	120	0	54	66	-
Mansfield	-	1,300	0	856	444	-
Marysville	-	462	0	281	182	-
Pyalong	-	75	0	37	38	-
Silver and Wallaby creeks – Melbourne Water	-	22,000	0	1,059	20,941	-
Strathbogie	-	23	0	18	5	-
Thornton	-	120	0	0	120	-
Upper Delatite	-	235	0	96	139	-
Violet Town	-	20	0	0	20	-
Woods Point	-	30	0	8	23	-

Yea	-	438	0	230	208	-
Rubicon – Hydro Ltd	-	-	-	-	-	-
Silver and Wallaby Creeks Environmental Entitlement	-	-	-	-	-	-
Take and use licences – unregulated surface water	-	24,359	(19)	10,496	13,882	-

Notes:

(1) Reported volumes relate to stock and domestic customers and delivery losses. Water available under Coliban Water and Grampians Wimmera Mallee Water's bulk entitlements in the waterworks districts are excluded from this line item (and reported against those bulk entitlements).

(2) The volume of allocation issued includes return flows of 164 ML, credited to Goulburn Valley Water for return flows from GMW customers.

(3) The water use reported under these entitlements is primarily in-stream use and is therefore not included in the calculation of total diversion for the Eildon–Goulburn Weir bulk entitlement. 2,371 ML of the use reported was diverted off-stream and is therefore included in the total diversion for the Eildon–Goulburn Weir bulk entitlement.

(4) This reflects use of water to manage the system including the net transfer of water to off-stream storages — Waranga basin and Greens Lake — as well as outfalls to the Campaspe, Loddon and Murray rivers during the water year.

(5) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Goulburn system source bulk entitlement.

The estimated volume of water harvested from small catchment dams in the Goulburn basin is provided in Table 6-35.

The capacity of small catchment dams for Goulburn basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 8,359 ML more for small catchment dam capacity and a decrease of 407 ML usage. For more information, see Appendix E.

Table 6-35 Estimated small catchment dam information for the Goulburn basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	57,724	28,862	n/a
Registered commercial and irrigation	21,719	18,244	n/a
Total	**79,443**	**47,106**	**64,349**

n/a: information not available.

6.6.3 Recycled water

Goulburn Valley Water operates all wastewater treatment plants in the Goulburn basin. About 89% of the volume of wastewater passing through treatment plants in the basin was recycled, an increase from 84% in 2014–15. In addition to the recycled water reported below, 132 ML was returned from the Mount Buller Resort to Black Dog Creek and other waterways during the water year.

Table 6-36 highlights the volumes and uses of water recycled in the Goulburn basin in 2015–16.

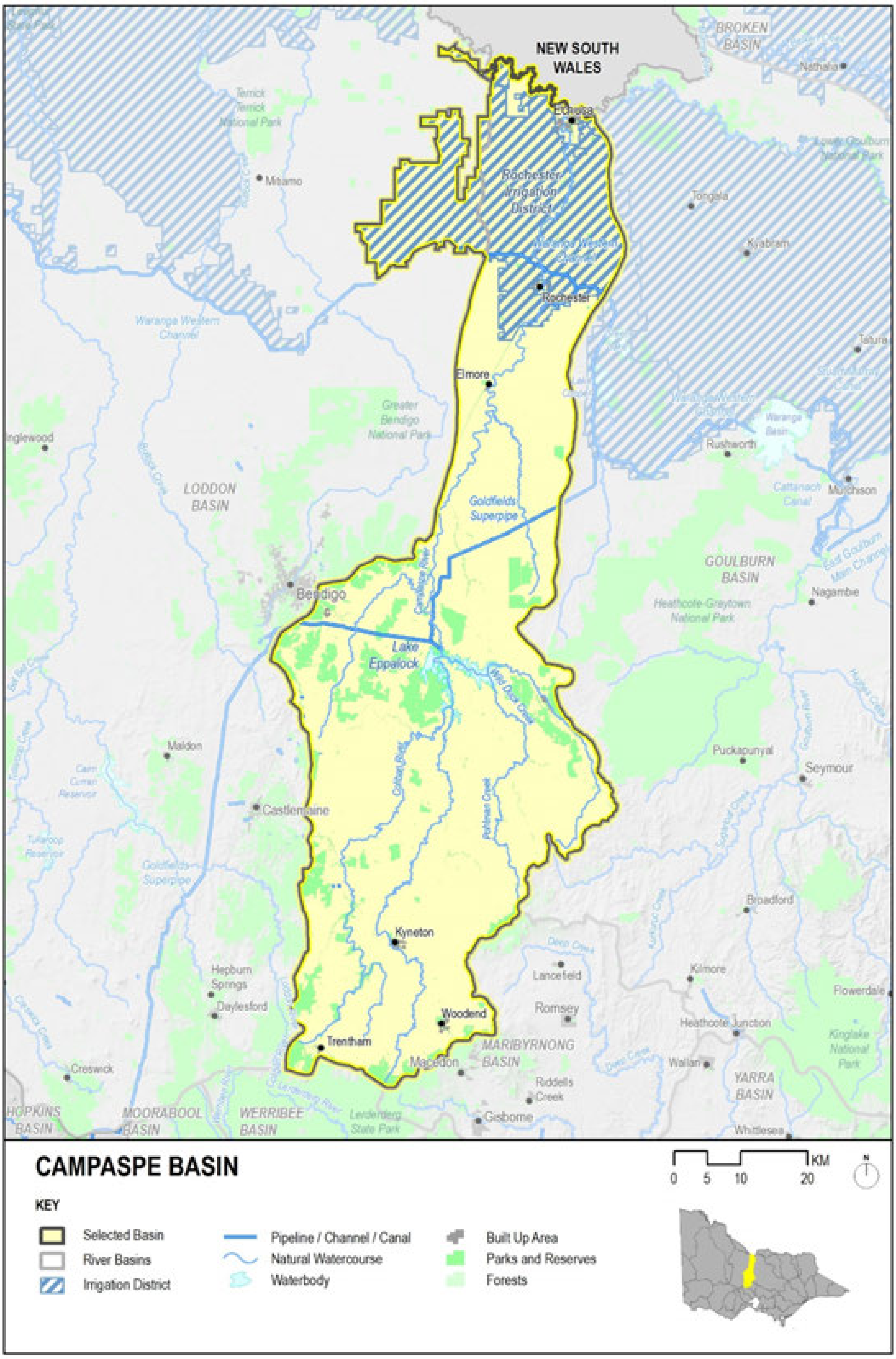
Table 6-36 Volume and use of recycled water in the Goulburn basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Alexandra	160	160	100%	110	50	0	0	0	0
Avenel	23	23	100%	0	23	0	0	0	0
Bonnie Doon	21	21	100%	0	21	0	0	0	0
Broadford	84	84	100%	0	84	0	0	0	0
Eildon	87	87	100%	87	0	0	0	0	0
Euroa	151	151	100%	89	62	0	0	0	0
Girgarre	0	0	0%	0	0	0	0	0	0
Kilmore	325	325	100%	0	325	0	0	0	0
Kyabram / Merrigum	262	262	100%	0	262	0	0	0	0
Mansfield	278	190	68%	80	110	0	0	88	0
Marysville	59	59	100%	59	0	0	0	0	0
Mooroopna	814	814	100%	0	814	0	0	0	0
Murchison	0	0	0%	0	0	0	0	0	0
Nagambie	111	111	100%	0	111	0	0	0	0
Seymour	334	334	100%	97	238	0	0	0	0
Shepparton	3,346	2,779	83%	0	2,779	0	0	567	0
Stanhope / Rushworth	28	28	100%	0	28	0	0	0	0
Tatura	1,244	1,055	85%	0	1,055	0	0	189	0
Tongala	298	298	100%	0	298	0	0	0	0
Upper Delatite	9	9	100%	0	9	0	0	0	0
Violet Town	21	21	100%	0	21	0	0	0	0
Yea	82	82	100%	67	15	0	0	0	0
Total 2015–16	**7,737**	**6,893**	**89%**	**589**	**6,305**	**0**	**0**	**844**	**0**
Total 2014–15	8,483	7,153	84%	352	6,801	0	0	1,330	0

6.7 Campaspe basin

The Campaspe basin (Figure 6-11) occupies 417,900 ha of north-central Victoria. It extends 150 km south from the Murray River to the Great Dividing Range and is 45 km across at its widest point.

Figure 6-11 Map of the Campaspe basin



6.7.1 Water resources overview

Rainfall across the Campaspe basin in 2015–16 was between 60% and 80% of the long-term average for the majority of the basin, with the northern tip receiving 80% to 100% of the long-term average. Catchment inflows to the Campaspe basin were 15% of the long-term average, compared to 24% in 2014–15.

The seasonal allocation for high-reliability water shares started at 50% and reached 65% in March 2016. No seasonal allocation to low-reliability water shares was made during the year.

The volume of water in major storages in the Campaspe basin was 48% of capacity at the start of the year and 26% at the end of June 2016.

In the Campaspe basin, licensed diversions were banned on 13 creeks for the whole year. During December 2015 to May 2016, 20 waterways were subject to irrigation bans. No urban water use restrictions were applied in the Campaspe basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-37 shows the responsibilities of the authorities within the Campaspe basin.

Table 6-37 Responsibilities for water resources management in the Campaspe basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies Rochester Irrigation District and Campaspe area	Manages licensed diversions	Provides bulk water supply to Coliban Water	Operates Lake Eppalock Obliged to meet passing flow requirements
Coliban Water	Provides irrigation and domestic and stock supplies off the Coliban Main Channel		Supplies urban water for most of the Campaspe basin including Echuca, Rochester and Kyneton	Operates Upper Coliban, Lauriston and Malmsbury reservoirs Obliged to meet passing flow requirements
Western Water			Supplies urban water for Woodend at the southern end of the basin	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
North Central Catchment Management Authority				Manages waterways in the whole of the Campaspe basin

Water for the environment

Important environmental assets (such as endangered flora and fauna species including Murray cod and painted snipe and communities of threatened riparian vegetation) depend on water for the environment in the Campaspe basin. Water from the Campaspe basin also feeds into the Murray basin, helping to maintain internationally significant environmental assets (such as Gunbower Forest and Kerang Wetlands).

In 2014–15, water for the environment in the Campaspe basin comprised:

- the *Campaspe River Environmental Entitlement 2013* comprising 20,652 ML of high-reliability and 2,966 ML of low-reliability entitlements held by the VEWH
- the *Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007* comprising 126 ML of high-reliability and 5,048 ML of low-reliability entitlements held by the VEWH
- 6,517 ML of high-reliability water shares and 395 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Coliban Water, Western Water and Goulburn–Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 14,484 ML of environmental water was delivered in-stream in the Campaspe basin.

6.7.2 Surface water resources

6.7.2.1 Water balance

The total volumes of water available and supplied from water resources in the Campaspe basin in 2015–16 are shown in Table 6-38. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Campaspe basin, the water balance shows catchment inflows in 2015–16 were 34,484 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 87,730 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 33,263 ML less (rather than 34,484 ML). For more information, see Appendix E.

Table 6-38 Balance of surface water in the Campaspe basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	179,801	272,348
Volume in storage at end of year	96,364	179,801
Change in storage	**(83,437)**	**(92,547)**
Inflows		
Catchment inflows (1)	54,467	88,951
Rainfall on major storages	7,788	12,544
Transfer from Waranga Western Channel to Lake Eppalock	450	1,778
Transfer to Campaspe basin from Waranga Western Channel	0	118
Treated wastewater discharged back to river	385	537
Total inflows	**63,089**	**103,928**
Outflows		
Diversions		
Urban diversions	25,982	18,322
Diversion for Coliban Water rural entitlements	10,222	13,712
Licensed diversions from regulated streams	8,416	10,045
Licensed diversions from unregulated streams (2)	707	982
Usage from small catchment dams (3)	22,032	28,776
Transfer from Campaspe basin to Western Waranga Channel	0	0
Transfer from Campaspe basin to White Swan Reservoir (Barwon basin)	7,329	563
Total diversions	***74,688***	***72,400***
Losses		
Evaporation losses from major storages	24,536	33,610
Losses from small catchment dams (3)	14,794	14,794
In-stream infiltration to groundwater, flows to floodplain and evaporation	6,092	5,300
Total losses	***45,422***	***53,704***
Water passed at outlet of basin		
Campaspe River outflows to Murray River	26,416	70,371
Total water passed at outlet of basin	***26,416***	***70,371***
Total outflows	**146,526**	**196,475**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflow and thus this is also reported differently to the 2014–15 published volume.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.7.2.2 Storages and flows

Levels for all major storages in the basin totalled 182,150 ML (48% of capacity) by the end of June 2015, compared to 274,972 ML (73% of capacity) in July 2014 (Table 6-39). In the Campaspe basin, major on-stream storages include Lake Eppalock and the Lauriston, Malmsbury and Upper Coliban reservoirs. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-39 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

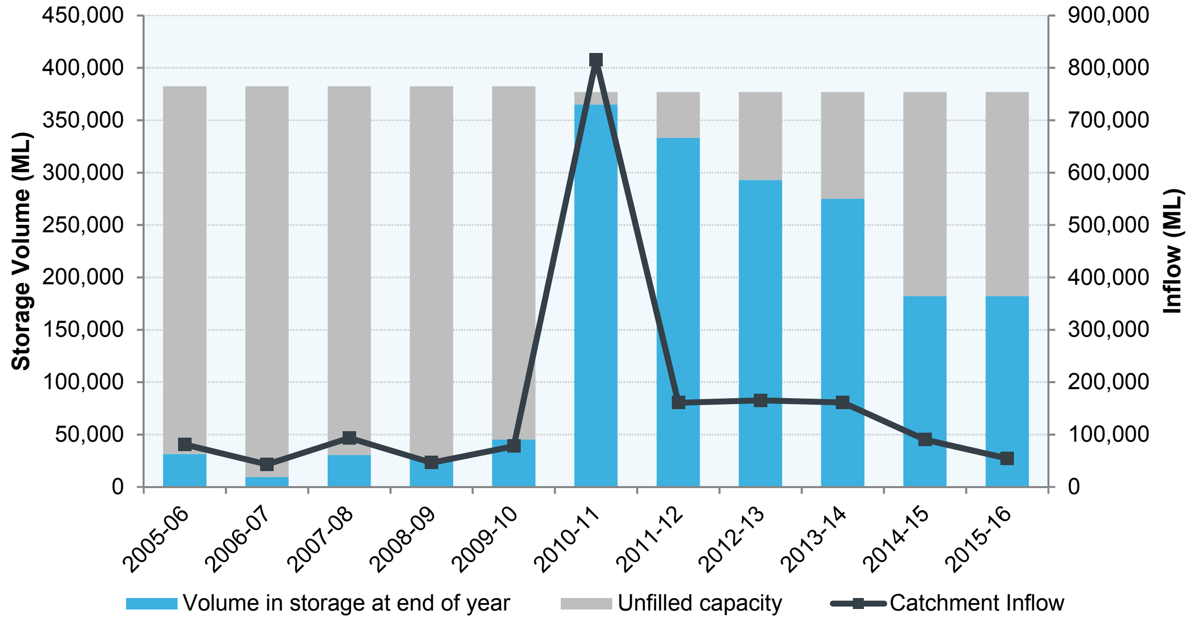
Table 6-39 Storage volumes in the Campaspe basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Eppalock	304,651	137,490	4,729	17,563	(58,994)	65,662
Lauriston Reservoir	19,790	17,390	1,020	2,064	(3,286)	13,060
Malmsbury Reservoir	12,034	4,480	733	1,865	(603)	2,745
Upper Coliban Reservoir	37,770	20,441	1,306	3,044	(3,806)	14,897
Campaspe Weir	2,624	2,349	n/a	n/a	292	2,641
Total storage volumes	**376,869**	**182,150**	**7,788**	**24,536**	**(66,397)**	**99,005**

n/a: information not available.

Catchment inflows to the Campaspe basin amounted to 54,467 ML in 2015–16, which is 15% of the long-term average of 352,000 ML (Figure 6-12). The amount of water flowing from the Campaspe basin into the Murray River in 2015–16 was26,416 ML, representing 42% of the total inflows to the basin.

Figure 6-12 Storage volumes and catchment inflows in the Campaspe basin



6.7.2.3 Entitlement volumes and diversions

Goulburn–Murray Water, Coliban Water and Western Water hold bulk entitlements in the Campaspe basin. Surface water is also diverted by licensed diverters and harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Campaspe basin are outlined in Table 6-40.

6.7 Campaspe basin

Table 6-40 Entitlement volumes in the Campaspe basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Campaspe System – Goulburn Murray Water) Conversion Order 2000 (1)	
High-reliability water shares	23,465
Low-reliability water shares	19,175
Bulk Entitlement (Axedale Goornong and Rochester) Conversion Order 1999 (2)	349
Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	5,174
Campaspe River Environmental Entitlement 2013	23,618
Operating provisions (whole of system) (3)	11,809
Subtotal: Bulk Entitlement (Campaspe System – Goulburn Murray Water) Conversion Order 2000	**83,590**
Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999 (4)	
Rural entitlements	15,742
Urban commitments	34,518
Subtotal: Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999	**50,260**
Bulk Entitlement (Trentham) Conversion Order 2012 (5)	**120**
Bulk Entitlement (Woodend) Conversion Order 2004	**470**
Take and use licences – unregulated surface water	**3,224**
Total volume of water entitlements in the Campaspe basin	**137,663**

Notes:

(1) Under this bulk entitlement, Goulburn–Murray Water releases water from Lake Eppalock to supply water share holders in the Campaspe system, to supply Coliban Water's Axedale and Goornong bulk entitlement and to supply the VEWH's environmental entitlement. The water that Goulburn–Murray Water may take is limited to an average annual volume of 83,590 ML over any consecutive 10-year period.

(2) Coliban Water may take, under its Axedale, Goornong and Rochester bulk entitlement, a maximum annual volume of 215 ML for Axedale and Goornong and an average of 134 per annum over any consecutive 10-year period for Rochester.

(3) This volume includes an allowance for volume supplied to the Goulburn system via the Campaspe supplement.

(4) Under this bulk entitlement, Coliban Water releases water from Lake Eppalock to supply rural and urban commitments. The water that Coliban Water may take is limited to an average annual volume of 50,260 ML over any consecutive three-year period.

(5) Coliban Water can take, under the Trentham bulk entitlement, an average of 120 ML per year over a three-year period.

n/a: Specified volume not applicable.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-41. Entitlements to water in regulated systems in the Campaspe basin provide for the right to carry over unused allocation to the next season. In the Campaspe basin, these entitlement holders can carry over unused water up to 100% of their entitlement volume; any unused water above this amount is written off as an end-of-season forfeiture. Water held above entitlement volume is also subject to a risk of spill; there were no spill events in 2015–16 affecting customers' accounts.

Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Campaspe valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report*.

The VEWH holds an environmental entitlement for the Campaspe River, but the water available under the entitlement is used to support streamflows and is not diverted out of the waterway.

Table 6-41 Allocation account balance summary for the Campaspe basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Campaspe system – Goulburn Murray Water						
Water shares	12,949	15,517	5,837	15,702	8,847	9,753
Axedale, Goornong and Rochester	313	230	(130)	73	17	324
Campaspe River – Living Murray Initiative (1)	0	83	0	63	0	20
Campaspe River Environmental Entitlement 2013 (1)	0	14,193	11,259	13,595	593	11,264
Operating provisions (whole of system) (2)	-	-	-	0	-	-
Diversion: Campaspe System – Goulburn Murray Water (1)				**15,775**		
Campaspe system – Coliban Water						
Rural entitlements	-	15,742	0	5,730	10,012	-
Urban commitments	-	34,518	0	14,900	19,618	-
Operating provisions (whole of system)	-	-	-	9,992	-	-
Diversion: Campaspe system – Coliban Water				**30,622**		
Trentham	-	120	0	87	33	-
Woodend	-	470	0	65	405	-
Take and use licences – unregulated surface water (GMW)	-	3,153	19	707	2,465	-

Notes:

(1) The water use reported under these two entitlements is in-stream use and is therefore not included in the calculation of total diversion for the Campaspe system – Goulburn–Murray Water bulk entitlement.

(2) The 'water use' refers to system losses and water made available to the Goulburn system via the Goulburn supplement. As there are no irrigation areas or districts in the Campaspe system there is zero loss (the volume of diversion and delivery are the same). In 2015–16 no supplement was provided to the Goulburn system.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Campaspe basin (Table 6-42).

The capacity of small catchment dams for Campaspe basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 1,131 ML less for small catchment dam capacity and a decrease of 6,743 ML usage. For more information, see Appendix E.

Table 6-42 Estimated small catchment dam information for the Campaspe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,076	16,038	n/a
Registered commercial and irrigation	7,136	5,994	n/a
Total	**39,212**	**22,032**	**42,349**

n/a: Information not available.

6.7.3 Recycled water

Coliban Water operates all wastewater treatment plants in the Campaspe basin except the Woodend Treatment Plant, which is operated by Western Water. About 82% of the wastewater discharged from treatment plants in the basin was recycled, a slight increase on 78% from the previous year.

Table 6-43 highlights the volumes and uses of water recycled in the Campaspe basin in 2015–16.

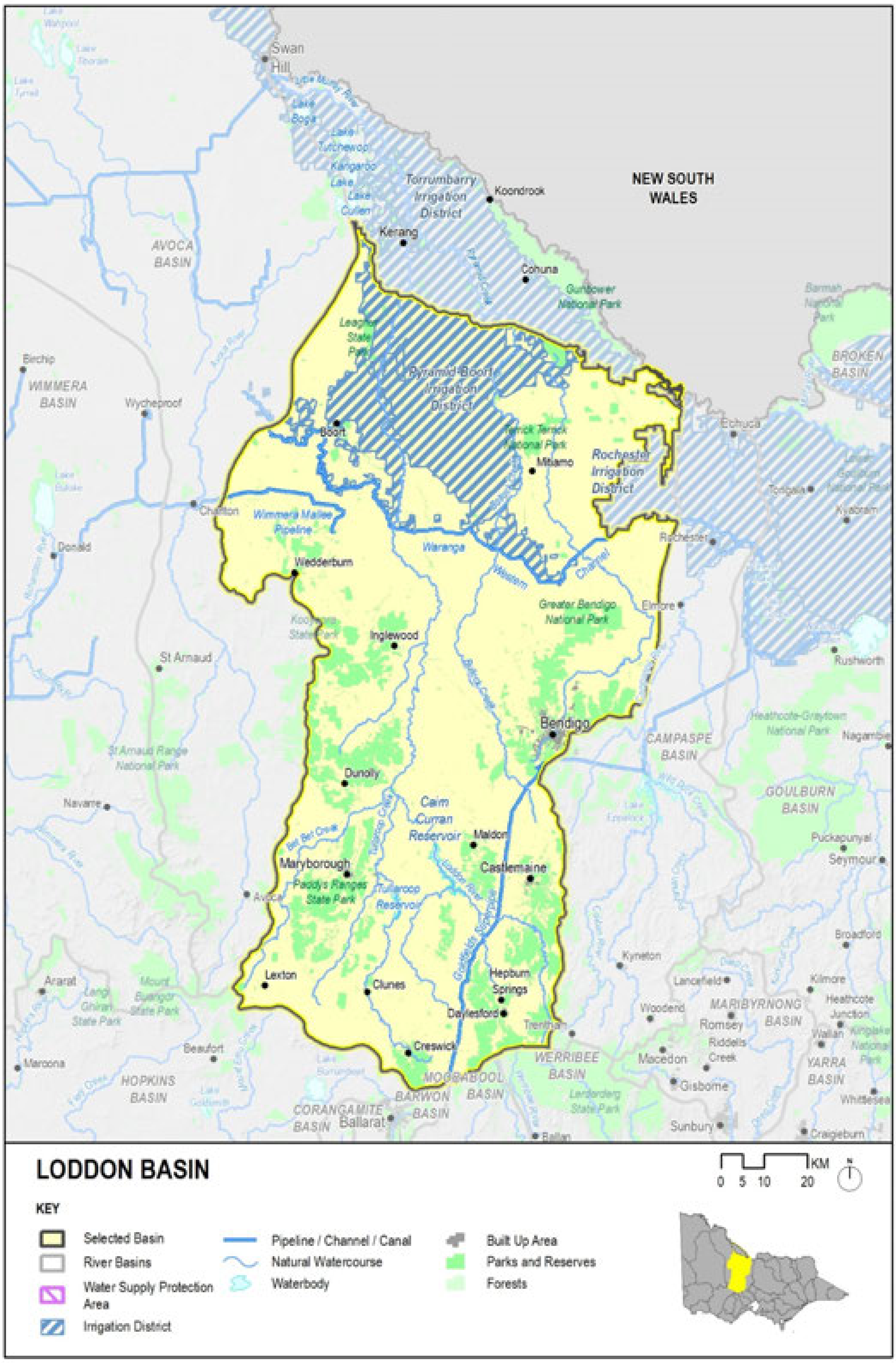
Table 6-43 Volume and use of recycled water in the Campaspe basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Axedale	15	15	100%	15	0	0	0	0	0
Echuca	1,148	1,148	100%	0	1,148	0	0	0	0
Elmore	0	0	0%	0	0	0	0	0	0
Heathcote	131	131	100%	131	0	0	0	0	0
Kyneton	635	377	59%	109	268	0	0	258	0
Lockington	0	0	0%	0	0	0	0	0	0
Rochester	0	0	0%	0	0	0	0	0	0
Woodend	230	103	44%	59	43	0	1	127	0
Total 2015–16	**2,159**	**1,774**	**82%**	**314**	**1,459**	**0**	**1**	**385**	**0**
Total 2014–15	2,550	1,980	78%	257	1,722	0	1	537	33

6.8 Loddon basin

The Loddon basin (Figure 6-13) is located in northern Victoria and includes the Loddon River, Bullarook River and various other small tributaries such as Bendigo Creek. The basin is crossed by the Waranga Western Channel, which provides water to users in the Loddon basin from the Goulburn basin (that is, the Pyramid Hill–Boort Irrigation District). For the purposes of the water accounts, the Loddon basin excludes the Torrumbarry Irrigation Area, which is mostly supplied from the Murray River.

Figure 6-13 Map of the Loddon basin



6.8.1 Water resources overview

In 2015–16, rainfall in most of the Loddon basin was between 60% and 80% of the long-term average. A small pocket in the north-west of the basin experienced higher rainfall, with between 80% and 100% of the long-term average. The catchment inflow volume was 21% of the long-term average of 373,000 ML.

The volume of water in major storages in the Loddon basin was 37% of capacity at the start of the year and by the end of June 2016 was 16%.

The year began with a 37% July allocation for high-reliability water shares in the Loddon system. This increased to 84% during August. No allocations were made to low-reliability water shares during the year. The Bullarook system did not receive an allocation on 1 July 2015, and high-reliability water shares only received 8% allocation by February 2016.

Bans on licensed diversions were in place for the majority of streams in the Loddon basin during summer, with 13 streams restricted for the whole of 2015–16. The number of streams with irrigation bans peaked at 26 from December 2015 to March 2016, and all but two of these bans continued into autumn. No urban water use restrictions applied in the Loddon basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-44 shows the responsibilities of the authorities within the Loddon basin.

Table 6-44 Responsibilities for water resources management in the Loddon basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Goulburn–Murray Water	Supplies the Pyramid–Boort Irrigation Area and domestic and stock supplies in Normanville area sourced from the Goulburn basin	Manages licensed diversions	Provides bulk supply to Coliban Water for towns supplied from the Loddon, Campaspe and Goulburn systems including Pyramid Hill, Boort and Bendigo	Operates major reservoirs including Cairn Curran, Laanecoorie, Tullaroop, Hepburn Lagoon and Newlyn reservoirs
Grampians Wimmera Mallee Water			Provides bulk supply to Coliban Water for towns supplied from the Wimmera–Mallee system (Borung, Korong Vale, Wedderburn and Wychitella)	
Central Highlands Water			Supplies towns in the southern part of the Loddon basin including Maryborough, Daylesford, Creswick and Clunes	Obliged to meet passing flow requirements
Coliban Water			Supplies towns in the eastern and northern parts of the Loddon basin including Bendigo, Castlemaine, Wedderburn, Mitiamo, Pyramid Hill and Boort	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
North Central Catchment Management Authority				Manages waterways for the whole of the Loddon basin

Water for the environment

Important environmental assets (such as endangered flora and fauna species including Murray cod and painted snipe and communities of threatened riparian vegetation) depend on water for the environment in the Loddon basin. Water from the Loddon basin also feeds into the Murray basin, helping to maintain internationally significant Ramsar-listed environmental assets including the Kerang Wetlands. The Kerang Wetlands support over 150 flora species and over 50 waterbird species including the endanger freckled duck and little bittern. Tullaroop Creek in the Loddon River system also has a population of regionally significant blackfish.

In 2015–16, water for the environment in the Loddon basin comprised:

- the *Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005*, of 3,480 ML high-reliability, 2,024 ML of low-reliability and 7,490 ML of provisional reliability entitlements held by the VEWH
- The *Environmental Entitlement (Birch Creek – Bullarook System) 2009*, which includes passing flows and 100 ML of water in Newlyn Reservoir when high-reliability water shares are greater than 20% in the Bullarook system at the start of December
- 3,826 ML of high-reliability water shares and 527 ML low-reliability water shares held for the environment
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water and Goulburn–Murray Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.8 Loddon basin

In 2015–16, a total of 7,372 ML of environmental water was used in the Loddon basin, 660 ML of this was diverted off-stream while the remaining 6,712 ML was delivered in-stream.

6.8.2 Surface water resources

6.8.2.1 Water balance

The total volumes of water available and supplied from water resources in the Loddon basin in 2015–16 are shown in Table 6-45.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Loddon basin, the water balance shows catchment inflows in 2015–16 were 37,944 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 110,715 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 31,607 ML less (rather than 37,944 ML). For more information, see Appendix E.

Table 6-45 Balance of surface water in the Loddon basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	84,106	128,747
Volume in storage at end of year	35,319	84,106
Change in storage	**(48,787)**	**(44,641)**
Inflows		
Catchment inflows (1)	79,109	117,053
Rainfall on major storages	4,799	6,542
Treated wastewater discharged back to river	4,943	5,138
Total inflows	**88,851**	**128,733**
Outflows		
Diversions		
Urban diversions	4,330	4,621
Licensed diversions from regulated streams	10,806	14,227
Transfer to Goulburn basin (through Loddon supplement)	0	0
Licensed diversions from unregulated streams (2)	5,036	5,610
Environmental water diversions	660	2,000
Usage from small catchment dams (3)	39,361	50,037
Total diversions	***60,193***	***76,495***
Losses		
Evaporation losses from major storages	16,982	22,234
Losses from small catchment dams (3)	33,918	29,579
In-stream infiltration to groundwater, flows to floodplain and evaporation	3,853	15,000
Total losses	***54,753***	***66,813***
Water passed at outlet of basin		
Loddon River outflows to Murray River (Appin South)	20,472	27,803
Wandella Creek at Fairley	0	0
Mount Hope Creek at Mitiamo	2,189	2,000
Bullock Creek, Calivil Creek and Nine Mile Creek	31	265
Total water passed at outlet of basin	***22,692***	***30,068***
Total outflows	**137,638**	**173,376**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The 2014–15 licensed diversions from unregulated streams value was incorrectly reported as 8,773 ML. The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in Appendix E for further detail.

6.8.2.2 Storages and flows

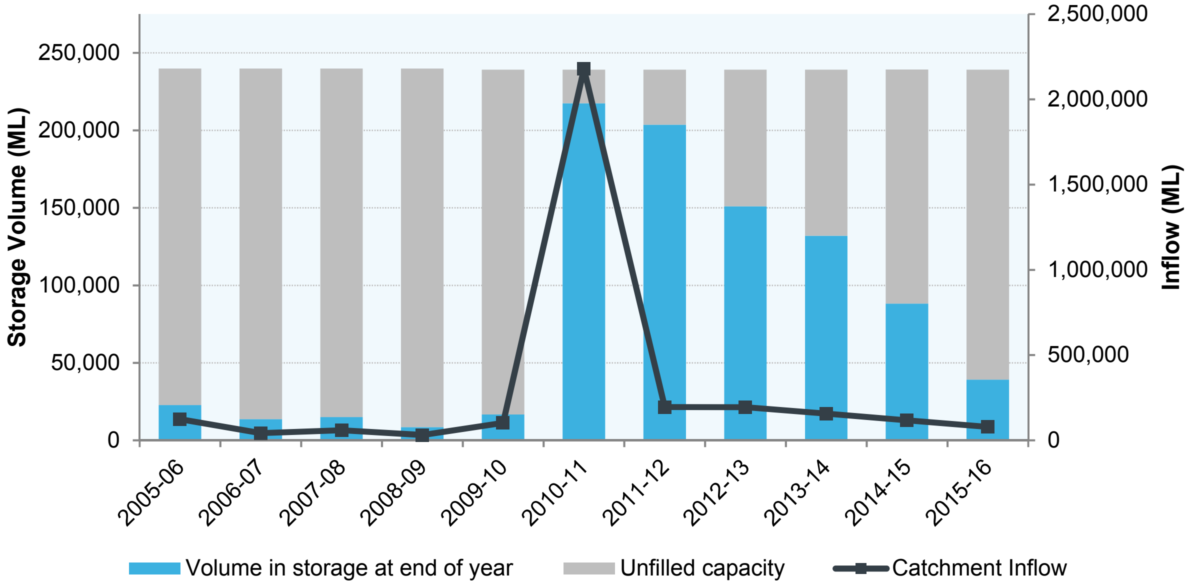
The volume of water held in major storages was 39,105 ML (16% of capacity) at the end of June 2016, compared to 88,146 ML (37% of capacity) at the beginning of the year (Table 6-46). The volume reported in the 'Catchment inflows less regulated releases' column is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year. Cairn Curran Reservoir, which comprises nearly two-thirds of the storage capacity in the basin, finished the year with 17,234 ML in storage (12% of capacity).

Table 6-46 Storage volumes in the Loddon basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Cairn Curran Reservoir	147,130	51,556	2,239	8,648	(27,912)	17,234
Hepburn Lagoon	2,457	1,173	408	1,153	18	446
Laanecoorie Reservoir	8,000	2,548	507	2,061	666	1,660
Newlyn Reservoir	3,012	1,356	195	568	(457)	526
Tullaroop Reservoir	72,950	27,473	1,450	4,552	(8,918)	15,453
Total on-stream storages	**233,549**	**84,106**	**4,799**	**16,982**	**(36,603)**	**35,319**
Off-stream storages						
Evansford Reservoir	1,346	1,126	88	252	(41)	921
Sandhurst Reservoir	2,590	2,072	111	326	738	2,595
Spring Gully Reservoir	1,680	842	148	317	(403)	270
Total off-stream storages	**5,616**	**4,040**	**347**	**895**	**294**	**3,786**
Total storage volumes	**239,165**	**88,146**	**5,146**	**17,877**	**(36,309)**	**39,105**

Catchment inflows were 21% of the long-term average of 373,000 ML, a decrease compared to the volume of inflows in 2014–15 (Figure 6-14). The amount of water flowing from the Loddon basin was 22,691 ML in 2015–16. This represents 26% of the total Loddon basin inflows.

Figure 6-14 Storage volumes and catchment inflows in the Loddon basin



6.8.2.3 Entitlement volumes and diversions

In the Loddon basin, surface water is diverted by Goulburn–Murray Water, Central Highlands Water, Coliban Water and the VEWH which all hold bulk entitlements in the basin. Surface water is also diverted by licensed diverters and harvested in small catchment dams.

Entitlements in the Loddon basin include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Loddon basin are outlined in Table 6-47.

6.8 Loddon basin

Table 6-47 Entitlement volumes in the Loddon basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Loddon System – Goulburn Murray Water) Conversion Order 2005 (1)	
High-reliability water shares – Loddon	21,391
Low-reliability water shares – Loddon	8,083
Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005	12,994
Bulk Entitlement (Loddon System – Part Maryborough – Central Highlands Water) Conversion Order 2005	1,200
Bulk Entitlement (Loddon System – Coliban Water) Conversion Order 2005	820
Goulburn supplement (2)	88,000
Subtotal: Bulk Entitlement (Loddon System – Goulburn Murray Water) Conversion Order 2005	**132,489**
Bulk Entitlement (Bullarook system – Goulburn Murray Water) Conversion Order 2009 (3)	
High-reliability water shares – Bullarook	758
Low-reliability water shares – Bullarook	381
Bulk Entitlement (Bullarook System – Central Highlands Water) Conversion Order 2009	500
Environmental Entitlement (Birch Creek – Bullarook System) 2009	100
Subtotal: Bulk Entitlement (Bullarook system – Goulburn Murray Water) Conversion Order 2009	**1,739**
Bulk Entitlement (Creswick) Conversion Order 2004	**500**
Bulk Entitlement (Daylesford –Hepburn Springs) Conversion Order 2004	**916**
Bulk Entitlement (Evansford – Talbot System – Part Maryborough – Central Highlands Water) Conversion Order 2006	**3,000**
Bulk Entitlement (Lexton) Conversion Order 2004	**45**
Take and use licences – unregulated surface water	**22,215**
Total volume of water entitlements in the Loddon basin	**160,903**

Notes:

(1) Under this bulk entitlement, Goulburn–Murray Water operates Cairn Curran Reservoir, Tullaroop Reservoir, Laanecoorie Reservoir and Loddon Weir to supply water share holders in the Loddon system and to supply the Loddon system bulk entitlements held by Central Highlands Water, Coliban Water and the VEWH.

(2) The Loddon system – Goulburn–Murray Water bulk entitlement specifies that after ensuring all Loddon system high-reliability entitlements can be satisfied in the current year and are provided for in the following year, supplies from the Loddon system can be used to supplement the Goulburn system.

(3) Under this bulk entitlement, Goulburn–Murray Water operates Newlyn Reservoir and Hepburns Lagoon to supply water share holders in the Bullarook system and to supply the Bullarook system bulk entitlements held by Central Highlands Water and the VEWH.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-48. Entitlements to water in regulated systems in the Loddon basin provide for the right to carry over unused allocation to the next season. In the Loddon basin, these entitlement holders can carry over unused water up to 50% of their entitlement volume, any unused water above this amount is written off (end-of-season forfeiture).

Diversions under these bulk entitlements are assessed against the Murray–Darling basin annual cap target for the Goulburn–Broken–Loddon Valley. Since 2012, cap compliance has been reported through the transition period water take compliance reports (refer to MDBA's website > Publications). Prior to this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-48 Allocation account balance summary for the Loddon basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Loddon System - Goulburn Murray Water						
Water shares - Loddon	3,123	16,835	(5,538)	7,857	994	5,570
Loddon River - Environmental Reserve (1)	2,000	10,413	223	7,372	2,561	2,703
Loddon System - Part Maryborough - Central Highlands Water	900	1,008	543	1,465	85	900
Loddon System - Coliban Water	322	498	0	376	55	390
Goulburn supplement (2)	-	-	-	0	-	-
Operating provisions (whole of system) (3)	-	-	-	2,665	-	-
Diversion: Loddon system - Goulburn Murray Water (4)				**13,023**		
Bullarook System - Goulburn Murray Water						
Water shares - Bullarook	268	61	70	284	7	108
Bullarook System - Central Highlands Water (5)	238	0	(70)	59	5	103
Environmental Entitlement Birch Creek - Bullarook System (6)	0	0	0	0	0	0
Diversion: Bullarook system - Goulburn Murray Water (7)				**343**		
Creswick	-	500	0	274	226	-
Daylesford - Hepburn Springs	-	916	0	659	257	-

Lexton	-	45	0	3	42	-
Evansford-Talbot System-Part Maryborough-Central Highlands Water	-	3,000	0	1,494	1,506	-
Take and use licences - unregulated surface water	-	22,340	(20)	5,036	17,284	-

Notes:
(1) 6,712 ML of the water use reported here is in-stream use and is therefore not included in the calculation of total diversion for the Loddon system – Goulburn-Murray Water bulk entitlement. 660 ML was diverted off-stream during the year and is therefore included in the total diversion from the Loddon system BE.
(2) The Loddon supplement supplies water to the Goulburn system, providing for entitlement holders with Goulburn water shares. As such, the volume is reported as a transfer to the Goulburn basin.
(3) This reflects use of water to manage the Loddon system. It equals the amount diverted to Serpentine Creek and not used by customers.
(4) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Loddon system source bulk entitlement.
(5) When allocations are less than 20%, CHW is only entitled to an equitable share of the available resource as determined by GMW for the purpose of supplying water for critical human needs and environmental needs. Since CHW can source water from other systems, it was allocated 0 ML.
(6) Allocation is only made to this entitlement when high-reliability water shares are greater than 20% in the Bullarook system at the start of December.
(7) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Bullarook system source bulk entitlement.

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Loddon basin (Table 6-49).

The capacity of small catchment dams for Loddon basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 5,762 ML less for small catchment dam capacity and a decrease of 10,676 ML usage. For more information, see Appendix E.

Table 6-49 Estimated small catchment dam information for the Loddon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	48,816	24,408	n/a
Registered commercial and irrigation	17,801	14,953	n/a
Total	**66,617**	**39,361**	**73,279**

n/a: information not available.

6.8.3 Recycled water

Coliban Water, Lower Murray Water and Central Highlands Water operate wastewater treatment plants within the Loddon basin. The percentage of wastewater produced in 2015–16 increased to 34%, compared to 27% in 2014–15.

Table 6-50 highlights the volumes and uses of water recycled in the Loddon basin in 2015–16.

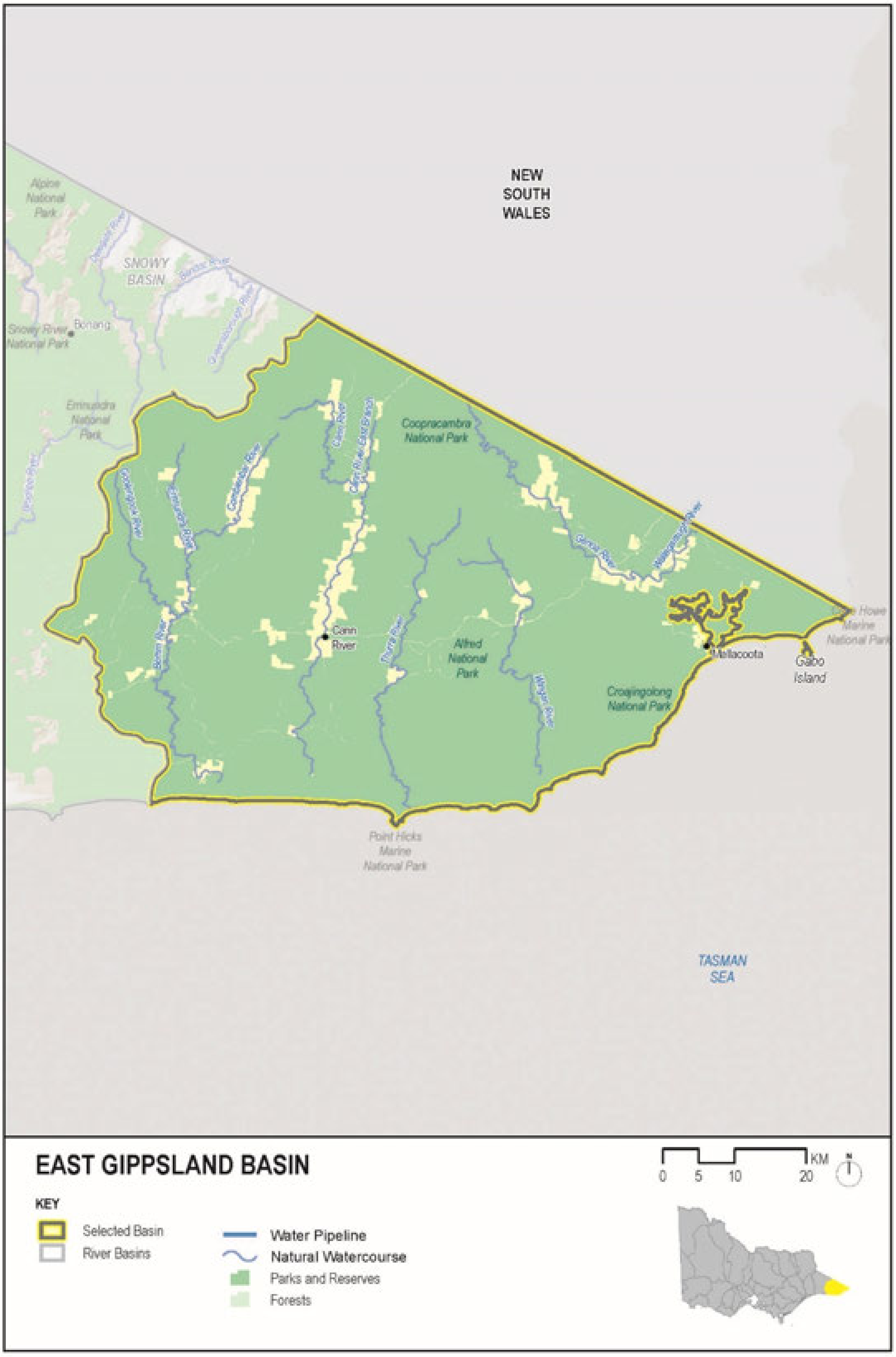
Table 6-50 Volume and use of recycled water in the Loddon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bendigo	5,533	1,608	29%	1,247	361	0	0	3,925	0
Boort	20	20	100%	0	20	0	0	0	0
Bridgewater / Inglewood	0	0	0%	0	0	0	0	0	0
Castlemaine	1,136	117	10%	117	0	0	0	1,019	0
Clunes	0	0	0%	0	0	0	0	0	0
Daylesford	356	356	100%	17	339	0	0	0	0
Dunolly	0	0	0%	0	0	0	0	0	0
Kerang	534	0	0%	0	0	0	0	0	534
Maryborough	503	661	131%	79	582	0	0	0	(157)
Pyramid Hill	0	0	0%	0	0	0	0	0	0
Wedderburn	28	28	100%	0	28	0	0	0	0
Total 2015–16	**8,110**	**2,790**	**34%**	**1,460**	**1,330**	**0**	**0**	**4,944**	**377**
Total 2014–15	7,776	2,064	27%	1,018	1,046	0	0	5,138	574

6.9 East Gippsland basin

The East Gippsland basin (Figure 6-15) is the easternmost basin in Victoria. The headwaters of the Genoa River originate in New South Wales and flow through Victoria before reaching the ocean near Mallacoota. Other rivers in the basin include the Betka, Wingan, Thurra, Cann and Bemm rivers.

Figure 6-15 Map of the East Gippsland basin



6.9.1 Water resources overview

In 2015–16, rainfall in the East Gippsland basin was between 100% and 125% of the long-term average, with a small area in the west of the basin receiving 80% to 100% of the long-term average.

Catchment inflows were 163% of the long-term annual average of 714,000 ML, compared to 190% recorded in 2014–15. Consumptive use in the basin is generally very low compared to water availability, and almost 100% of total inflows passed to Bass Strait in 2015–16.

All unregulated streams remained unrestricted and there were no urban water use restrictions applied in the East Gippsland basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-51 shows the responsibilities of the authorities within the East Gippsland basin.

Table 6-51 Responsibilities for water resources management in the East Gippsland basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Supplies urban water to towns including Mallacoota, Cann River and Bemm River	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways for the entire East Gippsland basin

Water for the environment

Environmental assets that rely on water in the East Gippsland basin include the Sydenham, Tamboon and Mallacoota inlets (all nationally significant wetlands), pristine estuaries, heritage river reaches and the swamp skink, Australian grayling, Australian bass, tangle orchid and eastern curlew.

In 2015–16, water for the environment in the East Gippsland basin comprised:

- water set aside for the environment through flow-sharing arrangements set out in bulk entitlements held by East Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.9.2 Surface water resources

6.9.2.1 Water balance

The total volumes of water available and supplied from water resources in the East Gippsland basin in 2015–16 are shown in Table 6-52. Very low volumes of surface water are used relative to the available resource in the basin.

No storage information is recorded in the water balance as there are no major on-stream storages in the East Gippsland basin.

About 1% of the catchment inflows were diverted for consumptive use, predominantly from small catchment dams.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the East Gippsland basin, the water balance shows catchment inflows in 2015–16 were 197,775 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 1,359,039 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 197,545 ML less (rather than 197,775ML). For more information, see Appendix E.

Table 6-52 Balance of surface water in the East Gippsland basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows (1)	1,161,494	1,359,269
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**1,161,494**	**1,359,269**
Outflows		
Diversions		
Urban diversions	104	163

Licensed diversions from unregulated streams	56	27
Usage from small catchment dams (2)	711	1,100
Total diversions	***871***	***1,290***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (2)	227	67
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***227***	***67***
Water passed at outlet of basin		
River outflows to the ocean	1,160,397	1,357,912
Total water passed at outlet of basin	***1,160,397***	***1,357,912***
Total outflows	**1,161,494**	**1,359,269**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

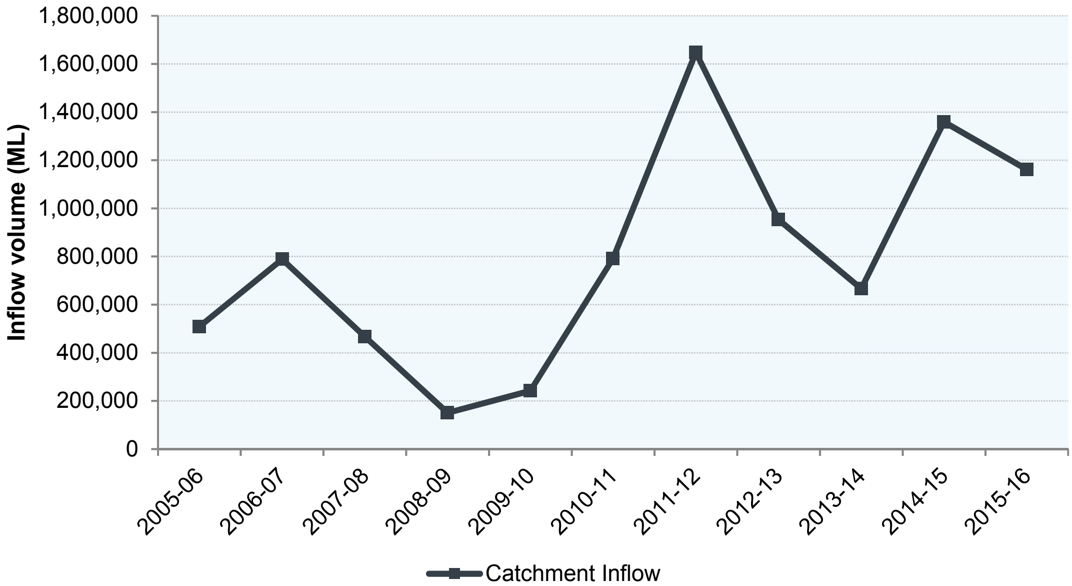
6.9.2.2 Storages and flows

Catchment inflows were 163% of the long-term annual average of 714,000 ML, a decrease from the 190% recorded in 2014–15 (Figure 6-16).

The amount of water flowing from the East Gippsland basin into Bass Strait was 1,160,397 ML in 2015–16, compared to 1,357,912 ML in 2014–15. Basin outflows were close to 100% of total inflows into the basin.

There are no major storages located within the East Gippsland basin.

Figure 6-16 Catchment inflows in the East Gippsland basin



6.9.2.3 Entitlement volumes and diversions

In the East Gippsland basin, surface water is diverted by East Gippsland Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the East Gippsland basin are outlined in Table 6-53.

Table 6-53 Entitlement volumes in the East Gippsland basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Bemm River) Conversion Order 1997	100
Bulk Entitlement (Cann River) Conversion Order 1997	192
Bulk Entitlement (Mallacoota) Conversion Order 1997	330
Take and use licences – unregulated surface water	659
Total volume of water entitlements in the East Gippsland basin	**1,281**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-54. The total volume of water diverted by bulk entitlement holders was similar to the volume reported in the *Victorian Water Accounts 2014–15*.

As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the East Gippsland basin (Table 6-54) remains significantly lower than the total licence volume.

Table 6-54 Allocation account balance summary for the East Gippsland basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Bemm River	100	0	24	76
Cann River	192	0	34	158
Mallacoota	330	0	46	284
Take and use licences – unregulated surface water	660	0	56	604

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the East Gippsland basin (Table 6-55).

The capacity of small catchment dams for East Gippsland basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 319 ML less for small catchment dam capacity and a decrease of 389 ML usage. For more information, see Appendix E.

Table 6-55 Estimated small catchment dam information for the East Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,126	563	n/a
Registered commercial and irrigation	176	148	n/a
Total	**1,302**	**711**	**937**

n/a: information not available.

6.9.3 Recycled water

East Gippsland Water operates wastewater treatment plants at Bemm River, Cann River and Mallacoota. As with 2014–15, 100% of wastewater was recycled in 2015–16 and used for agricultural applications including pasture and tree plantations.

Table 6-56 highlights the volumes and uses of water recycled in the East Gippsland basin in 2015–16.

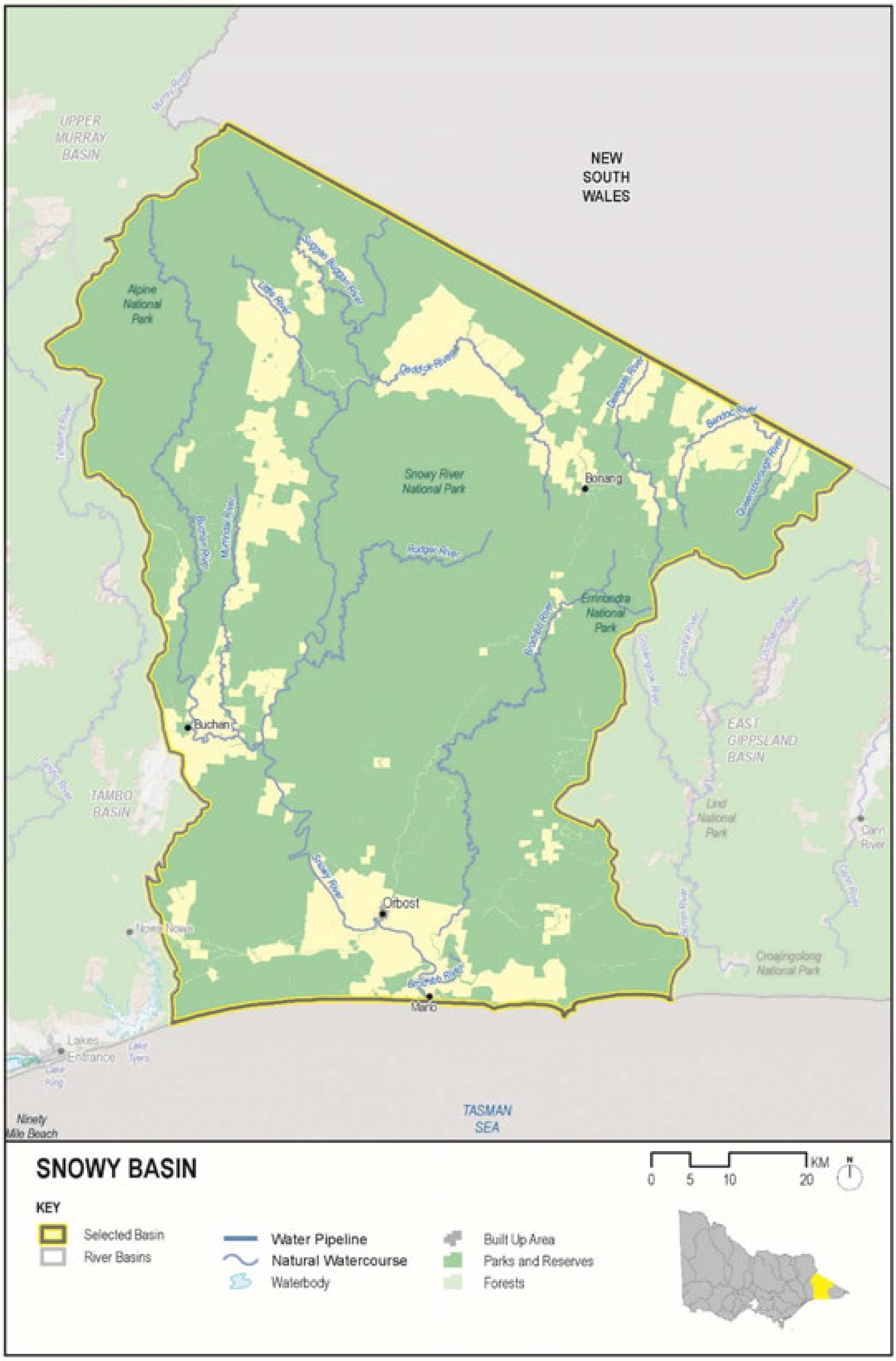
Table 6-56 Volume and use of recycled water in the East Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bemm River	8	8	100%	0	8	0	0	0	0
Cann River	33	33	100%	0	33	0	0	0	0
Mallacoota	59	59	100%	0	59	0	0	0	0
Total 2015–16	**100**	**100**	**100%**	**0**	**100**	**0**	**0**	**0**	**0**
Total 2014–15	176	176	100%	0	176	0	0	0	0

6.10 Snowy basin

The Snowy basin (Figure 6-17) is located in south-east Victoria. The Snowy River originates in New South Wales and is part of the Snowy Mountains Hydro-Electric Scheme, which connects it to the Murray and Murrumbidgee rivers. In the Victorian part of the basin, major tributaries such as the Deddick River, Buchan River and Brodribb River join the Snowy River before it flows into Bass Strait at Marlo.

Figure 6-17 Map of the Snowy basin



6.10.1 Water resources overview

In 2015–16, rainfall across the Snowy basin was 100% to 125% of the long-term average in much of the basin, with a small area in the south-east of the basin receiving slightly less rainfall: 80% to 100% of the long-term average. Catchment inflows were above-average. Total inflows from New South Wales and Victoria were 2,594,278 ML, compared to 2,054,861 ML in the previous year. Consumptive water use in the Snowy basin is generally low, compared to the total water resource, and more than 99% of the basin's total inflows for 2015–16 flowed into Bass Strait.

All unregulated streams remained unrestricted throughout 2015–16 and there were no urban water use restrictions applied in the Snowy basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-57 shows the responsibilities of the authorities within the Victorian portion of the Snowy basin.

Table 6-57 Responsibilities for water resources management in the Snowy basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages surface water licensed diversions		
East Gippsland Water		Supplies towns including Buchan, Orbost and Marlo	Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Manages environmental entitlements held in trust for the Snowy River
East Gippsland Catchment Management Authority			Manages waterways for the whole of the Snowy basin

Water for the environment

The health of the Snowy River depends on water. Environmental assets include Australian grayling populations, Australian bass, the lower Snowy wetlands and estuary (which are nationally important wetlands), heritage river reaches, the Ewings Marsh wetlands complex and the Snowy River daisy.

In 2015–16, water for the environment in the Snowy basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of the water licence issued to Snowy Hydro
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by East Gippsland Water
- environmental allocations from outcomes of the Snowy Water Inquiry
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.10.2 Surface water resources

6.10.2.1 Water balance

The total volumes of water available and supplied from water resources in the Snowy basin in 2015–16 are shown in Table 6-58. As these accounts provide a record of water availability and use across Victoria, this balance only considers the portion of the Snowy basin that is located within Victoria.

No storage information is recorded in the water balance as there are no major on-stream storages in the Snowy basin.

Catchment inflows from the Victorian portion of the basin accounted for 74% of the total inflows to the Snowy basin. The volume of water diverted within the Victorian portion of the basin represents less than 1% of the total inflows.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the increased catchment inflow overall within the basin. In the Snowy basin, the water balance shows catchment inflows in 2015–16 were 382,446 ML more than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 1,544,317 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 383,006 ML more (rather than 382,446 ML). For more information, see Appendix E.

6.10 Snowy basin

Table 6-58 Balance of surface water in the Snowy basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows from Victoria (1)	1,927,323	1,544,877
Catchment inflows from NSW (2)	666,955	509,984
Rainfall on major storages	-	-
Treated effluent discharged back to river	0	0
Total inflows	**2,594,278**	**2,054,861**
Outflows		
Diversions		
Urban diversions	718	635
Licensed diversions from unregulated streams	471	242
Usage from small catchment dams (3)	2,811	3,356
Total diversions	***4,000***	***4,233***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (3)	685	700
In-stream infiltration to groundwater, flows to floodplain and evaporation (4)	n/a	n/a
Total losses	***685***	***700***
Water passed at outlet of basin		
River outflows to the ocean	2,589,593	2,049,928
Total water passed at outlet of basin	***2,589,593***	***2,049,928***
Total outflows	**2,594,278**	**2,054,861**

Notes:

(1) Catchment inflows from Victoria is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) Catchment inflows from New South Wales recorded on the Snowy River at Burnt Hut Crossing (gauge 222013).

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(4) No suitable model is available to make an estimate of in-stream losses.

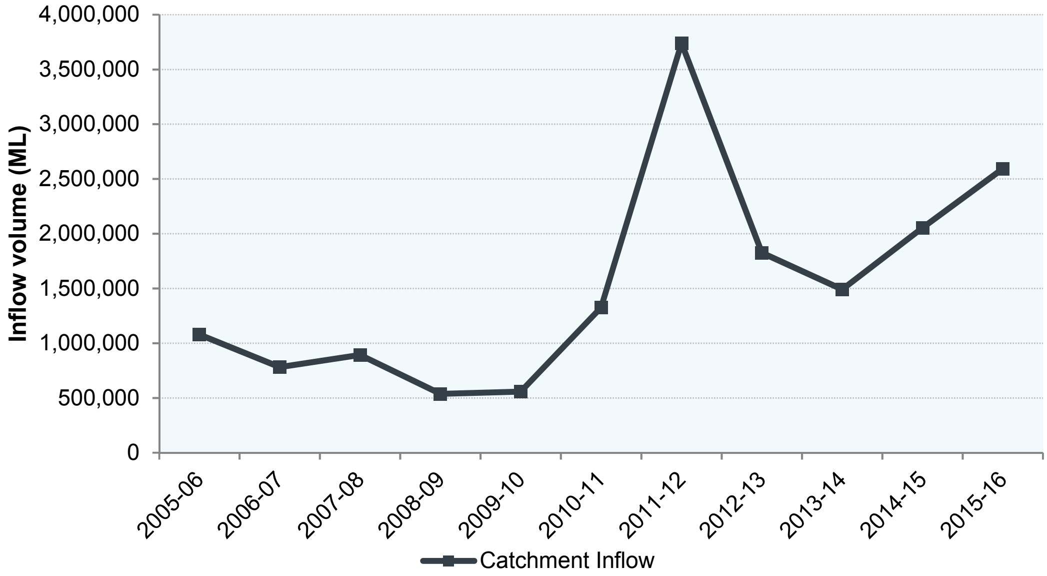
6.10.2.2 Storages and flows

Total inflows to the Victorian portion of the basin in 2015–16 were 1,927,323 ML, or 189% of the long-term average (of 1,022,000 ML), compared to 1,544,877 ML, or 151% of the long-term average in 2014–15 (Figure 6-18). Inflows from New South Wales are regulated by the Snowy Mountains Hydro-Electric Scheme. These inflows were 666,955 ML in 2015–16, up from 509,984 ML in 2014–15.

The amount of water flowing from the Snowy basin into Bass Strait was 2,589,593 ML in 2015–16. This represents over 99% of total inflows to the basin.

There are no major storages located within the Victorian portion of the Snowy basin.

Figure 6-18 Catchment inflows in the Snowy basin (including contribution from New South Wales)



6.10.2.3 Entitlement volumes and diversions

In the Snowy basin, surface water is diverted by East Gippsland Water and licensed diverters, and it is also harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Snowy basin are outlined in Table 6-59.

Table 6-59 Entitlement volumes in the Snowy basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Buchan) Conversion Order 1997	170
Bulk Entitlement (Orbost System) Conversion Order 1997	2,031
Take and use licences – unregulated surface water	3,962
Total volume of water entitlements in the Snowy basin	**6,163**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-60. The total volume of water diverted by bulk entitlement holders was similar to amount reported in the *Victorian Water Accounts 2014–15*.

As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the Snowy basin remains significantly lower than the total licence volume. The volume of water diverted from unregulated streams by licence holders in the Snowy basin was 471 ML (Table 6-60) which was higher than the 2014–15 volume of 242 ML.

Table 6-60 Allocation account balance summary for the Snowy basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Buchan	170	0	23	147
Orbost system	2,031	0	695	1,336
Take and use licences – unregulated surface water	3,963	0	471	3,492

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Snowy basin (Table 6-61).

The capacity of small catchment dams for Snowy basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 727 ML less for small catchment dam capacity and a decrease of 545 ML usage. For more information, see Appendix E.

Table 6-61 Estimated small catchment dam information for the Snowy basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,948	1,474	n/a
Registered commercial and irrigation	1,592	1,337	n/a
Total	**4,540**	**2,811**	**3,496**

n/a: information not available.

6.10.3 Recycled water

East Gippsland Water operates the sole wastewater treatment plant in the Snowy basin. As with 2014–15, 100% of wastewater was recycled in 2015–16 and used for agricultural applications including pasture and tree plantations. However, there was an increase in the volume of water produced from the previous year.

Table 6-62 highlights the volumes and uses of water recycled in the East Gippsland basin in 2015–16.

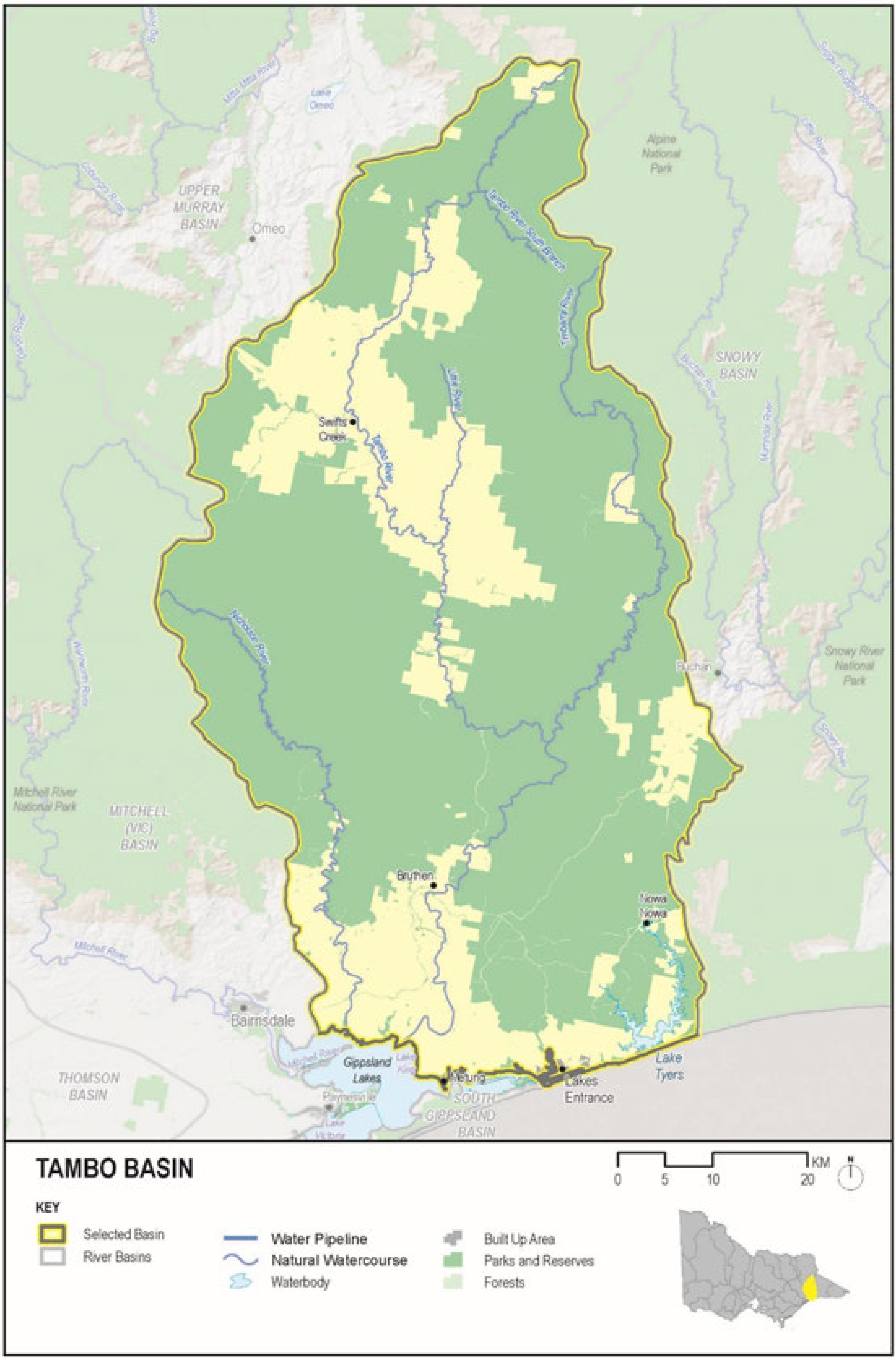
Table 6-62 Volume and use of recycled water in the Snowy basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Orbost	394	394	100%	0	394	0	0	0	0
Total 2015–16	**394**	**394**	**100%**	**0**	**394**	**0**	**0**	**0**	**0**
Total 2014–15	224	224	100%	0	224	0	0	0	0

6.11 Tambo basin

The Tambo basin (Figure 6-19) is located in south-east Victoria. The basin contains the Tambo River and the Nicholson River, which flow into the Gippsland Lakes.

Figure 6-19 Map of the Tambo basin



6.11 Tambo basin

6.11.1 Water resources overview

In 2015–16, rainfall in most of the Tambo basin was between 100% and 125% of the long-term average.

Catchment inflows were 146% of the long-term average of 297,800 ML, which is an increase from 113% reported in 2014–15. There are no large authorised diversions in the Tambo basin. Larger towns (such as Lakes Entrance) are supplied by the Bairnsdale water system. Therefore, about 99% of the basin inflows passed through to the Gippsland Lakes in 2015–16.

No bans were applied to rural users with all unregulated streams remaining unrestricted. There were also no urban water use restrictions applied in the Tambo basin in 2015–16, and all towns were on permanent water savings rules throughout the year.

Table 6-63 shows the responsibilities of the authorities within the Tambo basin.

Table 6-63 Responsibilities for water resources management in the Tambo basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Towns including Lakes Entrance, Bruthen and Swifts Creek are supplied from neighbouring basins	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways in the whole of the Tambo basin

Water for the environment

The Gippsland Lakes are important environmental assets partially dependent on water in the Tambo basin. They are listed as internationally significant wetlands under the Ramsar Convention and rely on the freshwater inputs from the Tambo basin to function ecologically. Other environmental assets that rely on water for the environment include fish populations (Australian grayling, black bream) and the Bosses, Nebbor, Russells and Tambo River East swamps, which are nationally important wetlands.

In 2015–16, water for the environment in the Tambo basin comprised:

- water set aside for the environment through the operation of passing flow conditions on licensed diversions and consumptive bulk entitlements held by East Gippsland Water
- all other water in the basin not allocated for consumptive use.

6.11.2 Surface water resources

6.11.2.1 Water balance

The total volumes of water available and supplied from water resources in the Tambo basin in 2015–16 are shown in Consumptive use in the Tambo basin is low, compared with the available resource in the basin.

No storage information is recorded in the water balance as there are no major on-stream storages in the Tambo basin.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the increased catchment inflow overall within the basin. In the Tambo basin, the water balance shows catchment inflows in 2015–16 were 97,824 ML more than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 337,716 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 383,006 ML more (rather than 97,824 ML). For more information, see Appendix E.

Table 6-64 Balance of surface water in the Tambo basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows (1)	435,656	337,832
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**435,656**	**337,832**
Outflows		
Diversions		
Urban diversions	24	48
Licensed diversions from unregulated streams	228	72

Usage from small catchment dams (2)	3,661	3,971
Total diversions	***3,913***	***4,091***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (2)	2,179	1,986
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***2,179***	***1,986***
Water passed at outlet of basin		
River outflows to the ocean	429,564	331,755
Total water passed at outlet of basin	***429,564***	***331,755***
Total outflows	**435,656**	**337,832**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

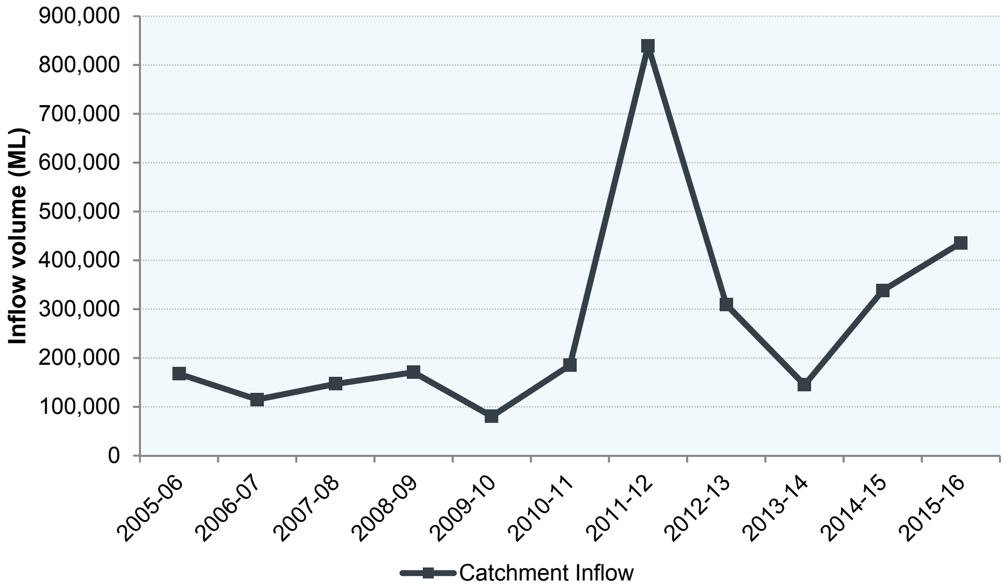
(3) No suitable model is available to make an estimate of in-stream losses.

6.11.2.2 Storages and flows

Catchment inflows were 146% of the long-term average of 297,800 ML, which is an increase from 113% reported in 2014–15 (Figure 6-20). The amount of water flowing from the Tambo basin into the Gippsland Lakes was 429,564 ML in 2015–16, which was about 99% of total inflows to the basin.

There are no major storages located within the Tambo basin.

Figure 6-20 Catchment inflows in the Tambo basin



6.11.2.3 Entitlement volumes and diversions

In the Tambo basin, surface water is diverted by East Gippsland Water and licensed diverters, and water is also harvested in small catchment dams.

Entitlements in the Tambo basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Tambo basin are outlined in Table 6-65.

Table 6-65 Entitlement volumes in the Tambo basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Nowa Nowa) Conversion Order 1997	118
Bulk Entitlement (Swifts Creek) Conversion Order 1997	224
Take and use licences – unregulated surface water	4,150
Total volume of water entitlements in Tambo basin	**4,492**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-66.

6.11 Tambo basin

The volume of water diverted from unregulated streams by licence holders in the Tambo basin (228 ML) was more in 2015–16 than the volume reported for 2014–15 (72 ML).

Table 6-66 Allocation account balance summary for the Tambo basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Nowa Nowa (1)	118	0	0	118
Swifts Creek	224	0	24	200
Take and use licences – unregulated surface water	4,150	0	228	3,922

Note:

(1) No water was taken under the Nowa Nowa bulk entitlement in 2015–16. East Gippsland Water supplied this town under the Bairnsdale bulk entitlement, reported in Table 6-71 in the Mitchell basin.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Tambo basin (Table 6-67).

The capacity of small catchment dams for Tambo basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 128 ML less for small catchment dam capacity and a decrease of 310 ML usage. For more information, see Appendix E.

Table 6-67 Estimated small catchment dam information for the Tambo basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,088	2,544	n/a
Registered commercial and irrigation	1,330	1,117	n/a
Total	**6,418**	**3,661**	**5,840**

n/a: information not available.

6.11.3 Recycled water

East Gippsland Water operates the wastewater treatment plants within the Tambo basin. As with 2014–15, 100% of wastewater passing through these treatment plants was recycled in 2015–16 and used for agricultural applications including pasture, tree plantations, racecourses and golf courses.

Table 6-68 highlights the volumes and uses of water recycled in the Tambo basin in 2015–16.

Table 6-68 Volume and use of recycled water in the Tambo basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Lakes Entrance	805	805	100%	0	805	0	0	0	0
Metung	149	149	100%	0	149	0	0	0	0
Total 2015–16	**954**	**954**	**100%**	**0**	**954**	**0**	**0**	**0**	**0**
Total 2014–15	504	504	100%	0	504	0	0	0	0

6.12 Mitchell basin

The Mitchell basin (Figure 6-21) is located in south-east Victoria and occupies 477,800 ha. Its waterways flow into the Gippsland Lakes near Bairnsdale.

Figure 6-21 Map of the Mitchell basin

6.12 Mitchell basin

6.12.1 Water resources overview

In 2015–16, rainfall in the Mitchell basin ranged between 80% and 125% of the long-term average, with the south of the basin experiencing higher rainfall than the north. Catchment inflows in the Mitchell basin were 58% of the long-term average of 884,500 ML, compared to 75% in 2014–15. Consumptive use in the basin is generally low when compared to the total water resource. As with 2014–15, about 97% of the total inflows were not diverted and therefore entered the Gippsland Lakes.

All unregulated streams remained unrestricted throughout 2015–16, and there were no urban water use restrictions applied in the Mitchell basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-69 shows the responsibilities of the authorities within the Mitchell basin.

Table 6-69 Responsibilities for water resources management in the Mitchell basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
East Gippsland Water		Supplies towns including Bairnsdale, Lakes Entrance and Paynesville	Obliged to meet passing flow requirements
East Gippsland Catchment Management Authority			Manages waterways in the Mitchell basin

Water for the environment

The Gippsland Lakes are important environmental assets which are partially dependent on water in the Mitchell basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from the Mitchell basin to function ecologically. Other environmental assets that rely on water include heritage river reaches, fish populations (including Australian grayling and black bream, waterbirds (for example, the great egret) and botanical values (for example, Yellowwood).

In 2015–16, water for the environment in the Mitchell basin comprised:

- water set aside for the environment through the release of passing flows, as a condition of the consumptive bulk entitlement held by East Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.12.2 Surface water resources

6.12.2.1 Water balance

The total volumes of water available and supplied from water resources in the Mitchell basin in 2015–16 are shown in Table 6-70. As well as supplying Bairnsdale, the Mitchell River is the source of supply for Bruthen, Nicholson, Johnsonville, Swan Reach, Metung and Lakes Entrance in adjacent basins. The river also supports irrigation on the Lindenow Flats. Diversions make up a relatively small proportion of total inflows, with about 3% of the total basin inflows diverted for consumptive use.

No storage information is recorded in the water balance as there are no major on-stream storages in the Mitchell basin.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Mitchell basin, the water balance shows catchment inflows in 2015–16 were 145,690 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 660,079 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 145,593 ML more (rather than 145,690 ML). For more information, see Appendix E.

Table 6-70 Balance of surface water in the Mitchell basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows (1)	514,486	660,176
Rainfall on major storages	-	-
Treated wastewater discharged back to river	138	119
Total inflows	**514,624**	**660,295**
Outflows		

Diversions		
Urban diversions	4,104	4,036
Licensed diversions from unregulated streams	7,508	7,884
Usage from small catchment dams (2)	4,517	4,558
Total diversions	***16,129***	***16,478***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (2)	950	1,006
In-stream infiltration to groundwater, flows to floodplain and evaporation	237	182
Total losses	***1,187***	***1,188***
Water passed at outlet of basin		
River outflows to the Gippsland Lakes	497,308	642,629
Total water passed at outlet of basin	***497,308***	***642,629***
Total outflows	**514,624**	**660,295**

Note:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts, compared to last year's accounts. See Appendix E for further detail.

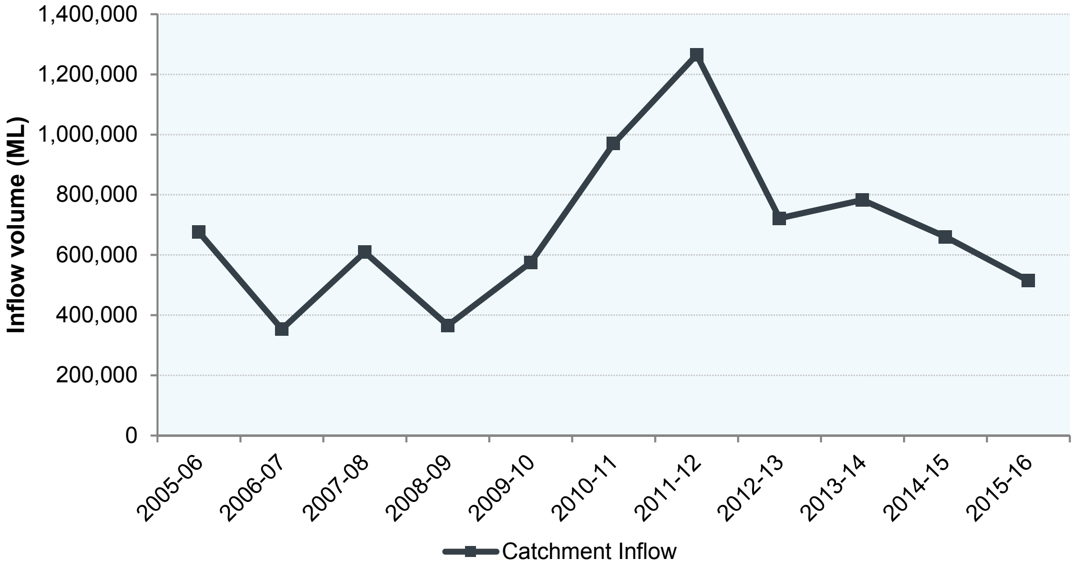
6.12.2.2 Storages and flows

Catchment inflows to the basin were 58% of the long-term average (of 884,500 ML), compared to 75% in 2014–15 (Figure 6-22).

The amount of water flowing from the Mitchell basin into the Gippsland Lakes was 497,308 ML in 2015–16, which is 97% of the total inflows into the basin. This is a decrease from 642,629 ML recorded in 2014–15.

There are no major storages located within the Mitchell basin.

Figure 6-22 Catchment inflows in the Mitchell basin



6.12.2.3 Entitlement volumes and diversions

In the Mitchell basin, surface water is diverted by East Gippsland Water and licensed diverters, and harvested in small catchment dams. The total volume of take and use licences in the Mitchell basin includes licences for irrigation as well as for domestic and stock purposes.

East Gippsland Water holds one bulk entitlement in the Mitchell basin, used to supply Bairnsdale, Lakes Entrance, Bruthen and surrounding towns.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water authorities or the VEWH). Rights to water in the Mitchell basin are outlined in Table 6-71.

6.12 Mitchell basin

Table 6-71 Entitlement volumes in the Mitchell basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Bairnsdale) Conversion Order 2000	9,208
Take and use licences – unregulated surface water	16,385
Total volume of water entitlements in the Mitchell basin	**25,593**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-72.

The volume of water diverted from unregulated streams by licence holders in the Mitchell basin (7,508 ML) was less in 2015–16 than the volume (7,884 ML) reported in the *Victorian Water Accounts 2014–15*.

Table 6-72 Allocation account balance summary for the Mitchell basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Bairnsdale	9,208	0	4,104	5,104
Take and use licences – unregulated surface water	16,385	0	7,508	8,877

The estimated volume of water harvested from small catchment dams is presented in Table 6-73.

The capacity of small catchment dams for Mitchell basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 124 ML less for small catchment dam capacity and a decrease of 41 ML usage. For more information, see Appendix E.

Table 6-73 Estimated small catchment dam information for the Mitchell basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,031	2,016	n/a
Registered commercial and irrigation	2,978	2,502	n/a
Total	**7,009**	**4,517**	**5,467**

n/a: information not available.

6.12.3 Recycled water

East Gippsland Water operates all treatment plants within the Mitchell basin. About 96% of wastewater produced was recycled in 2015–16, a slight decrease from 100% in 2014–15. All of the wastewater passing through the Bairnsdale and Lindenow treatment plants was recycled in 2015–16.

The Bairnsdale wastewater treatment plant has, as part of its treatment process, a series of constructed wetlands located within the Macleod Morass. The constructed wetlands provide additional filtration for water discharged from the treatment plant, before it is released into the morass as environmentally beneficial water for the deep freshwater marsh. This discharge is considered a beneficial allocation.

Table 6-74 highlights the volumes and uses of water recycled in the Mitchell basin in 2015–16.

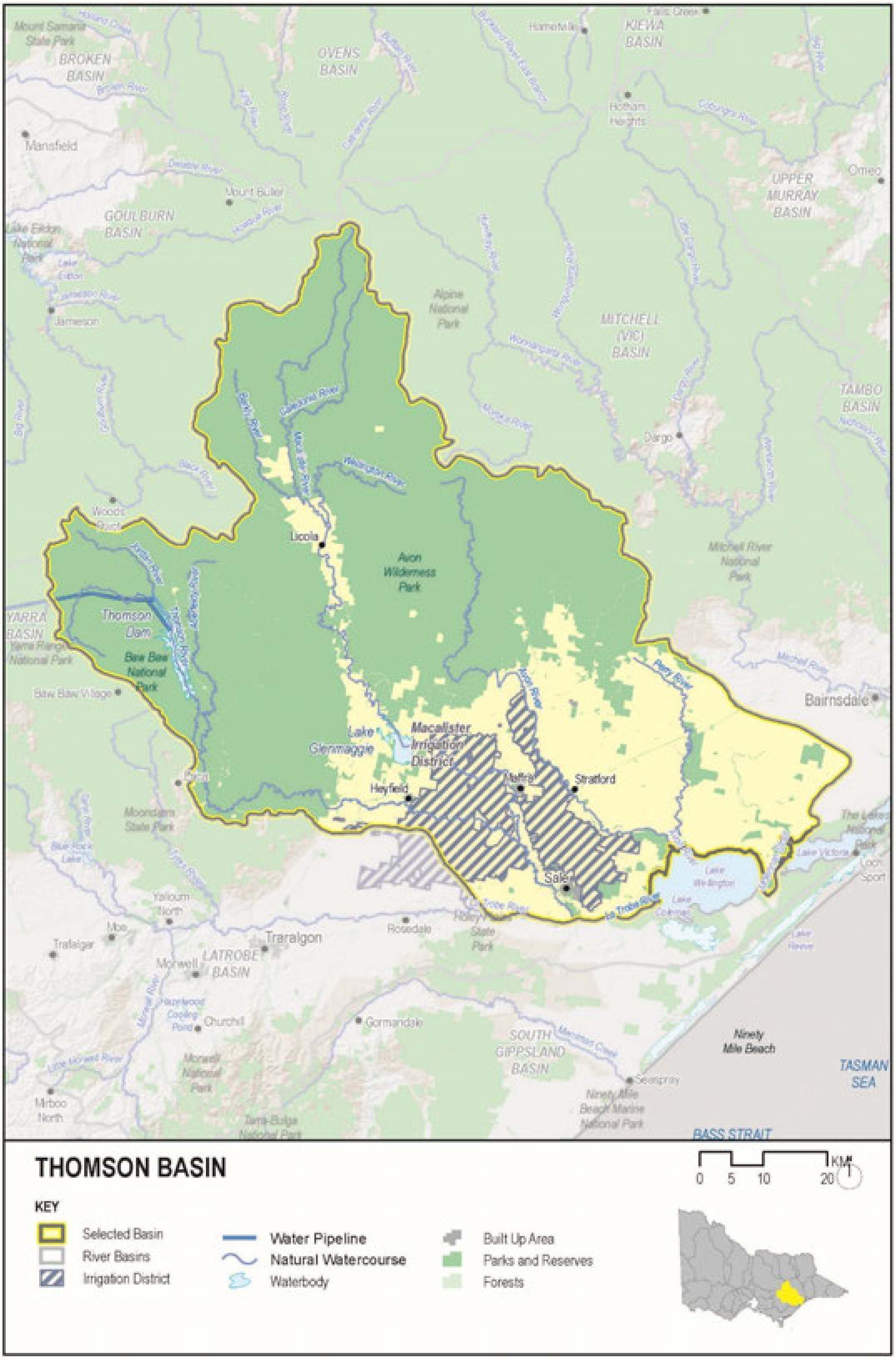
Table 6-74 Volume of recycled water in the Mitchell basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bairnsdale	1,293	1,293	100%	0	16	1,278	0	0	0
Lindenow	8	8	100%	0	0	8	0	0	0
Paynesville	409	339	83%	0	339	0	0	71	0
Total 2015–16	**1,710**	**1,640**	**96%**	**0**	**355**	**1,286**	**0**	**71**	**0**
Total 2014–15	1,775	1,775	100%	0	17	1,758	0	0	0

6.13 Thomson basin

The Thomson basin (Figure 6-23) is located in south-east Victoria. The Thomson and Macalister rivers join the Latrobe River before flowing into the Gippsland Lakes.

Figure 6-23 Map of the Thomson basin



6.13 Thomson basin

6.13.1 Water resources overview

In 2015–16, rainfall in the Thomson basin ranged from 80% to 125% of the long-term average, with a small pocket in the west receiving between 60% and 80% of the long-term average. Catchment inflows were 51% of the long-term average of 1,101,760 ML, compared to 67% in 2014–15. The amount of water flowing from the Thomson basin into the Gippsland Lakes represented 53% of the total inflows in the basin in 2015–16.

Major storages in the Thomson basin started the year at 71% of capacity and were at 55% at the end of June 2016.

The year began with a 100% July allocation for high-reliability water shares in the Macalister Irrigation District. In January 2016, a 5% allocation was made to low-reliability water shares, increasing to 20% by April 2016.

No bans were applied to rural users, with all unregulated streams remaining unrestricted. There were no urban water use restrictions applied in the Thomson basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-75 shows the responsibilities of the authorities within the Thomson basin.

Table 6-75 Responsibilities for water resources management in the Thomson basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Melbourne Water				Operates Thomson Reservoir, which supplies water to the Greater Yarra system – Thomson River Pool entitlement holders (Melbourne surface water supply system) and irrigators in the Macalister Irrigation District Releases water to the Thomson River for environmental flows Obliged to meet passing flow requirements
Southern Rural Water	Provides irrigation supplies to the Macalister Irrigation District	Manages groundwater and surface water licensed diversions	Provides bulk water supply to Gippsland Water	Operates Lake Glenmaggie Obliged to meet passing flow requirements
Gippsland Water			Supplies towns including Sale Maffra, Heyfield, Stratford and Boisdale	
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
West Gippsland Catchment Management Authority				Manages waterways in the Thomson basin

Water for the environment

The Gippsland Lakes are important environmental assets partially dependent on water in the Thomson basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on freshwater inputs from basins including the Thomson basin to function ecologically. The upper Thomson River is a heritage river reach and its Australian grayling populations also rely on water for the environment.

In 2015–16, water for the environment in the Thomson basin comprised:

- the *Bulk Entitlement (Thomson River – Environment) Order 2005* comprising 10,000 ML of high-reliability entitlement held by the VEWH and water set aside for the environment through the operation of passing flows released from the Thomson Reservoir
- the *Macalister River Environmental Entitlement 2010* comprising 12,461 ML of high-reliability and 6,230 ML of low-reliability entitlements held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated under entitlements.

In 2015–16, a total of 25,047 ML of held environmental water was delivered in-stream in the Thomson basin.

6.13.2 Surface water resources

6.13.2.1 Water balance

The total volumes of water available and supplied from water resources in the Thomson basin in 2015–16 are shown in Table 6-76. Irrigation water use in the Macalister Irrigation District comprised the majority of diversions within the basin.

A total volume of 167,574 ML was diverted to irrigation districts in 2015–16, higher than in 2014–15. Melbourne Water's transfer from the Thomson Reservoir to the Greater Yarra system – Thomson River Pool increased to 247,098 ML in 2015–16.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Thomson basin, the water balance shows catchment inflows in 2015–16 were 180,712 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 738,725 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 179,048 ML less (rather than 180,712 ML). For more information, see Appendix E.

Table 6-76 Balance of surface water in the Thomson basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	888,496	919,542
Volume in storage at end of year	678,930	888,496
Change in storage	**(209,566)**	**(31,046)**
Inflows		
Catchment inflows (1)	559,677	740,389
Rainfall on major storages	23,965	26,225
Return flows from irrigation	16,629	19,926
Treated wastewater discharged back to river	52	29
Total inflows	**600,323**	**786,569**
Outflows		
Diversions		
Urban diversions	1,484	1,349
Transfers to Yarra basin for urban use	247,098	148,744
Irrigation district diversions	167,574	164,271
Licensed diversions from regulated streams	17,920	18,190
Licensed diversions from unregulated streams	4,991	4,481
Usage from small catchment dams (2)	5,475	6,984
Total diversions	***444,542***	***344,019***
Losses		
Evaporation losses from major storages	30,360	30,972
Losses from small catchment dams (2)	2,398	2,552
In-stream infiltration to groundwater, flows to floodplain and evaporation	12,656	14,197
Total losses	***45,414***	***47,721***
Water passed at outlet of basin		
River outflows to Latrobe River	227,933	281,117
River outflows to Lake Wellington (3)	92,001	144,759
Total water passed at outlet of basin	***319,934***	***425,876***
Total outflows	**809,889**	**817,616**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) River outflows to Lake Wellington includes Perry River volume of 18,039.91 ML.

6.13.2.2 Storages and flows

The volume of water held in major storages was 678,930 ML (55% of capacity) at the end of June 2016, compared to 888,496 ML at the start of July 2015.

In the Thomson basin, major on-stream storages include the Thomson Reservoir and Lake Glenmaggie. Melbourne's biggest water storage, the Thomson Reservoir, began the year at 71% of capacity and decreased to 55% by the end of June 2016. Lake Glenmaggie finished the year with a volume of 81,017 ML, which is 46% of its total capacity. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-77 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

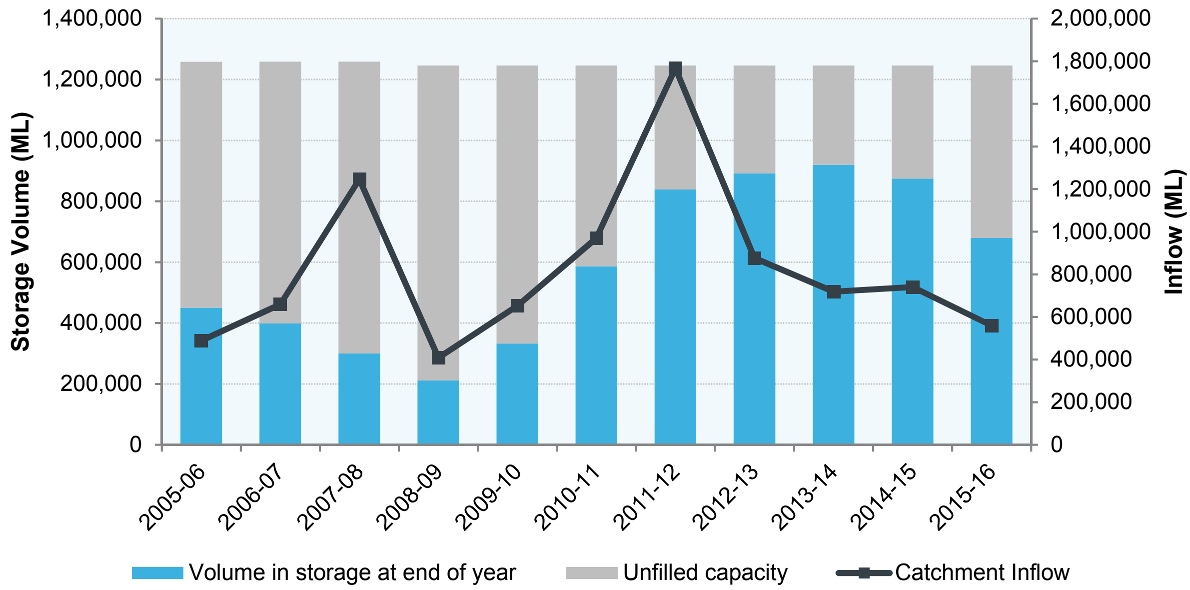
Table 6-77 Storage volumes in the Thomson basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Lake Glenmaggie	177,640	118,106	8,977	12,172	(33,894)	81,017
Thomson Reservoir [(1)]	1,068,000	770,390	14,988	18,188	(169,277)	597,913
Total storage volumes	**1,245,640**	**888,496**	**23,965**	**30,360**	**(203,171)**	**678,930**

Note:
(1) Volumes in store in the Thomson do not include 55,100 ML of volume in dead storage.

Catchment inflows to the Thomson basin amounted to 559,677 ML in 2015–16, which is 51% of the long-term average of 1,101,760 ML (Figure 6-24). The amount of water flowing from the Thomson basin into the Gippsland Lakes in 2015–16 was 319,934 ML, compared to 425,876 ML in 2014–15. This represents 57% of catchment inflows into the basin for 2015–16.

Figure 6-24 Storage volumes and catchment inflows in the Thomson basin



6.13.2.3 Entitlement volumes and diversions

Southern Rural Water, Gippsland Water, Melbourne Water and the VEWH hold bulk entitlements in the Thomson basin.

Melbourne Water holds a bulk entitlement to divert surface water from the Thomson River. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool which primarily supplies Melbourne and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

Details of the new entitlement arrangements are provided in the Yarra basin section of this chapter. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Thomson basin are outlined in Table 6-78.

Table 6-78 Entitlement volumes in the Thomson basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001 (1)	
High-reliability water shares	150,035
Low-reliability water shares	71,726
Bulk Entitlement (Thomson Macalister Towns – Gippsland Water) Conversion Order 2005	2,335
Macalister River Environmental Entitlement 2010	18,690
Subtotal: Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001	**242,787**
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014 (2)	**171,800**
Bulk Entitlement (Thomson River – Environment) Conversion Order 2005	**10,000**
Take and use licences – unregulated surface water	**17,239**
Total volume of water entitlements in the Thomson basin	**441,826**

Notes:

(1) Under this bulk entitlement, Southern Rural Water operates Lake Glenmaggie and Cowwarr Weir to supply water share holders in the Macalister Irrigation District and diverters on the Thomson and Macalister rivers and Rainbow Creek, and to supply water to Gippsland Water's Thomson Macalister towns bulk entitlement.

(2) This water is used to supply primary entitlement holders (City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-79. The total volume of water diverted by bulk entitlement holders was higher in 2015–16, compared to the volume reported in the *Victorian Water Accounts 2014–15*. The volume of water diverted from unregulated streams by licence holders in the Thomson basin was 4,991 ML, which was higher than the 2014–15 volume of 4,481 ML.

The VEWH holds environmental entitlements for the Thomson River and Macalister River, but the water available under these entitlements is used to support streamflows and is not diverted out of waterways in the basin.

Table 6-79 Allocation account balance summary for the Thomson basin

Water entitlement	Allocation issued (ML)	Net trade In / (Out) (ML)	Water use (ML)	End of season forfeitures (ML)
Thomson Macalister – Southern Rural Water				
Water shares (1)	170,088	(3,300)	140,376	26,412
Thomson Macalister Towns – Gippsland Water	2,335	0	1,484	851
Macalister River Environmental Entitlement 2010 (2) (3)	16,187	0	12,796	3,391
Operating provisions (whole of system) (4)	-	-	28,489	-
Net diversion: Thomson Macalister - Southern Rural Water (5)			**170,349**	0
Thomson River – Melbourne Water (6) (7)	171,800	0	247,098	(75,298)
Thomson River – Environment (8)	10,394	1,970	12,251	113
Take and use licences – unregulated surface water	17,239	0	4,991	12,249

Notes:

(1) Allocation issued includes 5,645 ML of spill allocation made available to water shares holders in 2015–16.

(2) Allocation issued includes 4,216 ML of water carried over on entitlement and the volume of 3,391 ML recorded as forfeited could be carried over into 2016–17. Water use reported reflects environmental in-stream use. This amount is not reflected in the water balance in Table 6-76 as it does not represent an actual diversion from the waterway. Unused water is available to be carried over under this entitlement (see Table 4-2).

(3) The environmental diversion reported here is not included in the total diversion for the Thomson Macalister – Southern Rural Water bulk entitlement as the water was not diverted out of the waterway.

(4) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.

(5) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Thomson Macalister source bulk entitlement (net of return flows from irrigation).

(6) Although in 2015–16 the water use was 247,098 ML, which suggests an overuse of 75,298 ML. The volume of water taken by Melbourne Water under this bulk entitlement is actually assessed against a 15-year average annual volume of 171,800 ML. The corresponding average annual volume of diversions over the 15 years to 2015–16 was 114,509 ML which is below the required average annual volume.

(7) The combined volume of water taken by Melbourne Water from the Thomson basin, Yarra basin and Silver and Wallaby creeks is assessed against a 15-year average annual volume of 555,000 ML. The corresponding average annual volume of diversions over the 15 years to 2015–16 was 396,079 ML.

(8) Allocation issued includes 394 ML of water carried over on entitlement and the volume of 113 ML recorded as forfeited could be carried over into 2016–17.

The estimated volume of water harvested from small catchment dams in the Thomson basin is provided in Table 6-80.

The capacity of small catchment dams for Thomson basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 1,848 ML less for small catchment dam capacity and a decrease of 1,510 ML usage. For more information, see Appendix E.

6.13 Thomson basin

Table 6-80 Estimated small catchment dam information for the Thomson basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,508	2,754	n/a
Registered commercial and irrigation	3,239	2,721	n/a
Total	**8,747**	**5,475**	**7,872**

n/a: information not available.

6.13.3 Recycled water

Gippsland Water operates all treatment plants within the Thomson basin. About 98% of wastewater was recycled in 2015–16, a slight increase on 97% in 2014–15. Recycled water within the basin is mainly used to irrigate pasture and for watering facilities (such as the Maffra Recreational Reserve).

Table 6-81 highlights the volumes and uses of water recycled in the Thomson basin in 2015–16.

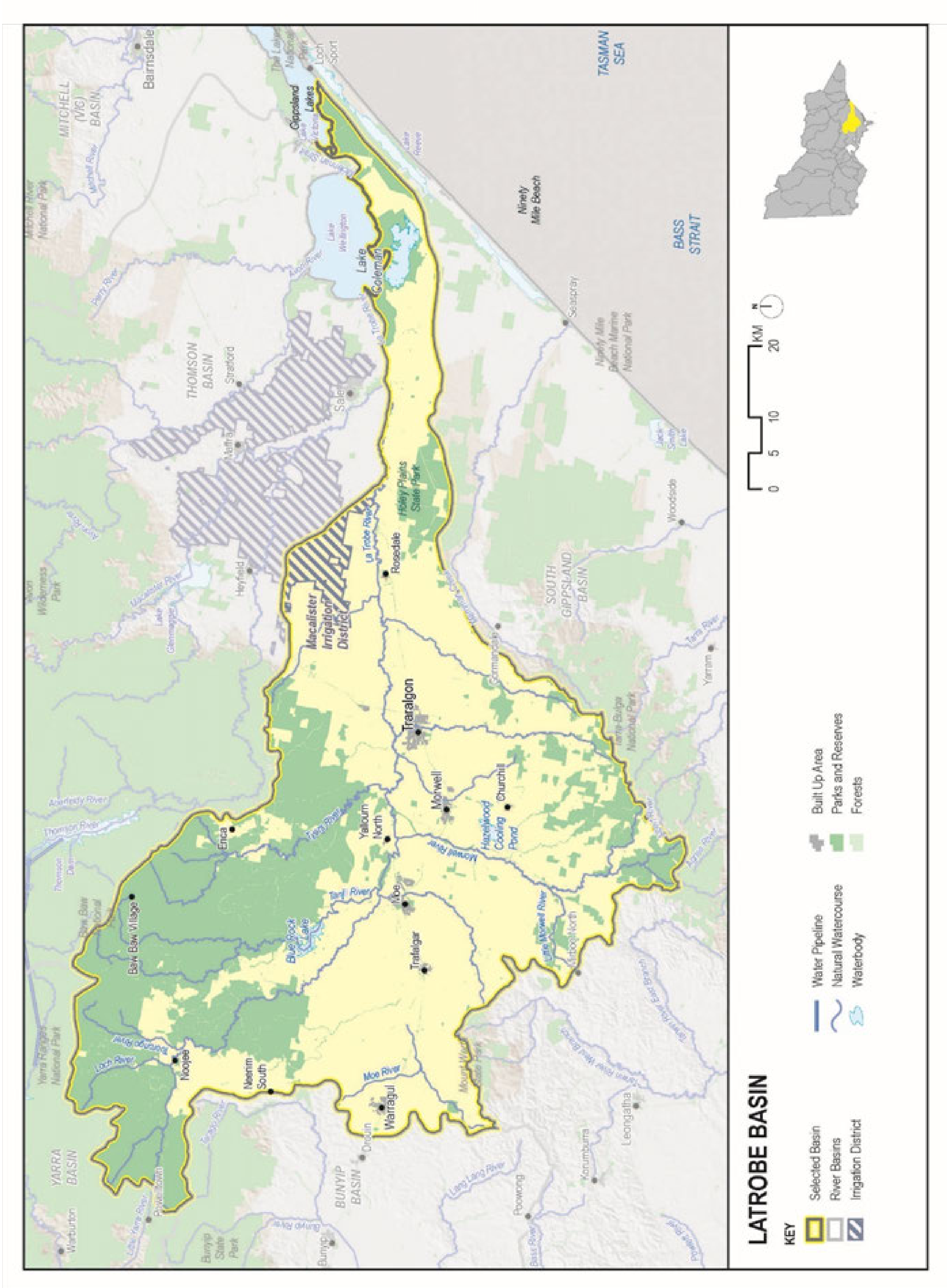
Table 6-81 Volume and use of recycled water in the Thomson basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heyfield	91	91	100%	0	91	0	0	0	0
Maffra	203	203	100%	6	197	0	0	0	0
Rawson	26	0	0%	0	0	0	0	26	0
Sale	683	683	100%	0	683	0	0	0	0
Stratford	128	128	100%	0	128	0	0	0	0
Total 2015–16	**1,131**	**1,105**	**98%**	**6**	**1,099**	**0**	**0**	**26**	**0**
Total 2014–15	943	914	97%	5	909	0	0	29	0

6.14 Latrobe basin

The Latrobe basin (Figure 6-25) lies between the Strzelecki Ranges and the Great Dividing Range. The Latrobe River flows east and joins the Thomson River before flowing into the Gippsland Lakes.

Figure 6-25 Map of the Latrobe basin



6.14 Latrobe basin

6.14.1 Water resources overview

In 2015–16, the Latrobe basin received between 60% and 100% of its long-term average rainfall. The amount of water flowing from the Latrobe basin into the Gippsland Lakes (excluding the Thomson River) represented 86% of the catchment inflows in the basin in 2015–16.

The volume of water in major storages remained high throughout the year, with major storages starting and ending the year at greater than 85% of capacity. No urban water use restrictions applied in the Latrobe basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year. Morwell Creek and Narracan Creek were on stage 1 restrictions from December 2015 through to the end of June 2016. All other unregulated waterways remained unrestricted.

Table 6-82 shows the responsibilities of the authorities within the Latrobe basin.

Table 6-82 Responsibilities for water resources management in the Latrobe basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages the Macalister Irrigation District (which is supplied from the Thomson basin)	Manages licensed diversions		Operates part of the Latrobe water supply system including Blue Rock Reservoir and Lake Narracan for supply to Gippsland Water, power stations and licensed diverters Obliged to meet passing flow requirements
Gippsland Water			Supplies towns including Moe, Morwell and Traralgon Provides industrial supply to Hazelwood and Energy Brix power stations and to other major industries	Operates Moondarra Reservoir Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
West Gippsland Catchment Management Authority				Manages waterways in the Latrobe basin

Water for the environment

The Gippsland Lakes and the Australian grayling population are important environmental assets partially dependent on water in the Latrobe basin. The lakes are listed as internationally significant wetlands under the Ramsar Convention and rely on the freshwater inputs from rivers including the Latrobe River to function ecologically. Australian grayling are listed in the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the Victorian *Flora and Fauna Guarantee Act 1988*.

In 2015–16, water for the environment in the Latrobe basin comprised:

- the *Lower Latrobe Wetlands Environmental Entitlement 2010 (1)*, held by the VEWH, which allows water to be diverted to floodplain wetlands including Dowd Morass, Sale Common and Heart Morass when river levels are above heights specified in the environmental entitlement
- the *Blue Rock Environmental Entitlement 2013*, held by the VEWH; it was amended on 14 April 2016 when the inflows share changed from 9% to 9.45%
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Southern Rural Water and Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 3,750 ML of environmental water was delivered in-stream in the Latrobe basin.

6.14.2 Surface water resources

6.14.2.1 Water balance

The total volumes of water available and supplied from water resources in the Latrobe basin in 2015–16 are shown in Table 6-83. The major industrial water users in the basin include electricity generators and Australian Paper. In 2015–16, these entities accounted for more than half the surface water diversions in the Latrobe basin. They also returned 37,135 ML to the Latrobe River system.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Latrobe basin, the water balance shows catchment inflows in 2015–16 were 152,554 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as

705,334 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 154,807 ML less (rather than 152,554 ML). For more information, see Appendix E.

Table 6-83 Balance of surface water in the Latrobe basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	244,694	241,433
Volume in storage at end of year	200,814	244,694
Change in storage	**(43,880)**	**3,261**
Inflows		
Catchment inflows (1)	552,528	703,081
Rainfall on major storages	8,519	9,373
Return flows from power stations and major industry	37,135	36,123
Treated wastewater discharged back to river	3,450	3,676
Total inflows	**601,632**	**752,253**
Outflows		
Diversions		
Urban and industrial diversions	115,730	113,451
Licensed diversions from regulated streams	6,976	4,685
Licensed diversions from unregulated streams	7,592	5,731
Usage from small catchment dams (2)	22,802	20,547
Total diversions	***153,100***	***144,414***
Losses		
Evaporation losses from major storages	13,670	12,025
Losses from small catchment dams (2)	5,610	5,612
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***19,280***	***17,637***
Water passed at outlet of basin		
River outflows to the Gippsland Lakes (excluding Thomson River)	473,132	586,940
Total water passed at outlet of basin	***473,132***	***586,940***
Total outflows	**645,512**	**748,991**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

6.14.2.2 Storages and flows

Storage levels for all major storages in the basin totalled 200,814 ML in June 2016 (Table 6-84), compared to 244,694 ML in July 2015. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-84 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Only volumes for major on-stream storages have been included in the water balance. The largest storage in the basin is Blue Rock Reservoir, which has an operating capacity of 198,280 ML. The volume of water held in Blue Rock Reservoir at the end of the year was 170,586 ML.

Table 6-84 Storage volumes in the Latrobe basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Blue Rock Reservoir (1)	198,280	208,098	5,286	8,386	(34,412)	170,586
Lake Narracan	7,230	6,138	1,686	2,357	(1,073)	4,394
Moondarra Reservoir	30,458	30,458	1,547	2,927	(3,244)	25,834
Total storage volumes	**235,968**	**244,694**	**8,519**	**13,670**	**(38,729)**	**200,814**

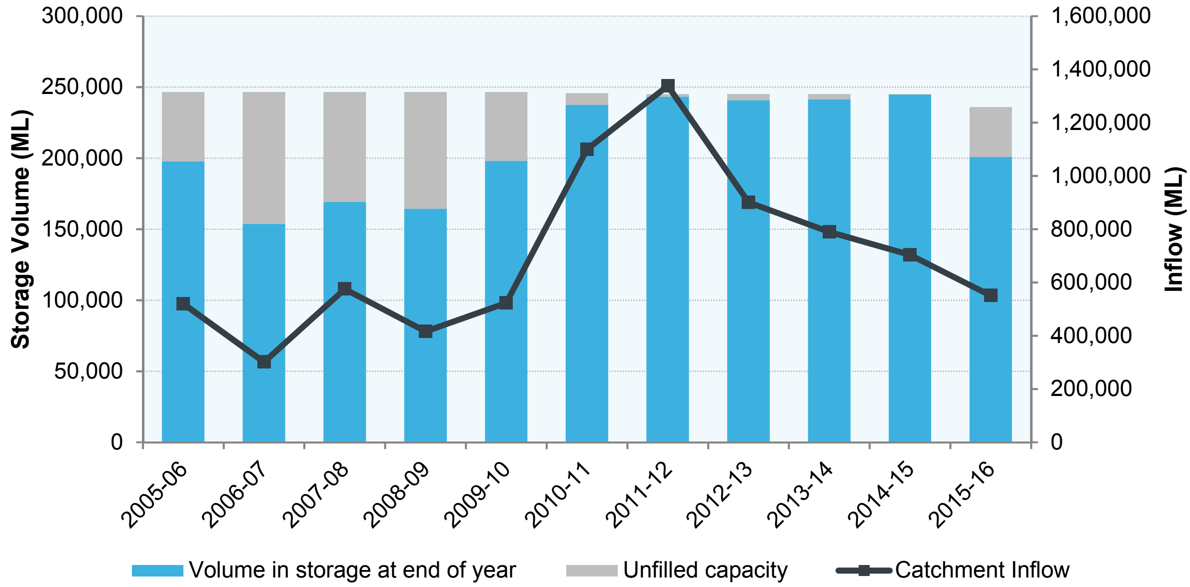
Note:

(1) A recent survey conducted confirmed the total capacity of Blue Rock Reservoir is 198,280 ML, which is 9,908 ML less than previously reported.

6.14 Latrobe basin

Catchment inflows were 65% of the long-term average of 847,400 ML, compared to 83% in 2014–15 (Figure 6-26). The amount of water flowing from the Latrobe basin into the Gippsland Lakes (excluding the Thomson River) decreased to 473,132 ML in 2015–16 from 586,940 ML in 2014–15.

Figure 6-26 Storage volumes and catchment inflows in the Latrobe basin



6.14.2.3 Entitlement volumes and diversions

In the Latrobe basin, surface water is diverted by Gippsland Water, Southern Rural Water, Latrobe Valley power stations, the VEWH and licensed diverters. Surface water is also harvested in small catchment dams.

Entitlements in the Latrobe basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Latrobe basin are outlined in Table 6-85.

Table 6-85 Entitlement volumes in the Latrobe basin

Water entitlements	Annual entitlement volume (ML)
Blue Rock Environmental Entitlement 2013 (1) (5)	n/a
Bulk Entitlement (Boolarra) Conversion Order 1997	145
Bulk Entitlement (Gippsland Water – Blue Rock) Conversion Order 1997 (5)	20,000
Bulk Entitlement (Erica) Conversion Order 1997	340
Bulk Entitlement (Latrobe – Southern Rural) Conversion Order 1996 (2) (5)	13,400
Lower Latrobe Wetlands Environmental Entitlement 2010 (3)	n/a
Bulk Entitlement (Mirboo North) Conversion Order 1997	270
Bulk Entitlement (Moe – Narracan Creek) Conversion Order 1998	3,884
Bulk Entitlement (Moondarra Reservoir) Conversion Order 1997	62,000
Bulk Entitlement (Noojee) Conversion Order 1997	73
Bulk Entitlement (Thorpdale) Conversion Order 1997	80
Bulk Entitlement (Latrobe – Loy Yang B) Conversion Order 1996 (5)	20,000
Bulk Entitlement (Latrobe – Loy Yang A) Conversion Order 1996 (5)	40,000
Bulk Entitlement (Latrobe – Loy Yang 3/4 Bench) Conversion Order 1996 (5)	25,000
Bulk Entitlement (Latrobe – Yallourn) Conversion Order 1996 (5)	36,500
Bulk Entitlement (Latrobe Reserve) Order 2013 (4) (5)	n/a
Take and use licences – unregulated surface water	18,915
Total volume of water entitlements in the Latrobe basin	**240,607**

Notes:

(1) The *Blue Rock Environmental Entitlement 2013* consists of a 9.45% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.

(2) This entitlement supplies water for take and use licences on the Tanjil River and Latrobe River Lower: 11,548 ML of entitlement was allocated for take and use licences for the 2015–16 year.

(3) Use of this entitlement depends on suitable river heights, as specified in the entitlement.

(4) The Latrobe Reserve consists of a 18.87% share of inflows into Blue Rock Reservoir after passing flow requirements have been met.

(5) A survey of Blue Rock Reservoir recorded a storage volume which is 9908 ML less than when the Latrobe regulated system bulk entitlements were first granted in 1996, resulting in a slightly decreased reliability for all seven bulk and environmental entitlement holders. On 14 April 2016, the

percentage inflow and capacity shares held under each entitlement were slightly increased to retain the original volumetric share and reliability. To offset this, a corresponding decrease was made to the Latrobe Reserve bulk entitlement.

n/a: Specified volume not applicable.

Allocation available under bulk entitlements for water corporations, VEWH and the Latrobe Valley power stations, and licences in 2015–16, is shown in Table 6-86.

The *Lower Latrobe Wetlands Environmental Entitlement 2010* held by the VEWH provides for unregulated flows in the Latrobe River to be diverted to floodplain wetlands. The volume of unregulated flows available for diversion varies depending on seasonal conditions.

Licence holders diverted a volume of 7,592 ML from unregulated streams in 2015–16, more than the 2014–15 volume of 5,731 ML (Table 6-86).

Table 6-86 Allocation account balance summary for the Latrobe basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Blue Rock Environmental Entitlement (1)	19,530	0	3,750	15,780
Boolarra	145	0	0	145
Gippsland Water – Blue Rock	20,000	0	6,727	8,423
Erica	340	0	63	277
Latrobe – Southern Rural Water (2)	12,065	(82)	6,976	5,007
Lower Latrobe Wetlands Environmental Entitlement (3)	-	-	-	-
Mirboo North	270	0	196	74
Moe – Narracan Creek	3,884	0	1,405	2,479
Moondarra Reservoir	62,000	0	44,044	17,956
Noojee (4)	73	0	0	73
Thorpdale	80	0	3	77
Latrobe – Loy Yang B	20,000	0	14,590	5,410
Latrobe – Loy Yang A	40,000	0	21,356	18,644
Latrobe – Loy Lang 3/4 Bench	25,000	0	0	25,000
Yallourn Energy Ltd	36,500	0	27,346	9,154
Latrobe Reserve	-	-	-	-
Take and use licences – unregulated surface water	23,787	82	7,592	16,277

Notes:

(1) Allocation issued reflects the total available water for the year (including opening carryover). Water use reported reflects environmental in-stream use. This amount is not reflected in the water balance in Table 6-83 as it is not an actual diversion from the waterway. Unused water is available to carry over in this system. For details refer to Table 4-1.

(2) This represents the water allocated and used by take and use licence holders.

(3) Use of this entitlement depends on suitable river heights, as specified in the entitlement. In March 2016, water under this entitlement was used to inundate Heart Morass. Volumes delivered to Heart Morass are not measured.

(4) Gippsland Water is not taking water from the Loch River under its Noojee bulk entitlement and instead supplies Noojee from Tarago Reservoir in the Bunyip basin.

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Latrobe basin (Table 6-87).

The capacity of small catchment dams for Latrobe basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 2,560 ML more for small catchment dam capacity and an increase of 2,255 ML usage. For more information, see Appendix E.

Table 6-87 Estimated small catchment dam information for the Latrobe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	12,701	6,351	n/a
Registered commercial and irrigation	19,585	16,451	n/a
Total	**32,286**	**22,802**	**28,412**

n/a: Information not available.

6.14.3 Recycled water

Gippsland Water operates all treatment plants within the Latrobe basin. About 3% of wastewater was recycled in 2015–16, a decrease from the 6% in 2014–15. The majority of wastewater produced in the basin is highly saline and unsuitable for recycling and was therefore was discharged to Bass Strait.

Table 6-88 highlights the volumes and uses of water recycled in the Latrobe basin in 2015–16.

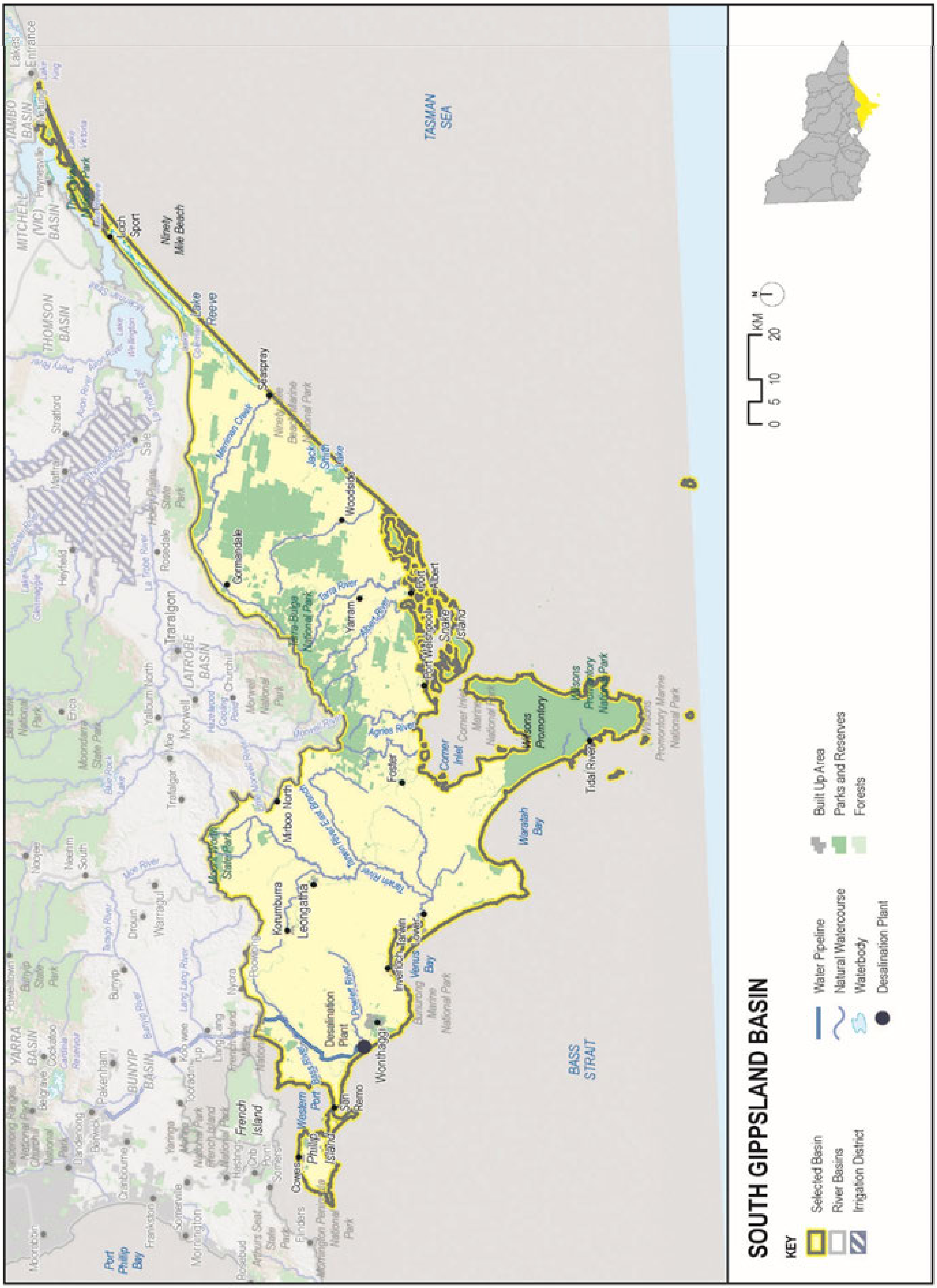
Table 6-88 Volume and use of recycled water in the Latrobe basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Mirboo North	93	93	100%	46	47	0	0	0	0
Moe	2,001	0	0%	0	0	0	0	2,001	0
Morwell	583	583	100%	0	0	583	0	0	0
Dutson Downs (regional outfall sewer)	7,608	0	0%	0	0	0	0	0	7,608
Saline wastewater outfall pipeline	9,538	0	0%	0	0	0	0	0	9,538
Warragul	1,439	0	0%	0	0	0	0	1,449	(10)
Willow Grove	14	14	100%	0	14	0	0	0	0
Total 2015–16	**21,276**	**690**	**3%**	**46**	**61**	**583**	**0**	**3,450**	**17,136**
Total 2014–15	12,579	708	6%	42	70	596	0	11,871	0

6.15 South Gippsland basin

The South Gippsland basin (Figure 6-27) is located in south-east Victoria. The basin includes the Bass River, which flows into Western Port, and smaller rivers that flow directly into Bass Strait.

Figure 6-27 Map of the South Gippsland basin



6.155 South Gippsland basin

6.15.1 Water resources overview

In 2015–16, most of the South Gippsland basin had rainfall between 60% and 80% of the long-term average. Wilson's Promontory and the north-west area of the basin received higher rainfall: between 80% and 100% of average rainfall.

Catchment inflows were 64% of the long-term average of 911,500 ML, a decrease when compared to 80% in 2014–15. The amount of water flowing from the South Gippsland basin into Bass Strait and Western Port represented 92% of the total inflows to the basin in 2015–16.

On 14 January 2016, South Gippsland water implemented stage 1 urban water use restrictions for Korumburra and Fish Creek, due to low reservoir levels and high demand. These restrictions were increased to stage 2 in March 2016. At this time, the Little Bass system (three towns) was also placed on stage 2 restrictions. All urban water use restrictions were lifted in June 2016. All other towns in the South Gippsland basin in 2015–16 remained on permanent water savings rules throughout the year. Bruthen Creek's irrigation ban from 2014–15 was lifted in August 2015 and reinstated in November. Albert River joined Bruthen in December and they were both on irrigation bans until the end of June 2016.

There was no order for water from the Victorian Desalination Project located at Wonthaggi during 2015–16.

Table 6-89 shows the responsibilities of the authorities within the South Gippsland basin.

Table 6-89 Responsibilities for water resources management in the South Gippsland basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages surface water licensed diversions		
South Gippsland Water		Supplies towns including Leongatha, Inverloch, Wonthaggi, Korumburra and Foster	Obliged to meet passing flow requirements
Westernport Water		Supplies towns including San Remo and Phillip Island	Obliged to meet passing flow requirements
Gippsland Water		Supplies towns in the far east of the basin including Seaspray	Obliged to meet passing flow requirements
West Gippsland Catchment Management Authority			Manages most waterways in the South Gippsland basin
Melbourne Water			Manages waterways in the far west of the South Gippsland basin
AquaSure (Consortium of Thiess and Suez)		Operate the Victorian Desalination Project, located near Wonthaggi	

Water for the environment

Important environmental assets in the South Gippsland basin depend on water. Corner Inlet and Western Port are listed as internationally significant wetlands under the Ramsar Convention and rely on the freshwater inputs from the South Gippsland basin to function ecologically. The Australian grayling population, listed in the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the Victorian *Flora and Fauna Guarantee Act 1988,* also relies on water for the environment.

In 2015–16, water for the environment in the South Gippsland basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Gippsland Water and South Gippsland Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.15.2 Surface water resources

6.15.2.1 Water balance

The total volumes of water available and supplied from water resources in the South Gippsland basin in 2015–16 are shown in Table 6-90. Diversions make up a relatively small proportion of total inflows, with about 6% of basin inflows diverted for consumptive use in 2015–16. Most inflows leave the basin and flow into Bass Strait or Western Port.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the South Gippsland basin, the water balance shows catchment inflows in 2015–16 were 150,397 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 736,448 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 157,140 ML less (rather than 150,397 ML). For more information, see Appendix E.

Table 6-90 Balance of surface water in the South Gippsland basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	6,829	7,968
Volume in storage at end of year	6,398	6,829
Change in storage	**(431)**	**(1,139)**
Inflows		
Catchment inflows (1)	579,308	729,705
Rainfall on major storages	1,336	1,564
Treated wastewater discharged back to river (2)	1,079	0
Total inflows	**581,723**	**731,269**
Outflows		
Diversions		
Urban diversions	7,902	7,526
Licensed diversions from unregulated streams	3,889	2,928
Usage from small catchment dams (3)	28,387	24,256
Total diversions	***40,178***	***34,710***
Losses		
Evaporation losses from major storages	1,626	1,625
Losses from small catchment dams (3)	7,747	5,135
In-stream infiltration to groundwater, flows to floodplain and evaporation (4)	n/a	n/a
Total losses	***9,373***	***6,760***
Water passed at outlet of basin		
River outflows to Bass Strait and Western Port	532,603	692,117
Total water passed at outlet of basin	***532,603***	***692,117***
Total outflows	**582,154**	**733,587**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The volume reported for 2014–15 has been revised since the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume. The 2014–15 report incorrectly reported a volume of 4,563 ML as the volume returned to the river. Some of this volume was actually discharged to the sea.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(4) No suitable model is available to make an estimate of in-stream losses.

6.15.2.2 Storages and flows

Storage levels for all major storages in the basin were 6,398 ML (61% of capacity) by the end of June 2016, compared to 6,829 ML (65% of capacity) in July 2015 (Table 6-91).

Table 6-91 shows detailed information for storages in the South Gippsland basin. The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-91 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-91 Storage volumes in the South Gippsland basin

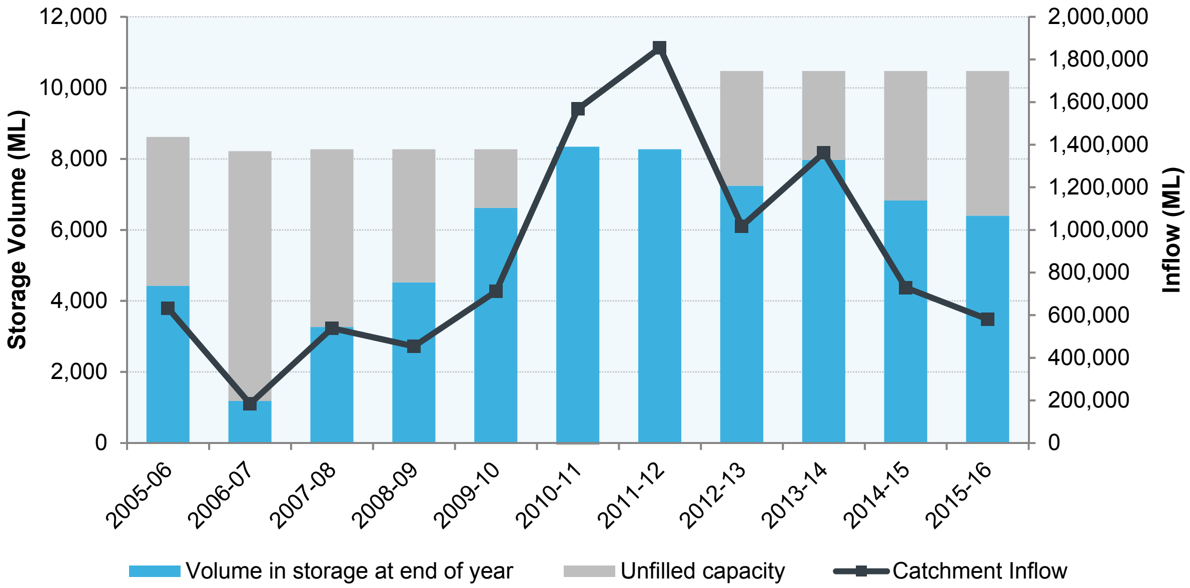
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Candowie Reservoir	4,463	2,738	701	711	(499)	2,229
Hyland Reservoir	671	285	55	79	133	394
Lance Creek Reservoir	4,200	2,989	476	686	520	3,299
Western Reservoir	1,137	817	104	150	(295)	476
Total storage volumes	**10,471**	**6,829**	**1,336**	**1,626**	**(141)**	**6,398**

Catchment inflows were 579,308 ML, or 64% of the long-term average (of 911,500 ML), a decrease from 80% of the average in 2014–15 (Figure 6-28).

The amount of water flowing from the South Gippsland basin into Western Port and Bass Strait was 532,603 ML in 2015–16. This represents 92% of the total inflows into the basin.

6.15 South Gippsland basin

Figure 6-28 Storage volumes and catchment inflows in the South Gippsland basin



6.15.2.3 Entitlement volumes and diversions

In the South Gippsland basin, surface water is diverted by Gippsland Water, South Gippsland Water and Westernport Water. Surface water is also diverted by licensed diverters and harvested in small catchment dams. Desalinated seawater from the Victorian Desalination Project located near Wonthaggi may be sourced to supplement surface water supplies from the Melbourne headworks. The Melbourne metropolitan retail water corporations have entitlements to this desalinated seawater.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the South Gippsland basin are outlined in Table 6-92.

Table 6-92 Entitlement volumes in the South Gippsland basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Devon North Alberton-Yarram and Port Albert) Conversion Order 1997	**853**
Bulk Entitlement (Dumbalk) Conversion Order 1997	**100**
Bulk Entitlement (Fish Creek) Conversion Order 1997	**251**
Bulk Entitlement (Foster) Conversion Order 1997	**326**
Bulk Entitlement (Korumburra) Conversion Order 1997	**1,000**
Bulk Entitlement (Leongatha) Conversion Order 1997	**2,476**
Bulk Entitlement (Loch, Poowong and Nyora) Conversion Order 1997	**420**
Bulk Entitlement (Meeniyan) Conversion Order 1997	**200**
Bulk Entitlement (Seaspray) Conversion Order 1997	**133**
Bulk Entitlement (Toora Port Franklin – Welshpool and Port Welshpool) Conversion Order 1997	**1,617**
Bulk Entitlement (Westernport) Conversion Order 1997	**2,911**
Bulk Entitlement (Westernport – Bass River) Order 2009	**3,000**
Bulk Entitlement (Wonthaggi – Inverloch) Conversion Order 1997	**5,600**
Take and use licences – unregulated surface water	**12,824**
Victorian Desalination Project	
Bulk Entitlement (Desalinated Water – City West Water Limited) Order 2014	39,595
Bulk Entitlement (Desalinated Water – South East Water Limited) Order 2014	53,454
Bulk Entitlement (Desalinated Water – Yarra Valley Water Limited) Order 2014	56,951
Total volume of water entitlements in the South Gippsland basin	**181,711**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-93. As in previous years, the volume of water diverted from unregulated streams by take and use licence holders in the South Gippsland basin remains significantly lower than the total licence volume.

Table 6-93 Allocation account balance summary for the South Gippsland basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Devon North Alberton –Yarram and Port Albert	853	0	478	375
Dumbalk	100	0	14	86
Fish Creek	251	0	111	140
Foster	326	0	180	146
Korumburra	1,000	0	673	327
Leongatha	2,476	0	1,732	744
Loch, Poowong and Nyora	420	0	231	189
Meeniyan	200	0	64	136
Seaspray	133	0	36	97
Toora Port Franklin – Welshpool and Port Welshpool	1,617	0	525	1,092
Western Port	2,911	0	2,139	772
Western Port – Bass River	3,000	0	0	3,000
Wonthaggi– Inverloch	3,800	0	1,719	2,081
Take and use licences – unregulated surface water	12,824	0	3,889	8,934
Desalinated water – City West Water (1)	0	0	0	0
Desalinated water – South East Water (1)	0	0	0	0
Desalinated water – Yarra Valley Water (1)	0	0	0	0

Note:

(1) In-line with the recommendation from the Melbourne metropolitan retail water corporations, the Minister for Water made a zero desalinated water order for the 2015–16 year.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the South Gippsland basin (Table 6-94).

The capacity of small catchment dams for South Gippsland basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 8,757 ML more for small catchment dam capacity and an increase of 4,131 ML usage. For more information, see Appendix E.

Table 6-94 Estimated small catchment dam information for the South Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,447	16,224	n/a
Registered commercial and irrigation	14,480	12,163	n/a
Total	**46,927**	**28,387**	**36,134**

n/a: Information not available.

6.15.3 Recycled water

South Gippsland Water, Westernport Water and Gippsland Water operate treatment plants within the South Gippsland basin. Recycling opportunities within the basin are limited, due to a small industrial base and crop types that are not suited to recycled water.

About 11% of wastewater was recycled in 2015–16, a slight increase from 8% in 2014–15. Westernport Water reuses water from its treatment plants at Coronet Bay and Cowes for sporting fields and significant gardens. Gippsland Water operates the Seaspray treatment plant and reuses all the recycled water to irrigate pasture.

Table 6-95 highlights the volumes and uses of water recycled in the South Gippsland basin in 2015–16.

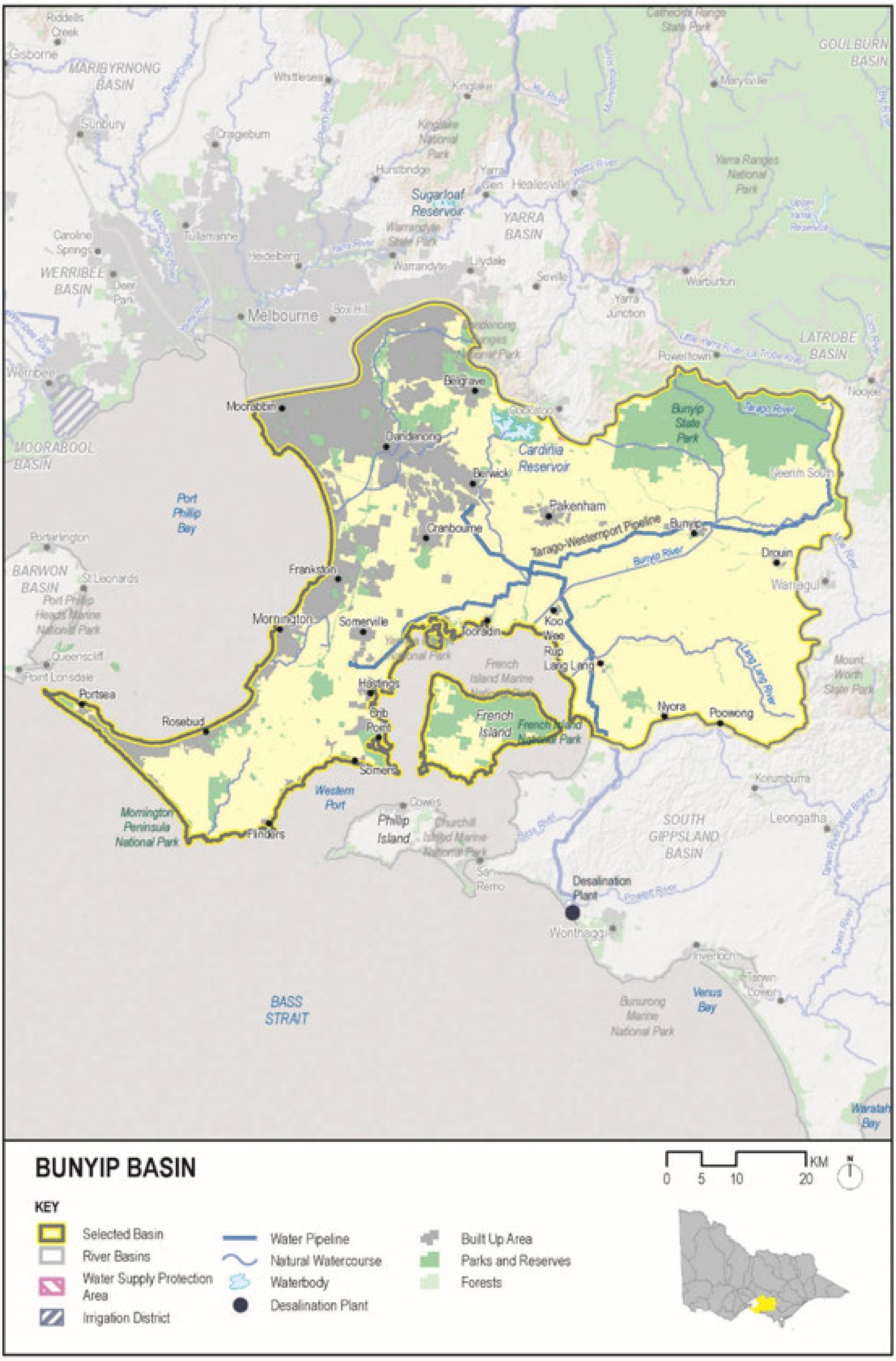
Table 6-95 Volume and use of recycled water in the South Gippsland basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Coronet Bay	183	143	78%	0	143	0	0	0	40
Cowes	1,148	153	12%	66	72	0	14	0	996
Foster	114	0	0%	0	0	0	0	0	114
Korumburra	555	0	0%	0	0	0	0	555	0
Leongatha Domestic	524	0	0%	0	0	0	0	524	0
Leongatha Trade Waste	976	0	0%	0	0	0	0	0	976
Meeniyan	16	16	100%	11	5	0	0	0	0
Seaspray	3	3	100%	0	3	0	0	0	0
Toora	20	6	28%	6	0	0	0	0	14
Waratah Bay	6	6	100%	0	6	0	0	0	0
Welshpool	38	0	0%	0	0	0	0	0	38
Wonthaggi / Cape Paterson / Inverloch	1,045	53	5%	0	53	0	0	0	993
Yarram / Tarraville	141	141	100%	0	141	0	0	0	0
Total 2015–16	**4,769**	**521**	**11%**	**83**	**423**	**0**	**14**	**1,079**	**3,171**
Total 2014–15	5,018	413	8%	16	393	0	4	1,179	3,426

6.16 Bunyip basin

The Bunyip basin (Figure 6-29) is located in south-east Victoria. The basin includes the Lang Lang and Bunyip rivers which flow into Western Port and the Patterson River which flows into Port Phillip Bay. The south-eastern suburbs of Melbourne are located within the Bunyip basin.

Figure 6-29 Map of the Bunyip basin



6.16 Bunyip basin

6.16.1 Water resources overview

In 2015–16, rainfall in the majority of the basin was between 80% and 100% of the long-term average, with small areas in the west receiving 60% to 80% of average rainfall. Catchment inflows to the Bunyip basin in 2015–16 were 86% of the long-term average, compared to 93% in 2014–15. The amount of water flowing from the Bunyip basin into Port Phillip Bay and Western Port represented about 88% of the catchment inflows in the basin.

Storage levels in the Bunyip basin started 2015–16 at just over 100% of total capacity and ended at 91%. All unregulated streams remained unrestricted throughout 2015–16.

There were no urban water use restrictions applied in the Bunyip basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-96 shows the responsibilities of the authorities within the Bunyip basin.

Table 6-96 Responsibilities for water resources management in the Bunyip basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages surface water and private diversions		
Melbourne Water		Operates Eastern Treatment Plant Provides bulk water supply to South East Water	Operates Tarago Reservoir Obliged to meet passing flows Manages waterways
South East Water		Supplies part of the metropolitan Melbourne area including Dandenong, Frankston, Pakenham and the Mornington Peninsula (1)	
Gippsland Water		Supplies towns in the east of the basin including Drouin and Neerim South	Obliged to meet passing flows
Victorian Environmental Water Holder			Holds and manages environmental entitlements in the basin
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway management in the Bunyip basin

Note:
(1) Metropolitan Melbourne is mostly supplied from the Yarra and Thomson basins.

Water for the environment

Western Port is an important environmental asset dependent on water in the Bunyip basin. The bay is listed as an internationally significant wetland under the Ramsar Convention and relies on the freshwater inputs from the Bunyip basin to function ecologically. There is also a nationally threatened population of dwarf galaxias and Australian grayling in the Tarago and Bunyip systems.

In 2015–16, water for the environment in the Bunyip basin comprised:

- the *Tarago and Bunyip Rivers Environmental Entitlement 2009*, comprising 10.3% of inflows (on average 3,000 ML a year) held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of the consumptive bulk entitlements held by Gippsland Water and Melbourne Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

In 2015–16, 2,117 ML of environmental water was delivered in-stream in the Bunyip basin.

6.16.2 Surface water resources

6.16.2.1 Water balance

The total volumes of water available and supplied from water resources in the Loddon basin in 2015–16 are shown in Table 6-97. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Bunyip basin, the water balance shows catchment inflows in 2015–16 were 39,174 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 525,587 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 59,170 ML less (rather than 39,174 ML). For more information, see Appendix E.

Table 6-97 Balance of surface water in the Bunyip basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	37,652	38,038
Volume in storage at end of year	34,303	37,652
Change in storage	**(3,349)**	**(386)**
Inflows		
Catchment inflows [(1)]	466,417	505,591
Rainfall on major storages	3,275	3,186
Treated wastewater discharged back to river [(2)]	858	316
Total inflows	**470,550**	**509,093**
Outflows		
Diversions		
Urban diversions	17,952	15,609
Licensed diversions from regulated streams	750	0
Licensed diversions from unregulated streams	5,545	4,593
Usage from small catchment dams [(3)]	32,837	15,525
Total diversions	***57,084***	***35,727***
Losses		
Evaporation losses from major storages	2,780	2,190
Losses from small catchment dams [(3)]	3,240	556
In-stream infiltration to groundwater, flows to floodplain and evaporation	832	1,164
Total losses	***6,852***	***3,910***
Water passed at outlet of basin		
River outflows to Port Phillip Bay and Western Port	409,964	469,843
Total water passed at outlet of basin	***409,964***	***469,843***
Total outflows	**473,899**	**509,480**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume. The 2014–15 report incorrectly reported a volume of 8,239 ML as volume returned to the river. 7,923 of this volume was discharged to the sea.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.16.2.2 Storages and flows

The Tarago Reservoir is the only major on-stream storage in the Bunyip basin. It ended the year at 34,303 ML after starting the year slightly over 100% (Table 6-98). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-98 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year. Cardinia Reservoir is an off-channel storage located within the Bunyip basin. It stores water harvested and transferred from the Yarra basin and is therefore not included in the Bunyip basin figures.

Table 6-98 Storage volumes in the Bunyip basin

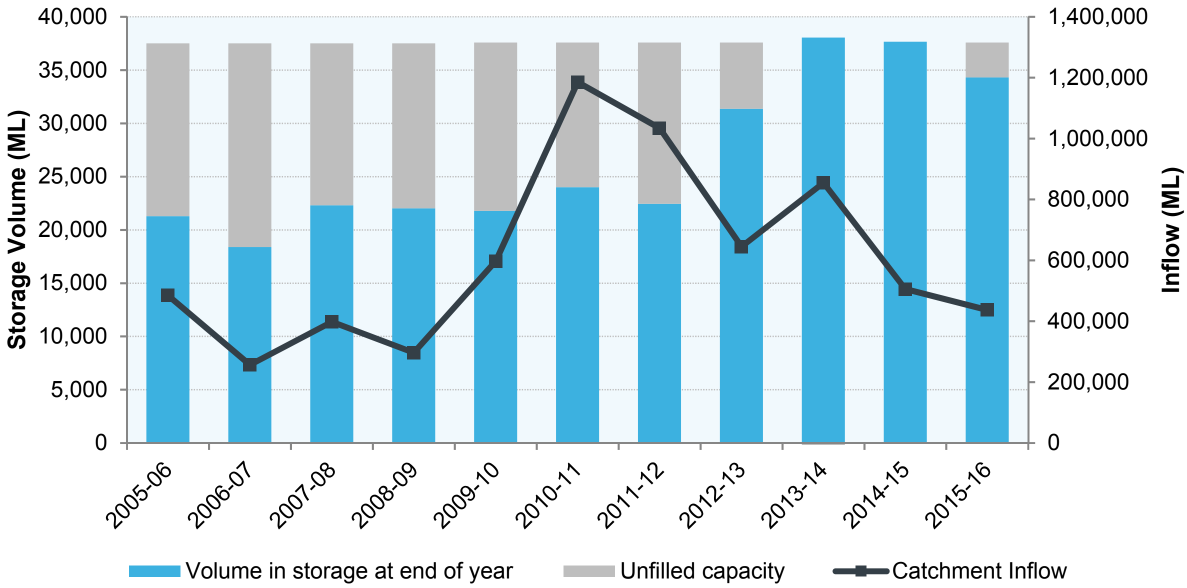
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Tarago Reservoir	37,580	37,652	3,275	2,780	(3,844)	34,303
Total storage volumes	**37,580**	**37,652**	**3,275**	**2,780**	**(3,844)**	**34,303**

Catchment inflows were 466,417 ML, or 86% of the long-term average of 541,000 ML, a decrease from 93% of the long-term average in 2014–15 (Figure 6-30).

The amount of water flowing from the Bunyip basin into Port Phillip Bay and Western Port was 409,964 ML in 2015–16, compared to 469,843 ML in 2014–15. This represents 88% of the catchment inflows into the basin for 2015–16.

6.16 Bunyip basin

Figure 6-30 Storage volumes and catchment inflows in the Bunyip basin



6.16.2.3 Entitlement volumes and diversions

Entitlements to water in the Bunyip basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Bunyip basin are outlined in Table 6-99.

Southern Rural Water, Gippsland Water and Melbourne Water all hold bulk entitlements in the Bunyip basin. Surface water is also diverted by licence diverters and is harvested in small catchment dams.

Melbourne Water holds a bulk entitlement to divert surface water in the Bunyip basin. This entitlement is one of four that contribute to the Greater Yarra System – Thomson River Pool which primarily supplies Melbourne, and supports regional urban water corporations Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105).

Table 6-99 Entitlement volumes in the Bunyip basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Tarago River – Gippsland Water) Conversion Order 2009 (1)	4,825
Bulk Entitlement (Tarago River – Southern Rural Water) Conversion Order 2009 (2)	1,260
Bulk Entitlement (Tarago and Bunyip Rivers – Melbourne Water) Order 2014 (3)	30,510
Tarago and Bunyip Rivers Environmental Entitlement 2009 (4)	3,000
Take and use licences – unregulated surface water	18,918
Total volume of water entitlements in the Bunyip basin	**58,513**

Notes:

(1) The maximum volume that can be taken each year is 275 ML plus 22,750 ML over any five-year period (4,550 ML annual average).

(2) The maximum volume that can be taken over any five-year period is 6,300 ML (1,260 ML annual average).

(3) Melbourne Water holds the source bulk entitlement on the Tarago and Bunyip rivers and can take an average annual amount of up to 30,510 ML over any consecutive five-year period. This water is used to supply primary entitlement holders (City West Water, South East Water, Yarra Valley water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

(4) The *Tarago and Bunyip Rivers Environmental Entitlement 2009* consists of a 10.3% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions.

The *Tarago and Bunyip Rivers Environmental Entitlement 2009* provides the VEWH with a 10.3% share of inflows to Tarago Reservoir. The water available under the entitlement is used to support streamflows and is not diverted out of the waterway.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-100. The volume of water diverted from unregulated streams by licence holders in the Bunyip basin in 2015–16 was slightly higher than the amount (4,593 ML) reported in the *Victorian Water Accounts 2014–15* (Table 6-100).

Table 6-100 Allocation account balance summary for the Bunyip basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Tarago River – Gippsland Water	4,825	0	3,501	1,324
Tarago River – Southern Rural Water (1)	1,260	0	750	510
Tarago River – Melbourne Water	30,510	0	14,451	16,059
Tarago and Bunyip Rivers Environmental Entitlement (2)	3,765	0	2,117	1,648
Take and use licences – unregulated surface water	18,983	0	5,545	13,438

Notes:

(1) 'Water use' represents the volume of water ordered via regulated release from Tarago Reservoir to supply licensed diverters downstream of Tarago Reservoir in 2015–16.

(2) Allocation represents the share of available water, net spills and opening carryover. Water use reported reflects environmental in-stream use: this amount is not reflected in the water balance in Table 6-97 as it does not reflect an actual diversion from the waterway. Unused water is available to carry over in this system. For details refer to Table 4-1.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Bunyip basin (Table 6-101).

The capacity of small catchment dams for Bunyip basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 27,022 ML more for small catchment dam capacity and an increase of 17,312 ML usage. For more information, see Appendix E.

Table 6-101 Estimated small catchment dam information for the Bunyip basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,867	11,934	n/a
Registered commercial and irrigation	24,885	20,903	n/a
Total	**48,752**	**32,837**	**36,076**

n/a: Information not available.

6.16.3 Recycled water

Gippsland Water, South East Water and Melbourne Water operate wastewater treatment plants within the Bunyip basin. Overall, 15% of wastewater was recycled for off-site purposes in 2015–16, an increase on the 6% of wastewater recycled for off-site purposes in 2014–15.

The largest treatment plant is the Eastern Treatment Plant operated by Melbourne Water, which recycled 6% of its total wastewater volume of 132,580 ML. The plant's recycled wastewater was mostly used on-site and this volume has not been included in the percentage of water recycled.

Table 6-102 highlights the volume and uses of water recycled in the Bunyip basin in 2015–16.

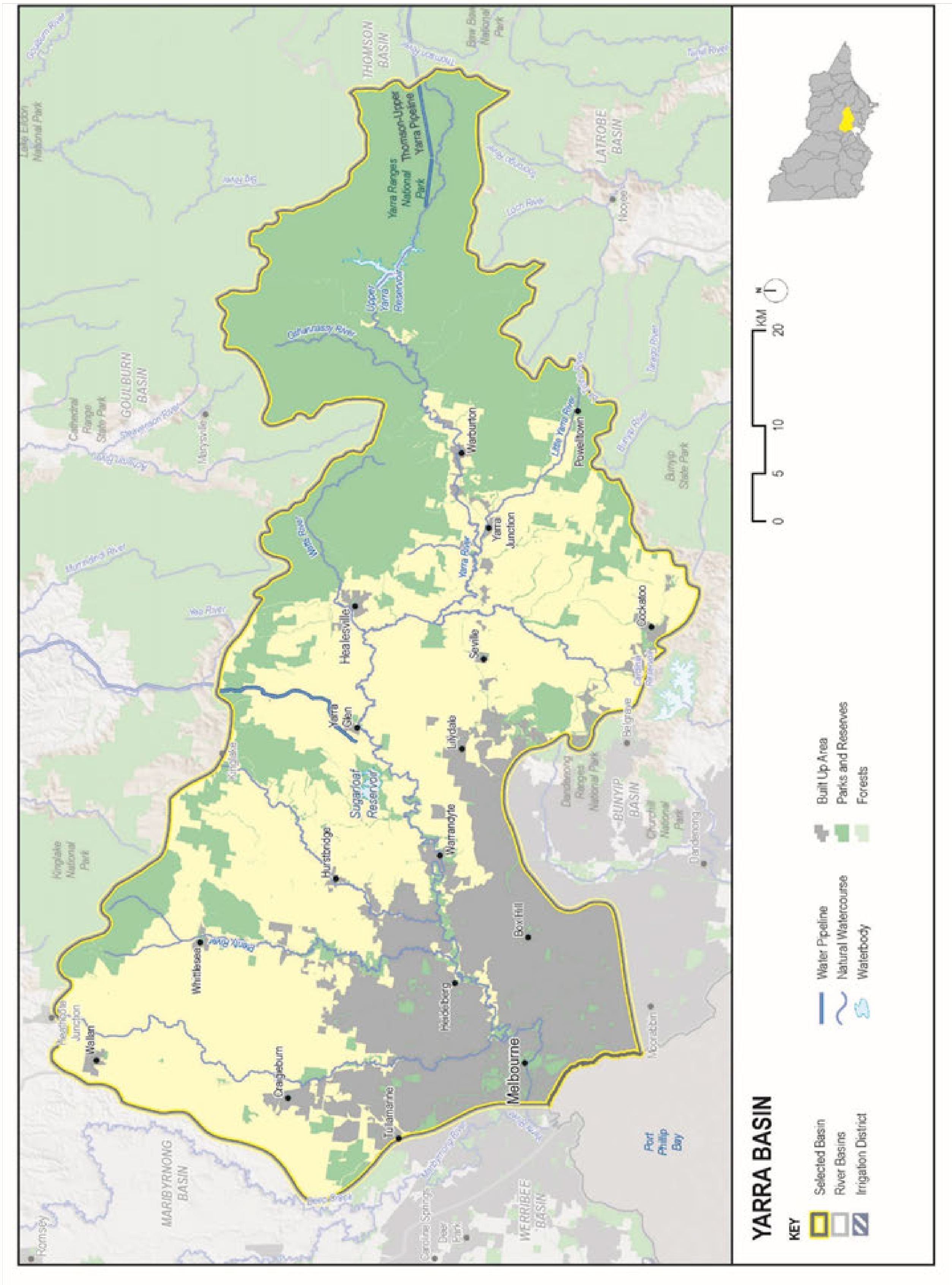
Table 6-102 Volume and use of recycled water in the Bunyip basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)					Volume discharged to the environment (ML)	Volume of other discharges (ML)
				To retailers	Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Blind Bight	181	181	94%	0	170	0	0	11	0.00	0
Boneo	3,934	1,579	35%	0	1,360	0	0	219	0.00	2,355
Drouin	586	114	19%	0	0	114	0	0	472.00	0
Eastern Treatment Plant	132,580	17,132	6%	7,623	0	0	0	9,509	0.00	115,448
Kooweerup	66	134	201%	0	134	0	0	0	0.00	(67)
Lang Lang	207	0	0%	0	0	0	0	0	160.00	47
Longwarry	298	108	36%	0	0	108	0	0	180.00	10
Mt Martha	6,232	499	1%	0	64	0	0	435	0.00	5,733
Neerim South	46	0	0%	0	0	0	0	0	46.00	0
Pakenham	1,066	986	90%	0	404	557	0	25	0.00	80
Somers	491	481	80%	0	334	58	0	90	0.00	10
Total 2015–16	**145,687**	**21,214**	**15%**	**7,623**	**2,466**	**837**	**0**	**10,289**	**858**	**123,616**
Total 2014–15	138,183	17,181	6%	5,531	2,286	526	0	8,838	316	120,686

6.17 Yarra basin

The Yarra basin (Figure 6-31) is located in south-east Victoria. The Yarra River originates in the Yarra Ranges National Park and flows through the heart of Melbourne before reaching Port Phillip Bay.

Figure 6-31 Map of the Yarra basin



6.17.1 Water resources overview

In 2015–16, rainfall within the Yarra basin was between 60% and 100% of the long-term average. Catchment inflows were 47% of the long-term average. This was a decrease from the previous year's inflows of 57%.

Major storages in the Yarra basin started the year at 61% of capacity and were at 63% at the end of June 2016.

An irrigation ban was in place on Pauls, Dixon and Steels creeks for almost all of 2015–16, with a short break in August and September. Use was restricted for a number private diversions in the Yarra basin over the summer months. At the peak, 17 streams were subject to pumping restrictions in February 2016. No urban water use restrictions were applied in the Yarra basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-103 shows the responsibilities of the authorities within the Yarra basin.

Table 6-103 Responsibilities for water resources management in the Yarra basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Melbourne Water	Manages surface water licensed diversions in the Yarra basin	Provides bulk water to the Melbourne retail water authorities	Manages waterways in the Yarra basin Operates storages for the Melbourne supply system (1) Obliged to meet passing flow requirements
Yarra Valley Water		Supplies the north and eastern part of the metropolitan Melbourne area including Healesville, Yarra Glen and Warburton from the Greater Yarra System – Thomson River Pool	
South East Water		Supplies the central and eastern part of the metropolitan Melbourne area from the Greater Yarra System – Thomson River Pool	
City West Water		Supplies the western part of the metropolitan Melbourne area from the Greater Yarra System – Thomson River Pool	
Western Water		Supplies the Bulla locality, which is in the basin, with water from both the Greater Yarra System – Thomson River Pool and water from the Maribyrnong basin	
Goulburn Valley Water		Supplies the Wallan locality, which is within this basin, using water sources from outside the basin	Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages environmental entitlements in the basin
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway management in the Yarra basin

Note:
(1) Melbourne is also supplied from the Thomson, Goulburn and Bunyip basins, as well as from the Victorian Desalination Project.

Water for the environment

Important environmental assets (such as the Australian grayling, river blackfish, Macquarie perch and numerous billabongs and wetlands) depend on water the Yarra. The Yarra River between Warburton and Warrandyte has been identified as a Victorian heritage river and depends on water for the environment.

In 2015–16, water for the environment in the Yarra basin comprised:

- the *Yarra River Environmental Entitlement 2006*, comprising 17,000 ML of high-reliability entitlement held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by the Melbourne metropolitan retailers
- water set aside for the environment through the operation of streamflow management plans
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 8,817 ML of environmental water was delivered in-stream in the Yarra basin.

6.17 Yarra basin

Melbourne headworks system: Greater Yarra system – Thomson River Pool

Melbourne's water has traditionally been sourced from the Yarra, Thomson, Bunyip, Tarago basins and the Goulburn (Silver and Wallaby creeks) basin. Since the Millennium Drought, major investment in infrastructure has brought other water sources on-line to support Melbourne's water security. These include the North–South Pipeline, which can bring water from the Goulburn River to be stored in Sugarloaf Reservoir and used to supply Melbourne. However, it can only be used once Melbourne’s storage levels fall below 30%. Another major investment has been the Victorian Desalination Project near Wonthaggi.

Surface water sourced from the Yarra, Thomson, Bunyip and Tarago basins and the Goulburn basin (Silver and Wallaby creeks) is known collectively as the Greater Yarra system – Thomson River Pool. This water is also used to provide supplies for regional urban water authorities which are connected to Melbourne (Barwon Water, Western Water, South Gippsland Water and Westernport Water).

Melbourne Water holds the bulk entitlements to surface water in the Thomson River, Yarra River, Tarago River and Silver and Wallaby creeks (Table 6-104), and uses this water to supply the bulk entitlement holders in the Greater Yarra system – Thomson River Pool — City West Water, South East Water, Yarra Valley Water, Barwon Water, South Gippsland Water, Western Water and Westernport Water (Table 6-105). Melbourne Water makes a seasonal determination at the beginning of each month to distribute the available water to entitlement holders according to their entitlement share. In 2015-16, seasonal determinations reached 82.6%.

Volumes of water taken from the river systems to supply the Greater Yarra System – Thomson River Pool are reported in each individual river basin section (Table 6-109), while the Melbourne retailers’ – South East Water, Yarra Valley Water and City West Water - deliveries to customers are accounted for in the distribution system chapter.

Table 6-104 Melbourne Water bulk entitlements to supply the Greater Yarra System – Thomson River Pool

Water entitlements	Annual entitlement volume (ML) (1)
Bulk Entitlement (Yarra River – Melbourne Water) Order 2014	400,000
Bulk Entitlement (Tarago and Bunyip Rivers – Melbourne Water) Order 2014	30,510
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014	171,800
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014	22,000

Note:

(1) The annual entitlement volume Melbourne Water may take is dictated by the cap compliance methodology as stated in its bulk entitlements, with the total cap (excluding for the Tarago system). However, an approved methodology for calculating the variable cap has not yet been approved by the Minister for Water.

Table 6-105 Greater Yarra System – Thomson River Pool bulk entitlements

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Greater Yarra System-Thomson River Pool- Barwon Water) Order 2014	16,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool-City West Water) Order 2014	155,227
Bulk Entitlement (Greater Yarra System-Thomson River Pool-South East Water) Order 2014	209,562
Bulk Entitlement (Greater Yarra System-Thomson River Pool-South Gippsland Water) Order 2014	1,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool-Western Water) Order 2014	18,250
Bulk Entitlement (Greater Yarra System-Thomson River Pool-Westernport Water) Order 2014	1,000
Bulk Entitlement (Greater Yarra System-Thomson River Pool-Yarra Valley Water) Order 2014	223,271
Total volume of water entitlements in the Yarra basin	**624,310**

6.17.2 Surface water resources

6.17.2.1 Water balance

The total volumes of water available and supplied from water resources in the Yarra basin in 2015–16 are shown in Table 6-106. Only volumes for major on-stream storages have been included in the water balance. Major off-stream storages such as Cardinia, Sugarloaf, Greenvale and Silvan reservoirs have not been included. The volume of water in the major on-stream storages was 138,935 ML in June 2016, compared to 141,842 ML in July 2015.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Yarra basin, the water balance shows catchment inflows in 2015–16 were 101,686 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 601,098 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 105,378 ML less (rather than 101,686 ML). For more information, see Appendix E.

Table 6-106 Balance of surface water in the Yarra basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	141,842	144,976
Volume in storage at end of year	138,935	141,842
Change in storage	**(2,907)**	**(3,134)**
Inflows		
Catchment inflows (1)	495,720	597,406
Rainfall on major storages	9,085	9,193
Transfers from Thomson	247,098	148,744
Transfers from Goulburn (Silver and Wallaby creeks)	1,059	1,454
Transfers from Goulburn via North-South pipeline (2)	0	0
Treated wastewater discharged back to river	0	0
Total inflows	**752,962**	**756,797**
Outflows		
Diversions		
Urban diversions	439,489	351,659
Licensed diversions from unregulated streams	8,356	9,588
Usage from small catchment dams (3)	17,346	15,824
Total diversions	***465,191***	***377,071***
Losses		
Evaporation losses from major storages	11,510	11,143
Losses from small catchment dams (3)	3,439	1,268
In-stream infiltration to groundwater, flows to floodplain and evaporation (4)	n/a	n/a
Total losses	***14,949***	***12,411***
Water passed at outlet of basin		
River outflows to Port Phillip Bay	275,730	370,448
Total water passed at outlet of basin	***275,730***	***370,448***
Total outflows	**755,869**	**759,930**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) There were no transfers from the Goulburn basin via the North–South Pipeline in the 2015–16 water year.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(4) No suitable model is available to make an estimate of in-stream losses.

6.17.2.2 Storages and flows

Melbourne Water operates seven major storages within the Yarra basin. Water is harvested by the Upper Yarra, O'Shannassy and Maroondah reservoirs. Sugarloaf and Yan Yean reservoirs are off-stream storages but have dual roles: to harvest water and to act as seasonal balancing reservoirs. Silvan and Greenvale reservoirs are off-stream storages and act as seasonal balancing reservoirs. Note that although Cardinia Reservoir is another major Melbourne Water storage that can be used to store water harvested from the Yarra basin, it is not reported here as it is an off-stream storage located within the Bunyip basin.

Storage levels for all major storages in the basin were 443,786 ML (63% of capacity) by the end of June 2016, compared to 430,411 ML at the start of July 2015 (Table 6-107). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-107 is the balancing item for each storage. It represents the flows of water in or out of the storage that are not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-107 Storage volumes in the Yarra basin

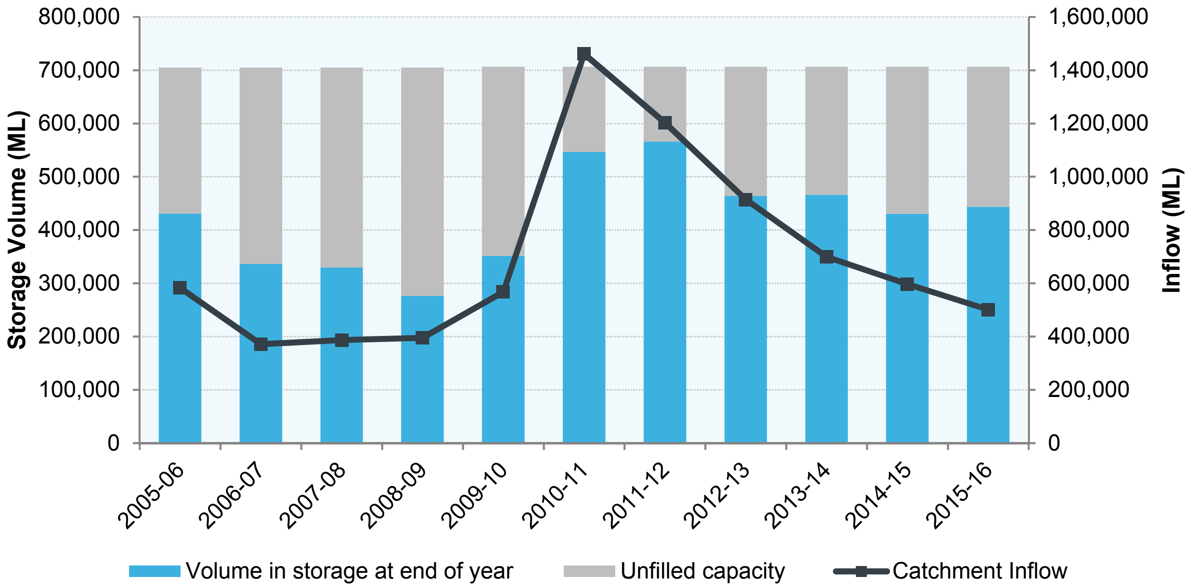
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Maroondah Reservoir	22,179	13,442	1,450	1,649	(2,411)	10,832
O'Shannassy Reservoir	3,123	1,879	284	227	387	2,323
Upper Yarra Reservoir	200,579	100,783	4,360	4,903	1,327	101,567
Yan Yean Reservoir	30,266	25,738	2,991	4,731	215	24,213
Total on-stream storages	**256,147**	**141,842**	**9,085**	**11,510**	**(482)**	**138,935**
Off-stream storages						

Cardinia Reservoir	286,911	166,957	8,741	8,251	14,146	181,593
Greenvale Reservoir	26,839	22,342	864	2,114	400	21,492
Silvan Reservoir	40,445	34,021	3,005	2,635	1,571	35,962
Sugarloaf Reservoir	96,253	65,249	2,301	3,962	2,216	65,804
Total off-stream storages	**450,448**	**288,569**	**14,911**	**16,962**	**18,333**	**304,851**
Total storage volumes	**706,595**	**430,411**	**23,996**	**28,472**	**17,851**	**443,786**

Catchment inflows to the Yarra basin in 2015–16 were 495,720 ML, or 47% of the long-term average (of 1,054,000 ML). This is lower than 2014–15, when catchment inflows were 597,406 ML or 57% of the long-term average (Figure 6-32).

The amount of water flowing from the Yarra basin into Port Phillip Bay was 275,730 ML in 2015–16. This represents 56% of the catchment inflows to the basin, compared to 62% in 2014–15.

Figure 6-32 Storage volumes and catchment inflows in the Yarra basin



6.17.2.3 Entitlement volumes and diversions

Melbourne Water holds a bulk entitlement to divert surface water in the Yarra basin. This entitlement is one of four which contribute to the Greater Yarra system – Thomson River Pool, which primarily supplies Melbourne and supports regional urban water corporations including Barwon Water, Western Water, South Gippsland Water and Westernport Water (Table 6-104 and Table 6-105). Entitlements in the Yarra basin include rights granted to authorities and individual (bulk entitlements, take and use licences, and rights granted to the VEWH for environmental entitlements). Rights to water in the Yarra basin are outlined in Table 6-108.

Table 6-108 Entitlement volumes in the Yarra basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Yarra River – Melbourne Water) 2014 (1)	400,000
Bulk Entitlement (Yarra Environment Entitlement) 2006	
High-reliability	17,000
Unregulated surface water	55
Subtotal: Bulk Entitlement (Yarra Environment Entitlement) 2006	**17,055**
Take and use licences – unregulated surface water	**42,793**
Total volume of water entitlements in the Yarra basin	**459,848**

Note:

(1) Melbourne Water holds the source bulk entitlement on the Yarra River and can take an average annual amount of up to 400,000 ML over any consecutive 15-year period. This water is used to supply the primary entitlement holders (City West Water, South East Water, Yarra Valley Water, Barwon Water, Western Water, South Gippsland Water and Westernport Water) with entitlement to the Greater Yarra system – Thomson River Pool which sources water from the Yarra River, Thomson River, Tarago River, Silver Creek and Wallaby Creek.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-109. The VEWH holds an environmental entitlement in the Yarra basin, but the water available under the entitlement is not diverted out of the waterway.

The total volume of water diverted from unregulated streams by licence holders in the Yarra basin was lower in 2015–16 than the volume reported in the *Victorian Water Accounts 2014–15*.

Table 6-109 Allocation account balance summary for the Yarra basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Yarra River – Melbourne Water (1)	400,000	0	191,332	208,668
Yarra Environment Entitlement	35,065 (2)	(1,970)	8,817 (3)	24,278 (4)
Take and use licences – unregulated surface water	42,793	(25)	8,356	34,412

Notes:

(1) 191,332 ML was used to supply entitlement holders that have bulk entitlements for the Greater Yarra system – Thomson River Pool.

(2) The VEWH has access to carryover so 'Allocation issued' includes both the 17,000 ML issued this year plus carryover of 18,065 ML from 2014–15. Allocation issued includes both the 17,000 ML issued this year plus any carryover from 2014–15 (18,065 ML).

(3) 'Water use' under the Yarra Environment Entitlement reflects environmental in-stream use. This amount is not included in the water balance in Table 6-106 as it is not an actual diversion from the waterway.

(4) The VEWH does not forfeit the water at the end of the season. Any unused water is carried over to the next year (see also Table 4-1).

The estimated volume of water harvested from small catchment dams in the Yarra basin is provided in Table 6-110.

The capacity of small catchment dams for Yarra basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 4,990 ML more for small catchment dam capacity and an increase of 1,522 ML usage. For more information, see Appendix E.

Table 6-110 Estimated small catchment dam information for the Yarra basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	18,375	9,188	n/a
Registered commercial and irrigation	9,712	8,158	n/a
Total	**28,087**	**17,346**	**20,784**

n/a: information not available.

6.17.3 Recycled water

Yarra Valley Water operate all treatment plants within the Yarra basin. Overall, 12% of wastewater was recycled in 2015–16, similar to the previous year.

Table 6-111 highlights the volumes of water recycled in the Yarra basin in 2015–16.

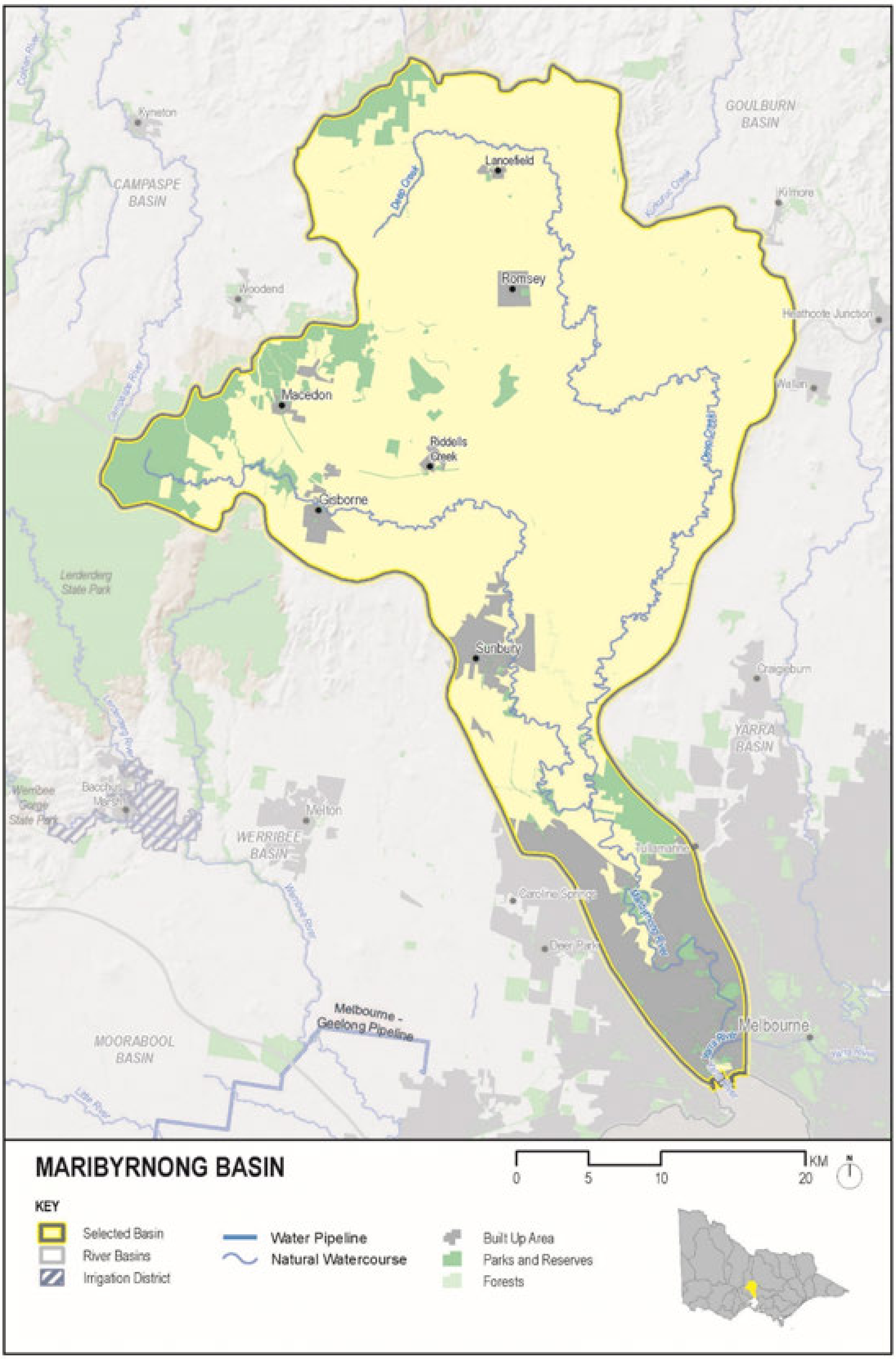
Table 6-111 Volume and use of recycled water in the Yarra basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aurora	1,226	640	38%	439	26	0	175	0	586
Brushy Creek	4,755	645	0%	17	0	0	629	4,109	0
Craigieburn	1,200	691	8%	97	0	0	594	509	0
Healesville	407	73	0%	0	0	0	73	334	0
Lilydale	3,299	889	4%	142	0	0	746	2,410	0
Monbulk	24	0	0%	0	0	0	0	24	0
Upper Yarra	848	130	0%	0	0	0	130	718	0
Wallan	818	728	89%	19	709	0	0	0	90
Whittlesea	298	110	28%	72	12	0	26	0	187
Total 2015–16	**12,875**	**3,906**	**12%**	**786**	**747**	**0**	**2,373**	**8,104**	**863**
Total 2014–15	11,495	3,749	12%	515	874	0	2,360	0	7,746

6.18 Maribyrnong basin

The Maribyrnong basin (Figure 6-33) is located north of Melbourne in central Victoria. The headwaters are located near Lancefield and Macedon, and the Maribyrnong River flows through Melbourne before joining the Yarra estuary just upstream of the mouth of the river into Port Phillip Bay.

Figure 6-33 Map of the Maribyrnong basin



6.18.1 Water resources overview

Rainfall across the Maribyrnong basin in 2015–16 was between 60% and 80% of the long-term average. Catchment inflows were 18% of the long-term average of 113,000 ML, lower than in 2014–15 which saw inflows at 20% of the long-term average.

The storage volume in Rosslynne Reservoir started the year at 44% of capacity; it was 15% of capacity at the end of June 2016.

An irrigation ban was in place on the Maribyrnong River for surface water users with winter-fill licences for the whole of 2015–16, with all surface users being subject to a ban from November 2015. There were also 13 other streams with total irrigation bans in place from December 2015 through to June 2016. No urban water use restrictions applied in the Maribyrnong basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-112 shows the responsibilities of the authorities within the Maribyrnong basin.

Table 6-112 Responsibilities for water resources management in the Maribyrnong basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Melbourne Water	Manages surface water licensed diversions in the lower Maribyrnong basin below the confluence of Deep Creek and the Maribyrnong River	Provides bulk water supplies to City West Water and Western Water (from Greater Yarra System – Thomson River Pool)	Manages waterways, drainage and floodplains in part of the Maribyrnong basin
City West Water		Supplies part of metropolitan Melbourne (1)	
Western Water		Supplies towns in the basin outside metropolitan Melbourne	Operates Macedon reservoirs Obliged to meet passing flow requirements
Southern Rural Water	Manages surface water licensed diversions in the upper Maribyrnong basin and groundwater licensed diversions in the whole of the basin		Operates Rosslynne Reservoir Obliged to meet passing flow requirements
Port Phillip and Westernport Catchment Management Authority			Responsible for waterway management in the Maribyrnong basin

Note:
(1) Melbourne is mostly supplied from the Yarra and Thomson basins.

Water for the environment

Important environmental assets (such as the Australian grayling and the Jacksons Creek platypus population) depend on water in the Maribyrnong. In 2015–16, water for the environment in the Maribyrnong basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Western Water and Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions (regulated and unregulated waterways)
- 300 ML of water purchased by Melbourne Water from rural customers to release equivalent environmental water for the Maribyrnong system
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 300 ML of environmental water was used in the Maribyrnong basin.

6.18.2 Surface water resources

6.18.2.1 Water balance

The total volumes of water available and supplied from water resources in the Maribyrnong basin in 2015–16 are shown in Table 6-113. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Maribyrnong basin, the water balance shows catchment inflows in 2015–16 were 2,476 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 23,193 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 3,386 ML less (rather than 2,476 ML). For more information, see Appendix E.

6.18 Maribyrnong basin

Table 6-113 Balance of surface water in the Maribyrnong basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	11,176	19,092
Volume in storage at end of year	3,732	11,176
Change in storage	**(7,444)**	**(7,916)**
Inflows		
Catchment inflows (1)	19,806	22,282
Rainfall on major storages	535	849
Treated wastewater discharged back to river	1,597	1,483
Total inflows	**21,938**	**24,614**
Outflows		
Diversions		
Urban diversions	5,854	6,013
Licensed diversions from regulated streams	399	736
Licensed diversions from unregulated streams	288	543
Usage from small catchment dams (2)	6,876	7,782
Total diversions	***13,417***	***15,074***
Losses		
Evaporation losses from major storages	773	1,226
Losses from small catchment dams (2)	6,678	4,861
In-stream infiltration to groundwater, flows to floodplain and evaporation	2,656	1,816
Total losses	***10,107***	***7,903***
Water passed at outlet of basin		
River outflows to the Yarra River	5,858	9,553
Total water passed at outlet of basin	***5,858***	***9,553***
Total outflows	**29,382**	**32,530**

Note:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.18.2.2 Storages and flows

The Rosslynne Reservoir is the only major on-stream storage in the Maribyrnong basin. The storage volume was 3,732 ML (15% of capacity) at the end of June 2016, compared to 11,176 ML (44% of capacity) at the start of July 2015 (Table 6-114). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-114 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

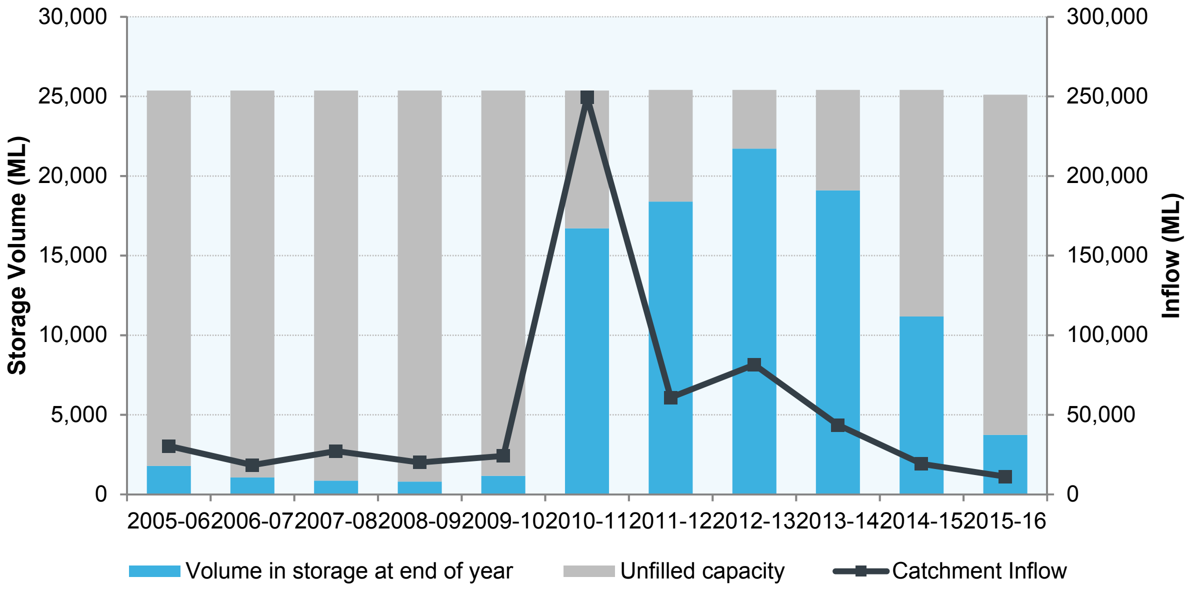
Table 6-114 Storage volumes in the Maribyrnong basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Rosslynne Reservoir	25,368	11,176	535	773	(7,206)	3,732
Total storage volumes	**25,368**	**11,176**	**535**	**773**	**(7,206)**	**3,732**

Catchment inflows were 19,806 ML, or 18% of the long-term average of 113,000 ML. This was a decrease from 2014–15 when inflows were 20% of the long-term average (Figure 6-34).

The amount of water flowing into the Yarra River in 2015–16 was 5,858 ML, compared to 9,553 ML in 2014–15. This represents 30% of the catchment inflows into the basin.

Figure 6-34 Storage volumes and catchment inflows in the Maribyrnong basin



6.18.2.3 Entitlement volumes and diversions

Melbourne Water, Western Water and Southern Rural Water hold bulk entitlements to divert surface water in the Maribyrnong basin. Surface water is also diverted out of waterways by licence holders and harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Maribyrnong basin are outlined in Table 6-115.

Table 6-115 Entitlement volumes in the Maribyrnong basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Gisborne – Barringo Creek) Conversion Order 2004 (1)	585
Bulk Entitlement (Lancefield) Conversion Order 2001	315
Bulk Entitlement (Macedon and Mount Macedon) Conversion Order 2004 (2)	873
Bulk Entitlement (Maribyrnong – Melbourne Water) Conversion Order 2000 (3)	1,396
Bulk Entitlement (Maribyrnong – Southern Rural Water) Conversion Order 2000 (4)	682
Bulk Entitlement (Maribyrnong – Western Water) Conversion Order 2000 (5)	6,100
Bulk Entitlement (Riddells Creek) Conversion Order 2001	300
Bulk Entitlement (Romsey) Conversion Order 2001	460
Take and use licences – unregulated surface water	2,086
Total volume of water entitlements in the Maribyrnong basin	**12,797**

Notes:

(1) This entitlement specifies that up to 585 ML can be diverted in any one year. The maximum volume that can be taken over any five-year period is 1,600 ML (320 ML annual average).

(2) This entitlement specifies that up to 873 ML can be diverted in any one year. The maximum volume that can be taken over any five-year period is 3,225 ML (645 ML annual average).

(3) This entitlement supplies water for take and use licences: 1,157 ML of entitlement was allocated for the 2015–16 year.

(4) This entitlement supplies water for take and use licences: 214 ML of entitlement was allocated for the 2015–16 year.

(5) This entitlement specifies that Western Water can take from the waterway up to an annual average of 6,100 ML over any period of five consecutive years.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-116. The volume of water diverted from unregulated streams by licence holders in the Maribyrnong basin was lower in 2015–16 than the volume (543 ML) reported in the *Victorian Water Accounts 2014–15* (Table 6-116).

6.18 Maribyrnong basin

Table 6-116 Allocation account balance summary for the Maribyrnong basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Gisborne – Barringo Creek	585	0	0	585
Lancefield	315	0	64	251
Macedon and Mount Macedon	873	0	161	712
Maribyrnong – Melbourne Water (1)	1,157	0	395	762
Maribyrnong – Southern Rural Water	214	0	3	211
Maribyrnong – Western Water	6,100	0	5,465	635
Riddells Creek	300	0	44	256
Romsey	460	0	120	340
Take and use licences – unregulated surface water	2,086	0	288	1,798

Note:

(1) Use against the Melbourne Water entitlement includes 300 ML of temporary water purchased by Melbourne Water from take and use licence holders to be used to provide environmental releases in the Maribyrnong system.

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Maribyrnong basin (Table 6-117).

The capacity of small catchment dams for Maribyrnong basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 835 ML more for small catchment dam capacity and a decrease of 907 ML usage. For more information, see Appendix E.

Table 6-117 Estimated small catchment dam information for the Maribyrnong basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,499	5,250	n/a
Registered commercial and irrigation	1,936	1,626	n/a
Total	**12,435**	**6,876**	**13,554**

n/a: information not available.

6.18.3 Recycled water

All wastewater treatment plants within the basin are operated by Western Water. About 20% of wastewater was reused in 2015–16, a decrease from 38% from 2014–15.

Table 6-118 highlights the volumes of water recycled in the Maribyrnong basin in 2015–16.

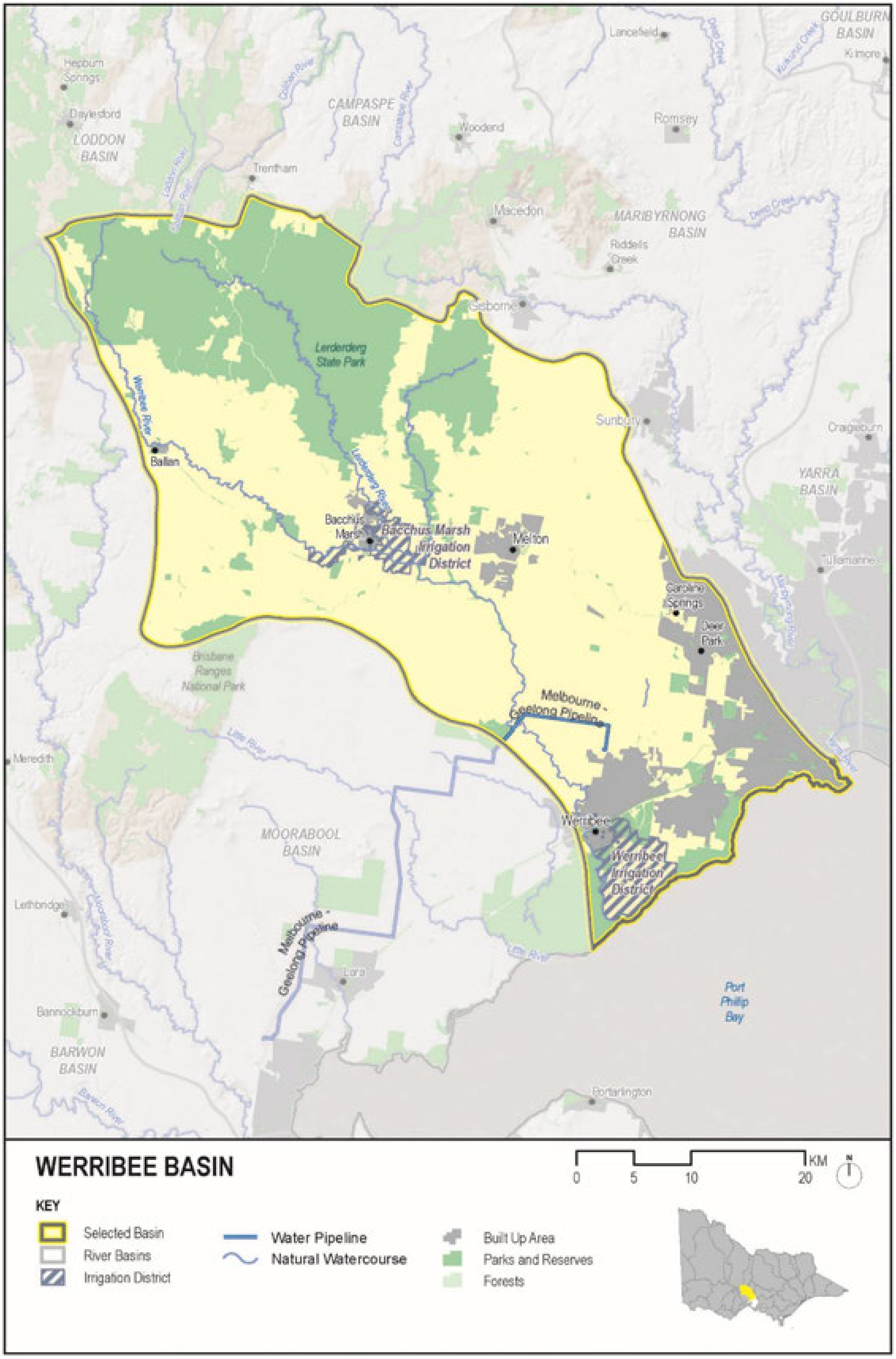
Table 6-118 Volume and use of recycled water in the Maribyrnong basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Gisborne	724	334	14%	77	24	0	233	390	0
Riddells Creek	172	137	80%	14	123	0	0	35	0
Romsey	190	190	100%	27	163	0	0	0	0
Sunbury	4,585	3,412	16%	395	321	0	2,696	1,172	0
Total 2015–16	**5,671**	**4,073**	**20%**	**513**	**631**	**0**	**2,929**	**1,597**	**0**
Total 2014–15	3,049	1,546	38%	405	748	0	393	1,483	20

6.19 Werribee basin

The Werribee basin (Figure 6-35) is located west of Melbourne. The Werribee and Lerderderg rivers meet upstream of Melton Reservoir and flow through Werribee before entering Port Phillip Bay.

Figure 6-35 Map of the Werribee basin



6.19 Werribee basin

6.19.1 Water resources overview

Rainfall in the Werribee basin in 2015–16 was between 60% and 80% of the long-term average. Catchment inflows were 21% of the long-term average, lower than in 2014–15 when inflows were 23% of the long-term average. The amount of water flowing from the Werribee basin into Port Phillip Bay represented 25% of the catchment flows into the basin in 2015–16.

Major storages in the Werribee basin started the year at 34% of capacity, compared to 15% by the end of June 2016.

The year began with 10% seasonal allocation for high-reliability water shares in July for the Werribee system. This was gradually increased to a maximum of 15% by October. No seasonal allocation was made to low-reliability water shares.

Licensed diversions from unregulated streams in the Werribee basin were largely unrestricted throughout the 2015–16 year, apart from the Lerderderg River which was subject to an irrigation ban from December 2015 to June 2016.

No urban water use restrictions applied in the Werribee basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-119 shows the responsibilities of the authorities within the Werribee basin.

Table 6-119 Responsibilities for water resources management in the Werribee basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages Werribee and Bacchus Marsh irrigation districts	Manages licensed diversions		Operates Pykes Creek Reservoir, Melton Reservoir and Merrimu Reservoir Obliged to meet passing flow requirements
Western Water			Supplies towns in the north of the basin including Melton and Bacchus Marsh	Operates Djerriwarrh Reservoir Obliged to meet passing flow requirements
Melbourne Water		Manages surface water licensed diversions for the lower reaches of Kororoit Creek	Provides bulk water to City West Water and Western Water from the Greater Yarra System – Thomson River Pool Operates the Western Treatment Plant and supplies recycled water to Southern Rural Water	Manages waterways, drainage and floodplains in all of the Werribee basin
City West Water			Supplies towns and manages wastewater in metropolitan Melbourne	
Central Highlands Water			Supplies Blackwood and Ballan	Obliged to meet passing flow requirements
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
Port Phillip and Westernport Catchment Management Authority				Responsible for waterway management in the Werribee basin

Water for the environment

Important environmental assets (such as the Australian grayling, tupong and red gums) depend on water in the Werribee basin. In 2015–16, water for the environment in the Werribee basin comprised:

- the *Werribee River Environmental Entitlement 2011* comprising 10% share of inflows (on average 1,500 ML per year) held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water, Western Water and Southern Rural Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions (regulated and unregulated waterways)
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 651 ML of environmental water was delivered in-stream in the Werribee basin.

6.19.2 Surface water resources

6.19.2.1 Water balance

The total volumes of water available and supplied from water resources in the Werribee basin in 2015–16 are shown in Table 6-120. Note that only on-stream storages greater than 1,000 ML capacity and the Djerriwarrh Reservoir have been included in the water balance. In the Werribee basin, major storages include the Melton, Merrimu and Pykes Creek reservoirs.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Werribee basin, the water balance shows catchment inflows in 2015–16 were 2,689 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 20,416 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 2,049 ML less (rather than 2,689 ML). For more information, see Appendix E.

Table 6-120 Balance of surface water in the Werribee basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	24,146	40,005
Volume in storage at end of year	10,341	24,146
Change in storage	**(13,805)**	**(15,859)**
Inflows		
Catchment inflows (1)	21,065	23,922
Rainfall on major storages	1,370	2,072
Transfers from other basins	0	0
Return flows from irrigation	0	0
Treated wastewater discharged back to river	168	5,095
Total inflows	**22,603**	**31,089**
Outflows		
Diversions		
Urban diversions	3,654	7,110
Irrigation district diversions and licensed diversions from regulated streams	10,602	11,587
Licensed diversions from unregulated streams	12	5
Usage from small catchment dams (2)	5,484	9,347
Total diversions	***19,752***	***28,049***
Losses		
Evaporation losses from major storages	2,232	5,054
Losses from small catchment dams (2)	5,728	5,371
In-stream infiltration to groundwater, flows to floodplain and evaporation	3,352	3,602
Total losses	***11,312***	***14,027***
Water passed at outlet of basin		
River outflows to Port Phillip Bay	5,344	4,872
Total water passed at outlet of basin	***5,344***	***4,872***
Total outflows	**36,408**	**46,948**

Note:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.19.2.2 Storages and flows

Storage levels for all major storages in the basin were 10,341 ML (15% of capacity) at 30 June 2016, compared to 24,146 ML (34% of capacity) at 1 July 2015 (Table 6-121). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-121 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-121 Storage volumes in the Werribee basin

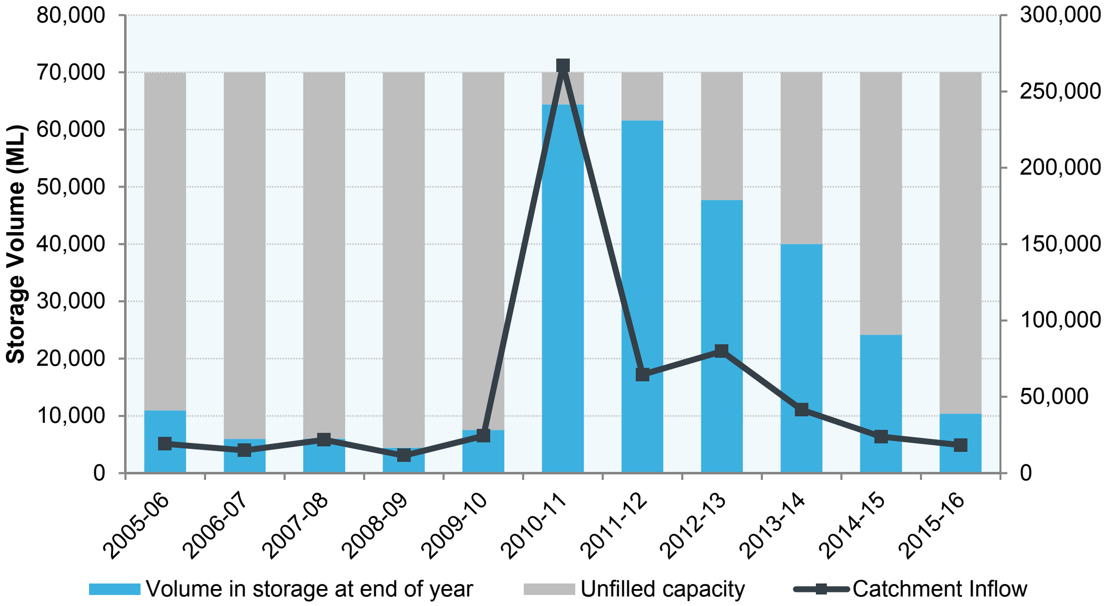
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Djerriwarrh Reservoir	1,014	555	388	90	(456)	397
Melton Reservoir	14,364	1,336	167	462	(91)	950
Merrimu Reservoir	32,516	9,482	362	781	(5,963)	3,100
Pykes Creek Reservoir	22,119	12,773	453	899	(6,433)	5,894
Total storage volumes	**70,013**	**24,146**	**1,370**	**2,232**	**(12,943)**	**10,341**

6.19 Werribee basin

Catchment inflows were 21,233 ML, or 21% of the long-term average of 102,000 ML. This was lower than the 2014–15 inflows of 23,922 ML (Figure 6-36).

In 2015–16, 5,344 ML of water flowed from the Werribee basin into Port Phillip Bay. This represents 25% of the catchment inflows into the basin. This is compared to about 4,872 ML reported in 2014–15.

Figure 6-36 Storage volumes and catchment inflows in the Werribee basin



6.19.2.3 Entitlement volumes and diversions

In the Werribee basin, surface water is diverted by Central Highlands Water, Western Water, Southern Rural Water and licensed diverters, and surface water is harvested in small catchment dams.

Entitlements include rights granted to individuals (for example, water shares and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Werribee basin are outlined in Table 6-122.

Table 6-122 Entitlement volumes in the Werribee basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	
High-reliability water shares	15,447
Low-reliability water shares	7,241
Bulk Entitlement (Myrniong) Conversion Order 2004	58
Operating provisions (whole of system)	4,939
Subtotal: Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	**27,685**
Bulk Entitlement (Ballan) Conversion Order 1998	**451**
Bulk Entitlement (Blackwood and Barry's Reef) Conversion Order 1998	**140**
Bulk Entitlement (Werribee system – Western Water) Conversion Order 2004	**9,986**
Werribee River Environment Entitlement 2011 (1)	**-**
Take and use licences – unregulated surface water	**1,021**
Total volume of water entitlements in the Werribee basin	**39,283**

Note:

(1) The Werribee River Environmental Entitlement 2011 consists of a 10% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-123. Entitlements to water in the regulated Werribee system provide for the right to carry over unused allocation to the next season. In the Werribee basin, these entitlement holders can carry over unused water except for 15% of the unused volume which is deducted for evaporation, and can hold up to 100% of their entitlement volume. The VEWH holds an environmental entitlement in the Werribee basin, which also enables it to carryover unused water at the end of each year subject to storage capacity and losses. The water available under the entitlement is used to provide environmental flows in the Werribee River and is not diverted out of the waterway.

Southern Rural Water diverted 10,653 ML to supply water share holders in the Werribee and Bacchus Marsh irrigation districts in 2015–16 (Table 6-123), compared to 11,587 ML in 2014–15.

Table 6-123 Allocation account balance summary for the Werribee basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Werribee system – Irrigation – SRW						
Water shares	5,928	2,330	850	5,065	546	3,497
Myrniong	11	47	0	51	1	6
Operating provisions (whole of system) (1)	-	-	-	5,537	-	-
Diversion: Werribee system – Irrigation – SRW (2)				**10,653**		
Ballan	-	451	0	0	451	0
Blackwood and Barry's Reef	-	140	0	49	91	0
Werribee system – Western Water	-	9,986	0	3,554	6,433	0
Werribee River Environment Entitlement (3)	714	102	1,234	651	0	1,399
Take and use licences – unregulated surface water	-	1,021	0	12	1,009	-

Notes:

(1) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.

(2) The water use reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Werribee system bulk entitlement.

(3) Allocation issued reflects the share of inflows available under this entitlement during the year (including opening carryover). Water use reported reflects environmental in-stream use: this amount is not reflected in the water balance in Table 6-120 as it is not an actual diversion from the waterway.

The estimated volume of water harvested from small catchment dams represents a significant portion of the total volume of surface water diverted in the Werribee basin (Table 6-124).

The capacity of small catchment dams for Werribee basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 3,217 ML less for small catchment dam capacity and a decrease of 3,863 ML usage. For more information, see Appendix E.

Table 6-124 Estimated small catchment dam information for the Werribee basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,284	4,642	n/a
Registered commercial and irrigation	1,002	842	n/a
Total	**10,286**	**5,484**	**11,212**

6.19.3 Recycled water

City West Water, Central Highlands Water, Western Water and Melbourne Water operate treatment plants within the Werribee basin. About 16% of wastewater was reused in 2015–16, an increase from 11% in 2014–15.

The largest treatment plant in the basin is Melbourne Water's Western Treatment Plant, which recycled 15% of wastewater in 2015–16. This included 15,609 ML for on-site irrigation and environmental management and 3,870 ML for habitat management at Ramsar-listed wetlands.

Table 6-125 highlights the volumes of water recycled in the Werribee basin in 2015–16.

Table 6-125 Volume and use of recycled water in the Werribee basin

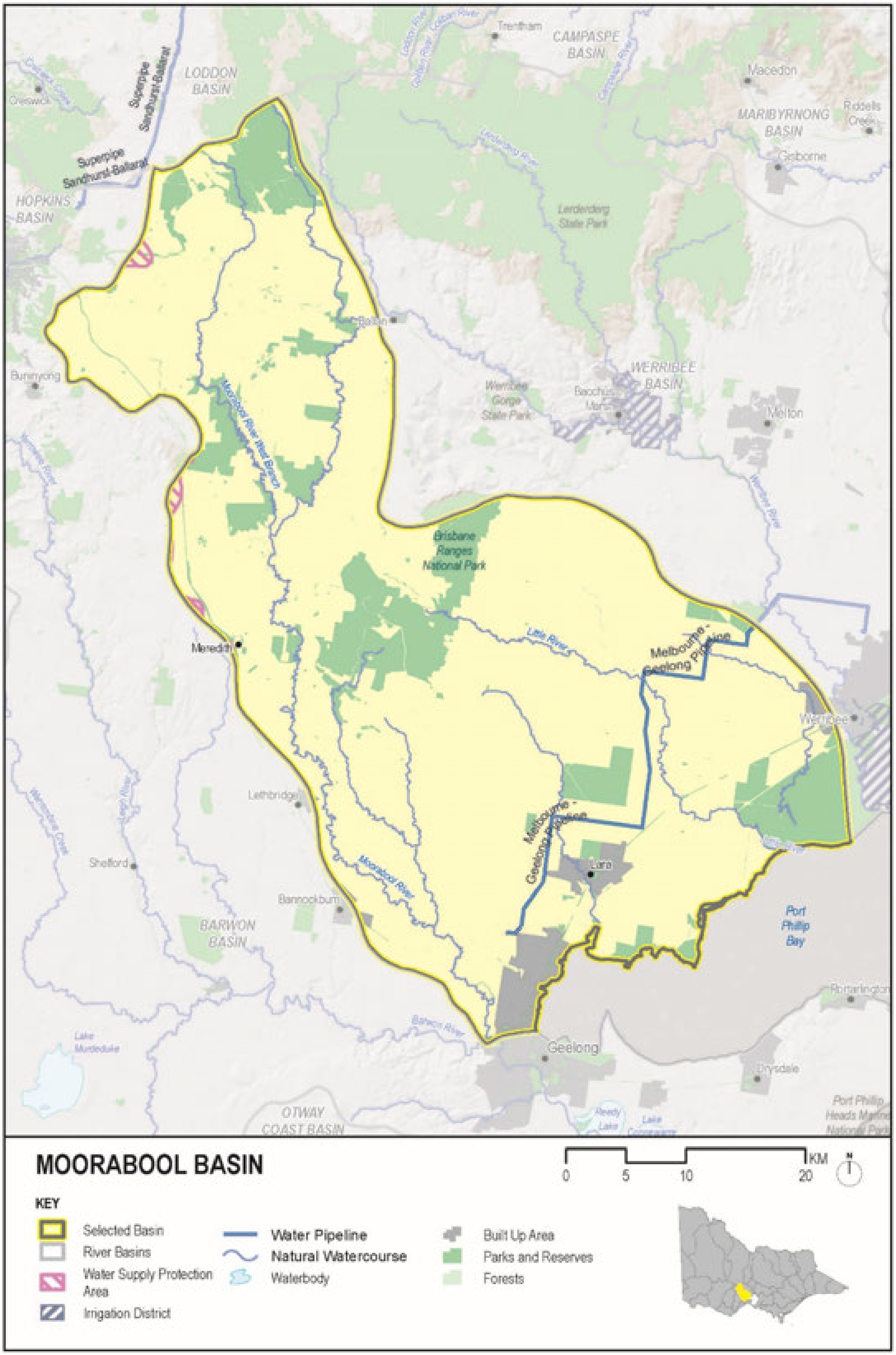
Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)					Volume discharged to the environment (ML)	Volume of other discharges (ML)
				To retailers	Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Altona	5,284	2,238	40%	0	2,107	0	0	131	0	3,046
Ballan	122	122	100%	0	0	122	0	0	0	0
Melton	4,355	4,187	85%	0	491	3,221	0	475	168	0
Parwan (Bacchus Marsh)	592	592	75%	0	35	411	0	146	0	0
Sunshine Golf Course Sewer Mining Plant (1)	47	47	100%	0	47	0	0	0	0	0
Western Treatment Plant	166,767	25,753	15%	6,222	5	15,609	3,870	47	0	141,014
Total 2015–16	**177,167**	**32,939**	**0**	**6,222**	**2,685**	**19,363**	**3,870**	**799**	**168**	**144,060**
Total 2014–15	170,043	37,015	11%	4,337	594	13,354	18,129	601	5,095	127,933

(1) Sunshine Golf Course Sewer Mining Plant was not reported in 2014–15. The 2014–15 figures reported here have been updated from the previous years' published version.

6.20 Moorabool basin

The Moorabool basin (Figure 6-37) is located west of Melbourne. The Moorabool River begins as two major tributaries on the southern slopes of the Great Dividing Range near Ballan and flows south-east to join the Barwon River near Geelong. The Moorabool basin also includes Little River, which flows into Port Phillip Bay.

Figure 6-37 Map of the Moorabool basin



6.20.1 Water resources overview

Rainfall in most of the Moorabool basin in 2015–16 was between 60% and 80% of the long-term average. Catchment inflows were 24% of the long-term average of 97,000 ML, lower than in 2014–15 when inflows were 52% of the long-term average.

Storage levels for the major storages in the basin started the year at 56% of capacity and held 31% at the end of June 2016. Diversion volumes were slightly lower than in 2014–15.

All unregulated streams remained mostly unrestricted throughout 2015–16, except for restrictions licensed diversions on the Moorabool River. Above Bungal, the irrigation ban from June 2015 continued throughout the year to the end of June 2016. Below Bungal, the 2014–15 stage 3 restrictions on licensed diversions remained in place until the end of September, when they were increased to an irrigation ban until the end of June 2016.

No urban water use restrictions applied in the Moorabool basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-126 shows the responsibilities of the authorities within the Moorabool basin.

Table 6-126 Responsibilities for water resources management in the Moorabool basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Barwon Water		Supplies Geelong and surrounding towns (1)	Manages reservoirs on the east Moorabool River and has a third of the share of Lal Lal Reservoir on the west Moorabool River Manages Stony Creek Reservoir on Stony Creek Obligation to meet passing flow requirements
Central Highlands Water		Supplies Ballarat and surrounding towns (2)	Manages reservoirs on the west Moorabool River and has two-thirds of the share of Lal Lal Reservoir Obliged to meet passing flow requirements
Corangamite Catchment Management Authority			Responsible for waterway management in Moorabool basin
Victorian Environmental Water Holder			Holds and manages environmental entitlements in the basin

Notes:

(1) Geelong's water supply is mainly sourced from the Barwon basin.

(2) Ballarat's water supply is sourced from both the Barwon and Moorabool basins.

Water for the environment

Important environmental assets (such as river blackfish and Australian grayling) between Lal Lal Reservoir and She Oaks Weir, as well as Hovells Creek Estuary (which is part of the Port Phillip Bay & Bellarine Peninsula Ramsar Site) depend on water in the Moorabool basin. In 2015–16, water for the environment in the Moorabool basin comprised:

- the *Moorabool River Environmental Entitlement 2010* comprising 11.9% of inflows (on average 2,500 ML per year) held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water and Barwon Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 240 ML of environmental water was delivered in-stream in the Moorabool basin.

6.20.2 Surface water resources

6.20.2.1 Water balance

The total volumes of water available and supplied from water resources in the Moorabool basin in 2015–16 are shown in Table 6-127. Most of the water used for consumptive purposes in the basin was sourced from small catchment dams.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Moorabool basin, the water balance shows catchment inflows in 2015–16 were 27,131 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 42,369 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 18,912 ML less (rather than 27,131 ML). For more information, see Appendix E.

6.20 Moorabool basin

Table 6-127 Balance of surface water in the Moorabool basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	42,930	49,661
Volume in storage at end of year	22,689	42,930
Change in storage	**(20,241)**	**(6,731)**
Inflows		
Catchment inflows (1)	23,457	50,588
Rainfall on major storages	2,753	3,452
Treated wastewater discharged back to river	0	0
Total inflows	**26,210**	**54,040**
Outflows		
Diversions		
Urban diversions (2)	8,059	8,255
Transfers to Barwon basin (White Swan Reservoir) (3)	1,140	4,147
Licensed diversions from unregulated streams	963	1,240
Usage from small catchment dams (4)	13,012	22,197
Total diversions	***23,174***	***35,839***
Losses		
Evaporation losses from major storages	5,626	5,665
Losses from small catchment dams (4)	8,233	7,266
In-stream infiltration to groundwater, flows to floodplain and evaporation	6,216	6,728
Total losses	***20,075***	***19,659***
Water passed at outlet of basin		
River outflows to Port Phillip Bay (Little River) and other small coastal streams	2,114	2,546
River outflows to the Barwon River (Moorabool River)	1,088	2,726
Total water passed at outlet of basin	***3,202***	***5,272***
Total outflows	**46,451**	**60,770**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The urban diversions figure represents water diverted from waterways in the Moorabool basin to directly supply urban customers in both the Barwon and Moorabool basins.

(3) The 1,140 ML transfer represents water that is transferred to White Swan Reservoir in the Barwon basin before being supplied to urban customers in the Ballarat area (which is located within both the Barwon and Moorabool basins).

(4) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.20.2.2 Storages and flows

The Moorabool basin has six main storages: the Bostock, Korweinguboora, Lal Lal, Moorabool, Upper Stony Creek and Wilson reservoirs. Lal Lal Reservoir accounts for about two-thirds of total storage capacity in the basin. Storage levels for all major storages (greater than 1,000 ML) in the basin were 26,612 ML (31% of capacity) at the end of June 2016, compared to 48,312 ML (56% of capacity) at the beginning of the year (Table 6-128).

Only volumes for major on-stream storages have been included in the water balance: Upper Stony Creek Reservoir has not been included. The volume of water in the basin's major on-stream storages started the year at 42,930 ML and were at 22,689 ML on 30 June 2016.

Table 6-128 Storage volumes in the Moorabool basin

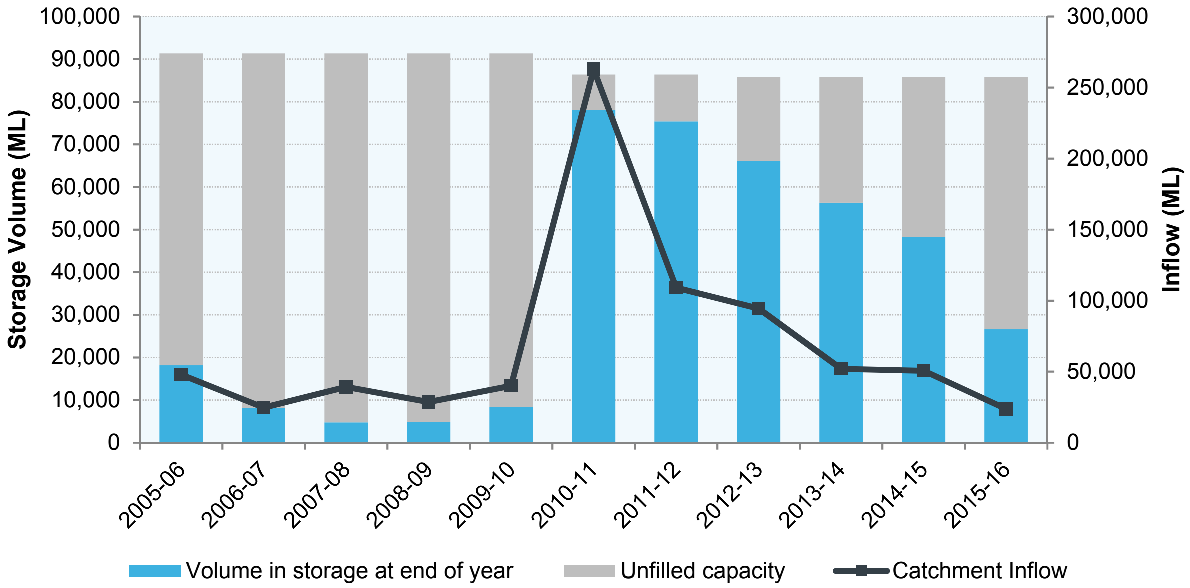
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Bostock Reservoir	7,455	123	661	971	229	42
Korweinguboora Reservoir	2,091	449	422	620	122	373
Lal Lal Reservoir	59,549	40,659	1,346	3,435	(17,054)	21,516
Moorabool Reservoir	6,192	1,691	307	559	(696)	742
Wilsons Reservoir	1,010	8	18	40	31	16
Total on-stream storages	**76,297**	**42,930**	**2,754**	**5,625**	**(17,368)**	**22,689**
Off-stream storages						
Upper Stony Creek Reservoir	9,494	5,382	n/a	n/a	(1,459)	3,923
Total off-stream storages	**9,494**	**5,382**	**n/a**	**n/a**	**(1,459)**	**3,923**
Total storage volumes	**85,791**	**48,312**	**2,754**	**5,625**	**(18,827)**	**26,612**

n/a: information not available.

Catchment inflows were 23,457 ML, or 24% of the long-term average of 97,000 ML. This was lower than the 2014–15 inflows of 50,588 ML (Figure 6-38).

The amount of water flowing from the Moorabool basin into Port Phillip Bay and the Barwon River was 3,202 ML in 2015–16, or 13% of the catchment inflows.

Figure 6-38 Storage volumes and catchment inflows in the Moorabool basin



6.20.2.3 Entitlement volumes and diversions

In the Moorabool basin, surface water is diverted by Barwon Water, Central Highlands Water and licensed diverters. Surface water is also harvested in small catchment dams. The VEWH holds an environmental entitlement in the Moorabool basin, but the water available under the entitlement is used to support streamflows and is not diverted out of the waterway.

Entitlements in the Moorabool basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or the VEWH). Rights to water in the Moorabool basin are outlined in Table 6-129.

Table 6-129 Entitlement volumes in the Moorabool basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Lal Lal – Barwon) Conversion Order 1995 (1)	5,925
Bulk Entitlement (Lal Lal – Central Highlands) Conversion Order 1995 (2)	12,575
Bulk Entitlement (Meredith) Conversion Order 1995	600
Bulk Entitlement (She Oaks) Conversion Order 1995 (3)	2,000
Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	9,000
Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	10,500
Moorabool River Environment Entitlement 2010 (4)	n/a
Take and use licences – unregulated surface water	3,567
Total volume of water entitlements in Moorabool basin	**44,167**

Notes:

(1) Under this entitlement, the authority may take up to a total of 5,925 ML in any one year and up to 17,775 ML in any consecutive three-year period.
(2) Under this entitlement, the authority may take up to a total of 12,575 ML in any one year and up to 37,725 ML in any consecutive three-year period.
(3) Under this entitlement, the authority may take up to 6,000 ML in any three consecutive years.
(4) The *Moorabool River Environmental Entitlement 2010* consists of an 11.9% share of inflows into storage, with the actual volume available in any year varying depending on inflow conditions.

n/a: Specified volume not applicable.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-130. The total volume of water diverted by bulk entitlement holders was slightly higher in 2015–16 than the volume reported in the *Victorian Water Accounts 2014–15*.

The volume of water diverted from unregulated streams by licence holders in the Moorabool basin in 2015–16 was lower than the volume (963 ML) reported in the *Victorian Water Accounts 2014–15* (Table 6-130).

6.20 Moorabool basin

Table 6-130 Allocation account balance summary for the Moorabool basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Lal Lal – Barwon	5,925	0	1,905	4,020
Lal Lal – Central Highlands	12,575	0	5,674	6,901
Meredith	600	0	0	600
She Oaks	2,000	0	0	2,000
Upper East Moorabool system	9,000	0	480	8,520
Upper West Moorabool system	10,500	0	1,140	9,360
Moorabool River Environment Entitlement (1)	970	0	240	730
Take and use licences – unregulated surface water	3,567	0	963	2,604

Note:

(1) Allocation issued to the Moorabool River Environmental Entitlement 2010 reflects the total available water for the year including carryover and adjustments made in 2015–16. 'Water use' reported reflects environmental in-stream use: this amount is not included in the water balance in Table 6-127as it is not an actual diversion from the waterway. Unused water is available to carry over under this entitlement and is not forfeited at the end of the season (see Table 4-1 for details).

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Moorabool basin (Table 6-131).

The capacity of small catchment dams for Moorabool basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 8,058 ML less for small catchment dam capacity and a decrease of 9,185 ML usage. For more information, see Appendix E.

Table 6-131 Estimated small catchment dam information for the Moorabool basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,187	6,594	n/a
Registered commercial and irrigation	7,641	6,418	n/a
Total	**20,828**	**13,012**	**21,245**

n/a: information not available.

6.20.3 Recycled water

Barwon Water operated the sole treatment plant within the Moorabool basin. About 96% of wastewater was recycled in 2015–16, compared to 100% in 2014–15. Most of the recycled water within the basin was used by a refinery.

Table 6-132 highlights the volumes of water recycled in the Moorabool basin in 2015–16.

Table 6-132 Volume and use of recycled water in the Moorabool basin

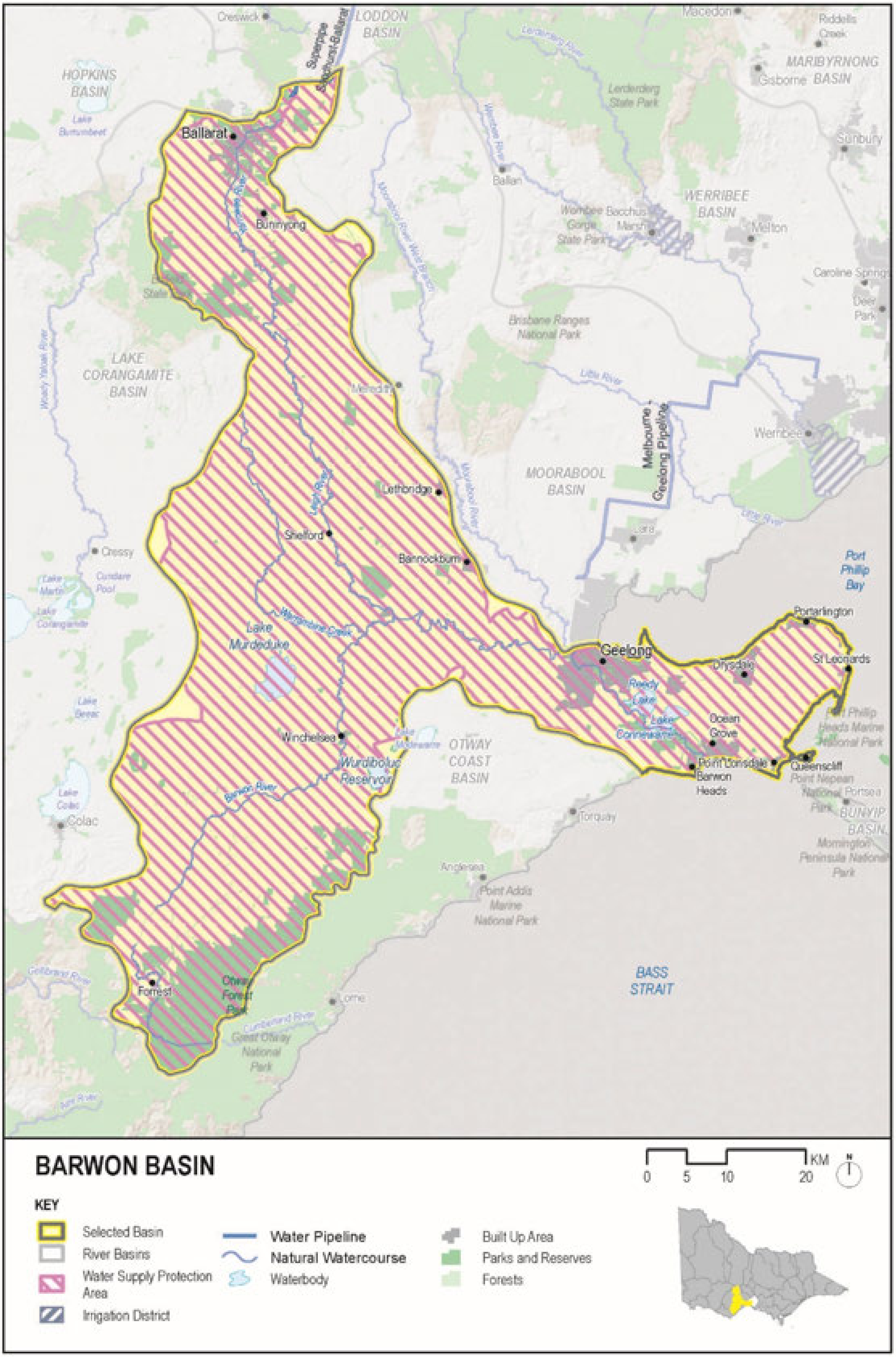
Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Northern Water Recycling Plant (1)	1,467	1,467	96%	1,411	0	0	57	0	0
Total 2015–16	**1,467**	**1,467**	**96%**	**1,411**	**0**	**0**	**57**	**0**	**0**
Total 2014–15	1,410	1,410	100%	1,410	0	0	0	0	0

(1) Percentage recycled does not include within plant process

6.21 Barwon basin

The Barwon basin (Figure 6-39) is located in western Victoria. The Barwon River originates in the Otway Ranges and receives inflows from the north from the Leigh River and the Moorabool River before it flows into the ocean at Barwon Heads.

Figure 6-39 Map of the Barwon basin



6.21 Barwon basin

6.21.1 Water resources overview

Rainfall in the Barwon basin in 2015–16 was between 60% and 80% of the long-term average, with the southernmost tip receiving between 80% and 100% of the long-term average. Catchment inflows in the Barwon basin in 2015–16 were 29% of the long-term average, a decrease from 35% in 2014–15.

Storage levels in the Barwon basin started the year at 56% and ended the year at 35% of total capacity.

The 2014–15 stage 3 restrictions on licensed diversions from the Barwon River were lifted from August to October 2015. However, in November 2015 the Barwon River was subject to stage 3 restrictions again, increasing to an irrigation ban in December which then lasted until end of June 2016.

No urban water use restrictions applied in the Barwon basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-133 shows the responsibilities of the authorities within the Barwon basin.

Table 6-133 Responsibilities for water resources management in the Barwon basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Barwon Water		Geelong and surrounding towns (1)	Operates West Barwon Reservoir and Lake Wurdee Boluc Obliged to meet passing flow requirements
Central Highlands Water		Ballarat and surrounding towns (2)	Operates White Swan and Gong Gong reservoirs Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages environmental entitlements in the basin
Corangamite Catchment Management Authority			Manages waterways for the whole of the Barwon basin

Notes:

(1) Geelong's water supply is also sourced from the Moorabool basin, and from the Melbourne system via the Melbourne to Geelong Pipeline.

(2) Ballarat's water supply is mainly sourced from the Moorabool basin and the Campaspe and Goulburn basin via the Goldfields Superpipe.

Water for the environment

The Bellarine Peninsula contains internationally significant wetlands listed under the Ramsar Convention which rely on freshwater inputs from the Barwon basin to maintain good ecological function. Other important environmental assets include the Lake Connewarre complex, native fish populations (such as Australian grayling and Yarra pygmy perch, Australian mudfish and tupong), the native waterbird population (particularly migratory shorebirds including the common greenshank, Pacific golden plover, curlew sandpiper and red-necked stint), and platypus populations in the upper and middle catchment.

In 2015–16, water for the environment in the Barwon basin comprised:

- the *Barwon River Environmental Entitlement 2011*
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Barwon Water and Central Highlands Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.21.2 Surface water resources

6.21.2.1 Water balance

The total volumes of water available and supplied from water resources in the Barwon basin in 2015–16 are shown in Table 6-134.

The major storages in the Barwon basin are the West Barwon and Wurdee Buloc reservoirs operated by Barwon Water, and the White Swan and Gong Gong reservoirs operated by Central Highlands Water.

Transfers from the Moorabool basin to the Barwon basin decreased from 4,147 ML in 2014–15 to 1,140 ML in 2015–16. This water was transferred to White Swan Reservoir and used to supply the Ballarat system. The Goldfields Superpipe was used to transfer 7,329 ML from the Campaspe basin to White Swan Reservoir to augment supplies to Ballarat. The greater Geelong area, serviced by Barwon Water, is a major water user in the Barwon basin. Water supplied to Geelong is also sourced from the Moorabool basin.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Barwon basin, the water balance shows catchment inflows in 2015–16 were 20,388 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as

118,442 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 13,622 ML less (rather than 20,388 ML). For more information, see Appendix E.

Table 6-134 Balance of surface water in the Barwon basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	23,961	27,458
Volume in storage at end of year	12,967	23,961
Change in storage	**(10,994)**	**(3,497)**
Inflows		
Catchment inflows (1)	104,820	125,208
Rainfall on major storages	2,002	2,247
Inflows from the Moorabool River	1,088	2,726
Transfers from the Corangamite basin via Woady Yaloak Channel	0	0
Transfers from Moorabool basin to White Swan Reservoir (2)	1,140	4,147
Transfers from Campaspe basin to White Swan Reservoir	7,329	563
Treated wastewater discharged back to river (3)	8,206	8,697
Total inflows	**124,585**	**143,588**
Outflows		
Diversions		
Urban diversions	33,013	28,524
Licensed diversions from unregulated streams	1,767	1,615
Usage from small catchment dams (4)	20,793	30,898
Total diversions	***55,573***	***61,037***
Losses		
Evaporation losses from major storages	2,779	2,995
Losses from small catchment dams (4)	15,883	0
In-stream infiltration to groundwater, flows to floodplain and evaporation	9,186	10,404
Total losses	***27,848***	***13,399***
Water passed at outlet of basin		
River outflows to the ocean	52,158	60,106
Total water passed at outlet of basin	***52,158***	***60,106***
Total outflows	**135,579**	**134,542**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The 1,140 ML transfer represents water that is transferred to White Swan Reservoir from the Moorabool basin before being supplied to urban customers in the Ballarat area (which is located within both the Barwon and Moorabool basins).

(3) The volume reported for 2014–15 has been revised from the 2014–15 published report. The revision required a recalculation of catchment inflows and thus this is also reported differently to the 2014–15 published volume. The 2014–15 report incorrectly reported a volume of 18,810 ML as volume returned to the river. The volume was actually discharged to the sea.

(4) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.21.2.2 Storages and flows

Storage levels for all major storages in the basin started the year at 43,557 ML in July 2015 and were 26,897 ML (35% of capacity) at the end of June 2016. Only the on-stream storages of West Barwon Dam, Gong Gong Reservoir and White Swan Reservoir are included in the water balance. The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-135 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

6.21 Barwon basin

Table 6-135 Storage volumes in the Barwon basin

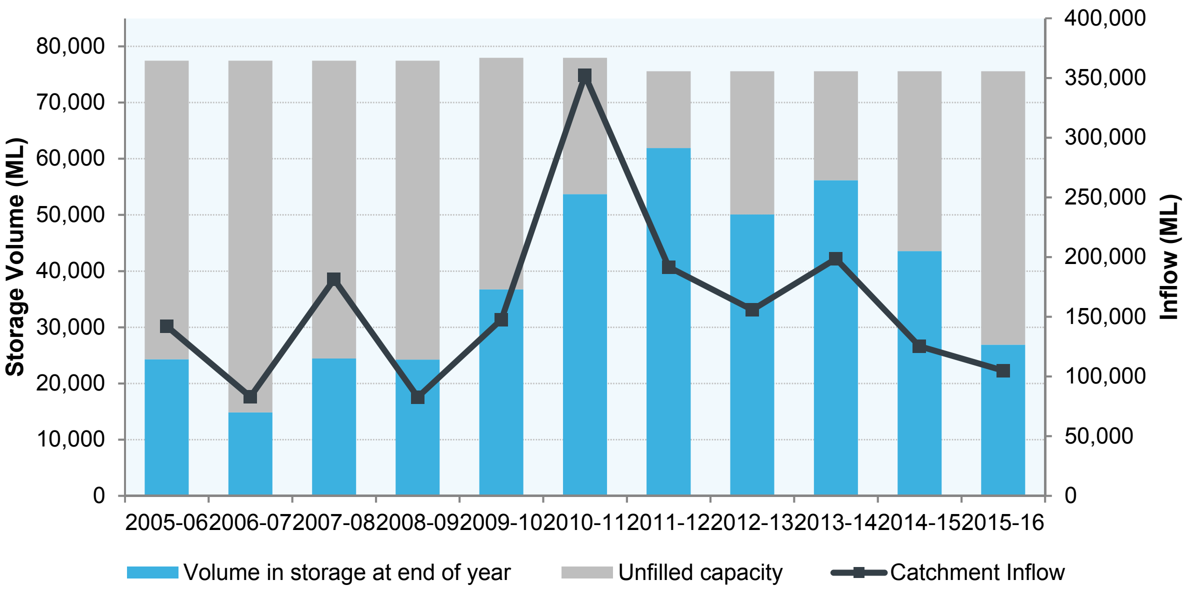
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Gong Gong Reservoir	1,902	502	25	44	(236)	247
West Barwon Reservoir	21,504	16,543	1,406	1,804	(11,699)	4,446
White Swan Reservoir (1)	14,107	6,916	571	931	1,718	8,274
Total on-stream storages	**37,513**	**23,961**	**2,002**	**2,779**	**(10,217)**	**12,967**
Off-stream storages						
Wurdee Boluc Reservoir	40,431	19,596	n/a	n/a	(5,666)	13,930
Total off-stream storages	**40,431**	**19,596**	**n/a**	**n/a**	**(5,666)**	**13,930**
Total storage volumes	**77,944**	**43,557**	**2,002**	**2,779**	**(15,883)**	**26,897**

Note:
(1) White Swan Reservoir is treated as an on-stream storage for the purpose of the water balance.

Catchment inflows to the Barwon basin amounted to 104,820 ML in 2015–16, which is 29% of the long-term average (of 360,000 ML). This is a decrease from inflows of 35% of the long-term average in 2014–15 (Figure 6-40).

The amount of water flowing from the Barwon basin into Corio Bay and Bass Strait was 52,158 ML in 2015–16. This represents 50% of the catchment inflows to the basin.

Figure 6-40 Storage volumes and catchment inflows in the Barwon basin



6.21.2.3 Entitlement volumes and diversions

In the Barwon basin, surface water is diverted by Barwon Water, Central Highlands Water and licensed diverters, and water is harvested in small catchment dams.

Entitlements in the Barwon basin include rights granted to individuals (for example, take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Barwon basin are outlined in Table 6-136.

Table 6-136 Entitlement volumes in the Barwon basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlements (Upper Barwon System) Conversion Order 2002 (1)	43,466
Bulk Entitlement (Yarrowee – White Swan System) Conversion Order 2002 (2) (3)	12,267
Barwon River Environmental Entitlement 2011 (4)	n/a
Take and use licences – unregulated surface water	5,515
Total volume of water entitlements in the Barwon basin	**61,248**

Notes:
(1) This entitlement specifies that the authority may take up to 130,400 in any successive three-year period.
(2) This entitlement specifies that the authority may take up to 36,800 in any successive three-year period.

(3) This bulk entitlement includes up to 10,500 ML extracted from the Upper West Moorabool system under Central Highlands Water's Upper West Moorabool bulk entitlement in the Moorabool basin.
(4) Use of this entitlement depends on suitable river heights as specified in the entitlement.
n/a: Specified volume not applicable

Water available under bulk entitlements and licences for 2015–16 is presented in Table 6-137. The total volume of water diverted by bulk entitlement holders was greater in 2015–16 than the volume reported in the *Victorian Water Accounts 2014–15*.

The *Barwon River Environmental Entitlement 2011* allows unregulated flows to be diverted to floodplain wetlands. The volume of unregulated flows available for diversion varies, depending on seasonal conditions. No volumetric use gets recorded against this entitlement.

Table 6-137 Allocation account balance summary for the Barwon basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Upper Barwon system	43,466	0	25,610	17,856
Yarrowee – White Swan system	12,267	0	7,403	4,864
Barwon River Environmental Entitlement (1)	0	0	0	0
Take and use licences – unregulated surface water	5,666	(5)	1,767	3,894

Note:
(1) Use under this entitlement depends on suitable river heights.

The estimated volume of water harvested from small catchment dams represents a significant portion of the total surface water diversions in the Barwon basin (Table 6-138).

The capacity of small catchment dams for Barwon basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 6,383 ML less for small catchment dam capacity and a decrease of 10,105 ML usage. For more information, see Appendix E.

Table 6-138 Estimated small catchment dam information for the Barwon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	24,327	12,164	n/a
Registered commercial and irrigation	10,273	8,629	n/a
Total	**34,600**	**20,793**	**36,676**

n/a: information not available.

6.21.3 Recycled water

Barwon North and Central Highlands Water operate treatment plants within the Barwon basin. Overall, 10% of wastewater was recycled in 2015–16, a slight increase on 8% from 2014–15.

Table 6-139 highlights the volumes of water recycled in the Barwon basin in 2015–16.

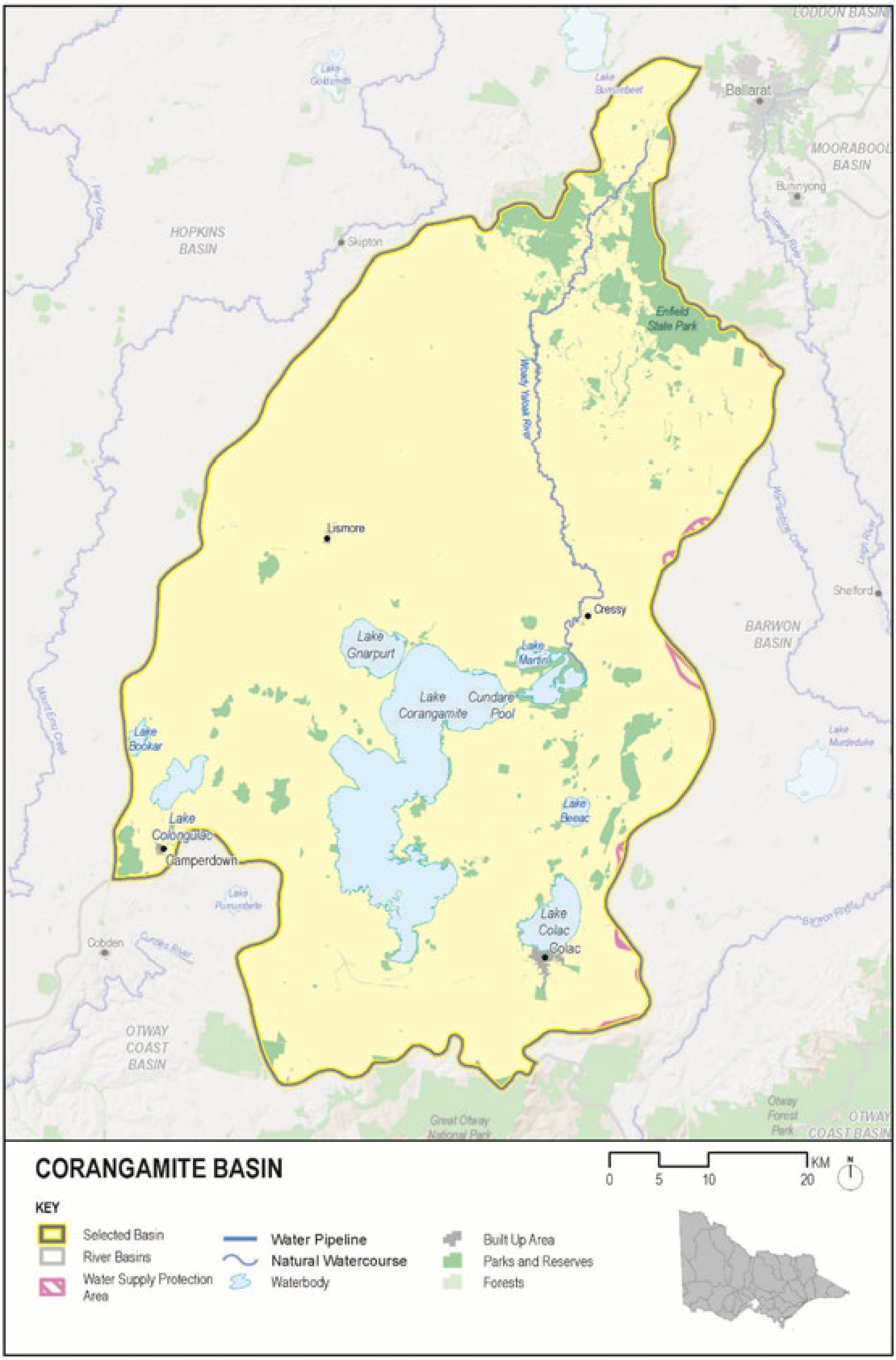
Table 6-139 Volume and use of recycled water in the Barwon basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ballarat North	2,523	746	13%	0	0	335	411	1,778	0
Ballarat South	6,489	61	0%	0	0	0	61	6,428	0
Bannockburn	155	155	100%	0	52	0	103	0	0
Black Rock	21,978	3,915	18%	949	1,554	0	1,412	0	18,063
Portarlington	296	296	100%	0	209	0	87	0	0
Winchelsea	45	45	100%	0	7	0	38	0	0
Total 2015–16	**31,486**	**5,218**	**10%**	**949**	**1,822**	**335**	**2,112**	**8,206**	**18,063**
Total 2014–15	30,572	4,001	8%	931	1,279	95	1,697	8,697	17,873

6.22 Corangamite basin

The Corangamite basin (Figure 6-41) is located in western Victoria. Rivers and streams within the basin terminate in a series of inland lakes, the largest of which is Lake Corangamite.

Figure 6-41 Map of the Corangamite basin



6.22.1 Water resources overview

In 2015–16, rainfall in the Corangamite basin was between 60% and 100% of the long-term average. Catchment inflows across the basin were 13% of the long-term average of 316,000 ML, significantly lower than in 2014–15 when the inflows were 47% of the long-term average. The amount of water flowing from the Corangamite basin into the Ramsar-listed Western District Lakes represented 67% of the catchment inflows in 2015–16.

No licensed diversion restrictions were applied to unregulated streams in the Corangamite basin in the 2015–16 year.

Barwon Water raised the level of urban water use restrictions on the Colac system to stage 3 during the year. These restrictions were lifted on June 10. No other urban water use restrictions applied in the Corangamite basin in 2015–16, with all remaining towns on permanent water savings rules throughout the year.

Table 6-140 shows the responsibilities of the authorities within the Corangamite basin.

Table 6-140 Responsibilities for water resources management in the Corangamite basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Barwon Water		Supplies Colac and surrounding towns (from the Otway Coast basin)	
Central Highlands Water		Supplies Ballarat and surrounding towns (from the Ballarat supply which is sourced in the Moorabool and Goulburn basins) (1)	
Wannon Water		Provides urban water supply to Camperdown, Lismore and Derrinallum (from the Otway Coast basin)	
Corangamite Catchment Management Authority			Manages waterways for the Corangamite basin

Note:

(1) Ballarat's water supply is mainly sourced from the Barwon and Moorabool basins.

Water for the environment

The Western District Lakes are internationally significant wetlands listed under the Ramsar Convention and rely on the freshwater inputs from the Corangamite basin to function ecologically. These lakes include Corangamite, Gnarpurt, Milangil, Terangpom, Beeac, Colongulac and Cundare. Wetlands of national importance include the Kooraweera Lakes, Lough Calvert, Lake Thurrumbong and Cundare Pool. The native fish community and the Corangamite water skink also rely on water for the environment.

In 2015–16, water for the environment in the Corangamite basin comprised:

- the component of water in the basin not allocated for consumptive use
- water set aside for the environment through the operation of passing flow conditions on licensed diversions.

6.22.2 Surface water resources

6.22.2.1 Water balance

The total volumes of water available and supplied from water resources in the Corangamite basin in 2015–16 are shown in Table 6-141. Urban water use within the Corangamite basin is mostly supplied from the Otway Coast basin and the Moorabool basin due to the availability of higher-quality water. No storage information is recorded in the water balance as there are no major on-stream storages in the Corangamite basin.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Corangamite basin, the water balance shows catchment inflows in 2015–16 were 106,803 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 143,303 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 102,659 ML less (rather than 106,803 ML). For more information, see Appendix E.

6.22 Corangamite basin

Table 6-141 Balance of surface water in the Corangamite basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows (1)	40,645	147,448
Rainfall on major storages	-	-
Treated wastewater discharged back to river	1,453	1,705
Total inflows	**42,098**	**149,153**
Outflows		
Diversions		
Urban diversions	0	0
Licensed diversions from unregulated streams	98	70
Usage from small catchment dams (2)	8,365	12,366
Total diversions	***8,463***	***12,436***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (2)	6,391	6,534
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***6,391***	***6,534***
Water passed at outlet of basin		
River outflows to the Corangamite Lakes	27,244	130,182
River outflows to Barwon basin via Woady Yaloak Channel	0	0
Total water passed at outlet of basin	***27,244***	***130,182***
Total outflows	**42,098**	**149,152**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

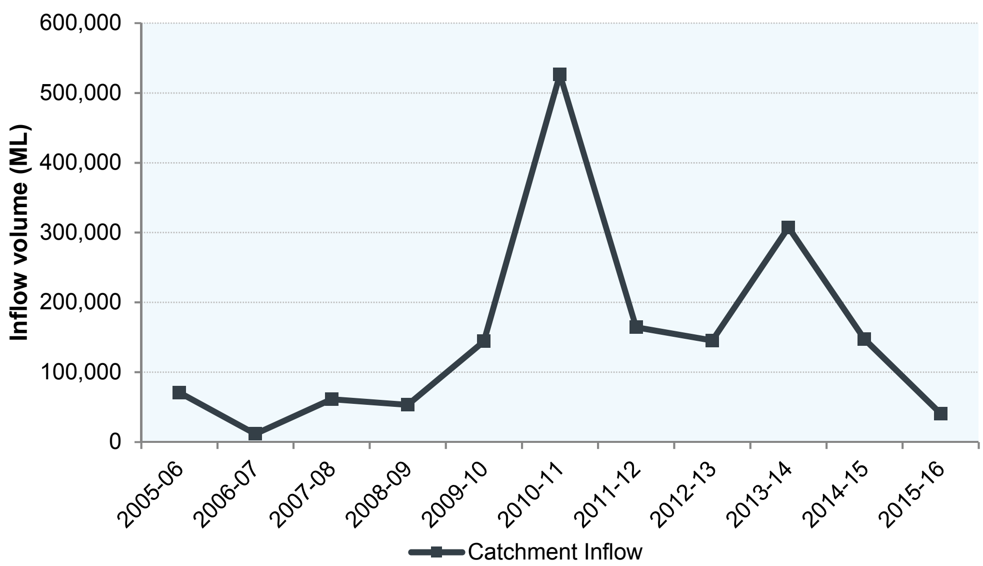
6.22.2.2 Storages and flows

Catchment inflows across the basin were 13% of the long-term average, significantly lower than in 2014–15 when the inflows were 47% of the long-term average of 316,000 ML (Figure 6-42).

Outflows from the Corangamite basin into the Corangamite Lakes were 27,244 ML in 2015–16, or 67% of the catchment inflows.

There are no major water supply storages in the Corangamite basin.

Figure 6-42 Catchment inflows in the Corangamite basin



6.22.2.3 Entitlement volumes and diversions

In the Corangamite basin, surface water is diverted from unregulated streams by licence holders and surface water is harvested in small catchment dams. No water authorities divert surface water in this basin.

The total licensed volume and the estimated volume of water diverted by licence holders in the basin was the same in 2015–16 as the volume reported in the *Victorian Water Accounts 2014–15* (Table 6-142).

Table 6-142 Entitlement volumes in the Corangamite basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	1,177
Total volume of water entitlements in the Corangamite basin	**1,177**

Allocation available under take and use licences in the Corangamite basin for 2015–16 is presented in Table 6-143.

Table 6-143 Allocation account balance summary for the Corangamite basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences – unregulated surface water	1,177	0	98	1,079

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Corangamite basin (Table 6-144).

The capacity of small catchment dams for Corangamite basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 3,947 ML less for small catchment dam capacity and a decrease of 4,001 ML usage. For more information, see Appendix E.

Table 6-144 Estimated small catchment dam information for the Corangamite basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,116	5,058	n/a
Registered commercial and irrigation	3,937	3,307	n/a
Total	**14,053**	**8,365**	**14,756**

n/a: information not available.

6.22.3 Recycled water

Barwon Water and Wannon Water operate treatment plants within the Corangamite basin. Overall, 15% of wastewater was recycled in 2015–16, a decrease from 22% from 2014–15. Recycled water was primarily used for agricultural purposes in this region (Table 6-145).

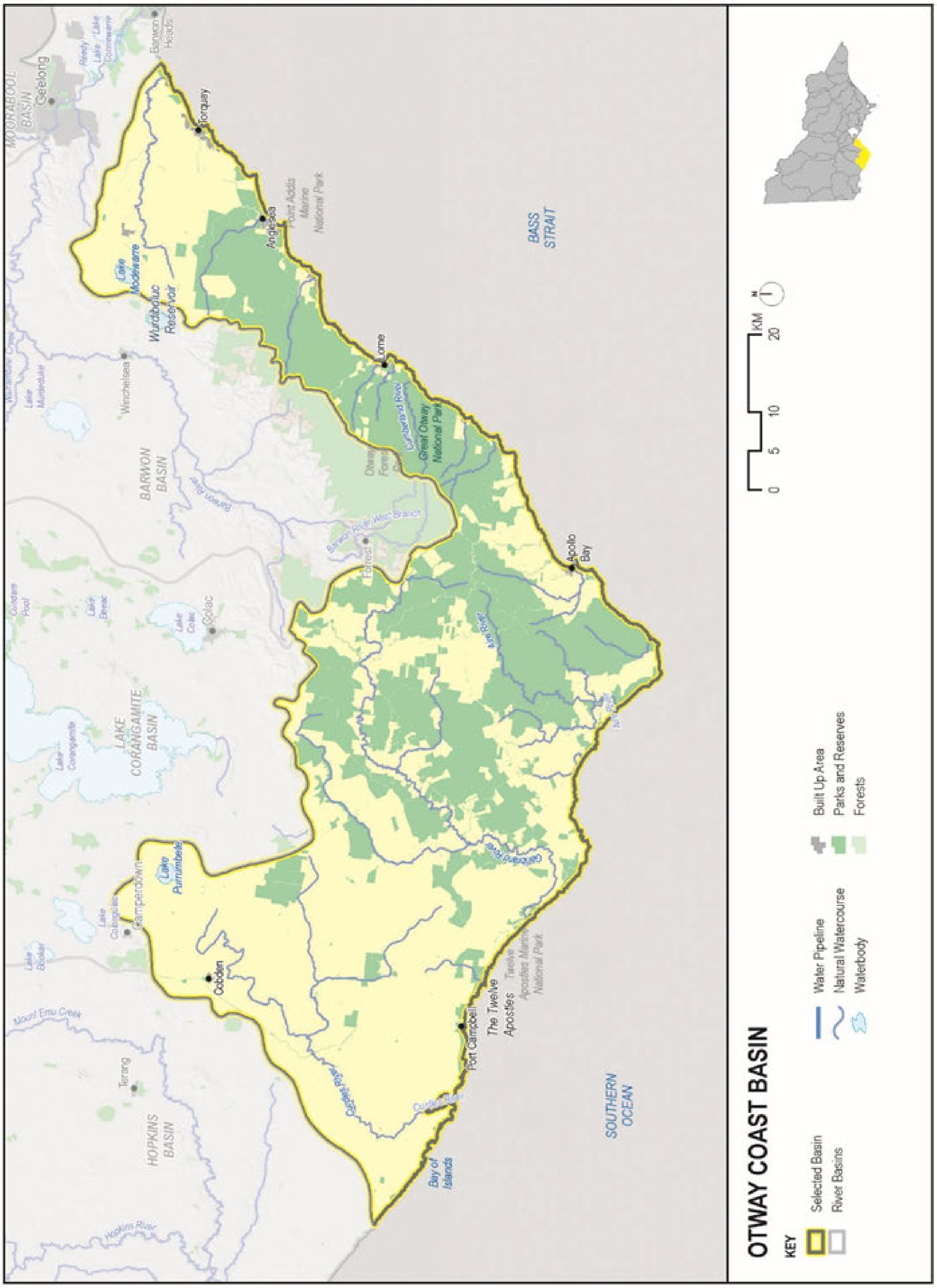
Table 6-145 Volume and use of recycled water in the Corangamite basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Camperdown Industrial	39	39	100%	0	39	0	0	0	0
Camperdown Municipal	217	217	100%	17	200	0	0	0	0
Colac	1,453	0	0%	0	0	0	0	1,453	0
Total 2015–16	**1,709**	**256**	**15%**	**17**	**239**	**0**	**0**	**1,453**	**0**
Total 2014–15	2,051	509	22%	10	447	0	52	1,705	(163)

6.23 Otway Coast basin

The Otway Coast basin (Figure 6-43) is located in south-west Victoria. It encompasses the numerous small creeks and rivers that flow to the coast from the Otway Ranges between Torquay and Peterborough.

Figure 6-43 Map of the Otway Coast basin



6.23.1 Water resources overview

In 2015–16, rainfall in the southern part of the Otway Coast basin was between 80% and 100% of the long-term average, while in the eastern and western areas of the basin rainfall was between 60% and 80% of the average. Catchment inflows in the Otway Coast basin in 2015–16 were 47% of the long-term average of 884,000 ML, compared to 65% in 2014–15. The amount of water flowing into Bass Strait represented 92% of the catchment inflows in the basin in 2015–16.

Storage levels in West Gellibrand Reservoir started 2015–16 at 74% and ended the year at 64% of total capacity.

The only restriction on licensed diversions in the 2015–16 year was an irrigation ban on the Curdies River between November 2015 and June 2016.

Barwon Water placed Lorne of stage 2 restrictions in March 2017 and raised the level to stage 3 in May. Further in May Barwon Water placed the Apollo Bay system on stage 3 until all restrictions were removed on June 10. No other urban water use restrictions applied in the Otway Coast basin in 2015–16, with all remaining towns on permanent water savings rules throughout the year.

Table 6-146 shows the responsibilities of the authorities within the Otway Coast basin.

Table 6-146 Responsibilities for water resources management in the Otway Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Wannon Water		Supplies towns including Port Campbell, Peterborough, Simpson and Cobden	Obliged to meet passing flow requirements
Barwon Water		Supplies the majority of towns in the basin including Lorne, Aireys Inlet, Apollo Bay, and towns in the northern part of the basin from Geelong's water supply (which comes from the Barwon basin). Also, transfers water out of the basin to supply Colac and surrounding towns	Operates West Gellibrand Reservoir and other reservoirs used to supply towns Obliged to meet passing flow requirements
Corangamite Catchment Management Authority			Manages waterways for the Otway Coast basin

Water for the environment

Several important environmental assets in the Otway basin depend on water for the environment, including:

- Aire River (a heritage river) and more specifically the Lower Aire wetlands, which are of national significance
- the Aire River estuary, which is of state significance
- the upper Aire River, which is a representative river
- Elliot River, Parker River, Grey River, Carisbrook Creek and Smythes Creek, which are ecologically healthy
- native fish community (such as river blackfish and Australian grayling) and their habitat (such as remnant riparian vegetation)
- lakes Costin and Craven
- endangered, flow-dependent ecological vegetation classes including estuarine wetland and swamp scrub
- the native bird population including the great egret (a Victorian rare or threatened species), Cape Barren goose and Australasian bittern
- native mammals including platypus and swamp antechinus
- macroinvertebrate communities in areas such as Elliot River, St Georges River and Wye River.

In 2015–16, water for the environment in the Otway Coast basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Barwon Water and Wannon Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.23.2 Surface water resources

6.23.2.1 Water balance

The total volumes of water available and supplied from water resources in the Otway Coast basin in 2015–16 are shown in Table 6-147. Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the

6.23 Otway Coast basin

Otway Coast basin, the water balance shows catchment inflows in 2015–16 were 155,490 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 578,838 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 159,454 ML less (rather than 155,490 ML). For more information, see Appendix E.

Table 6-147 Balance of surface water in the Otway Coast basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	1,374	1,856
Volume in storage at end of year	1,181	1,374
Change in storage	**(193)**	**(482)**
Inflows		
Catchment inflows (1)	419,384	574,874
Rainfall on major storages	272	160
Treated effluent discharged back to river	28	89
Total inflows	**419,684**	**575,123**
Outflows		
Diversions		
Urban diversions	13,865	12,911
Licensed diversions from unregulated streams	855	691
Usage from small catchment dams (2)	15,556	12,728
Total diversions	***30,276***	***26,330***
Losses		
Evaporation losses from major storages	209	221
Losses from small catchment dams (2)	4,591	3,455
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***4,800***	***3,676***
Water passed at outlet of basin		
River outflows to the ocean	384,801	545,599
Total water passed at outlet of basin	***384,801***	***545,599***
Total outflows	**419,877**	**575,605**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

6.23.2.2 Storages and inflows

The only major storage in the basin is the West Gellibrand Reservoir, which began the year at 74% of capacity and decreased to 64% by the end of June 2016 (Table 6-148).The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-148 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-148 Storage volumes in the Otway Coast basin

Storage (1)	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
West Gellibrand Reservoir	1,856	1,374	272	209	(256)	1,181
Total storage volumes	**1,856**	**1,374**	**272**	**209**	**(256)**	**1,181**

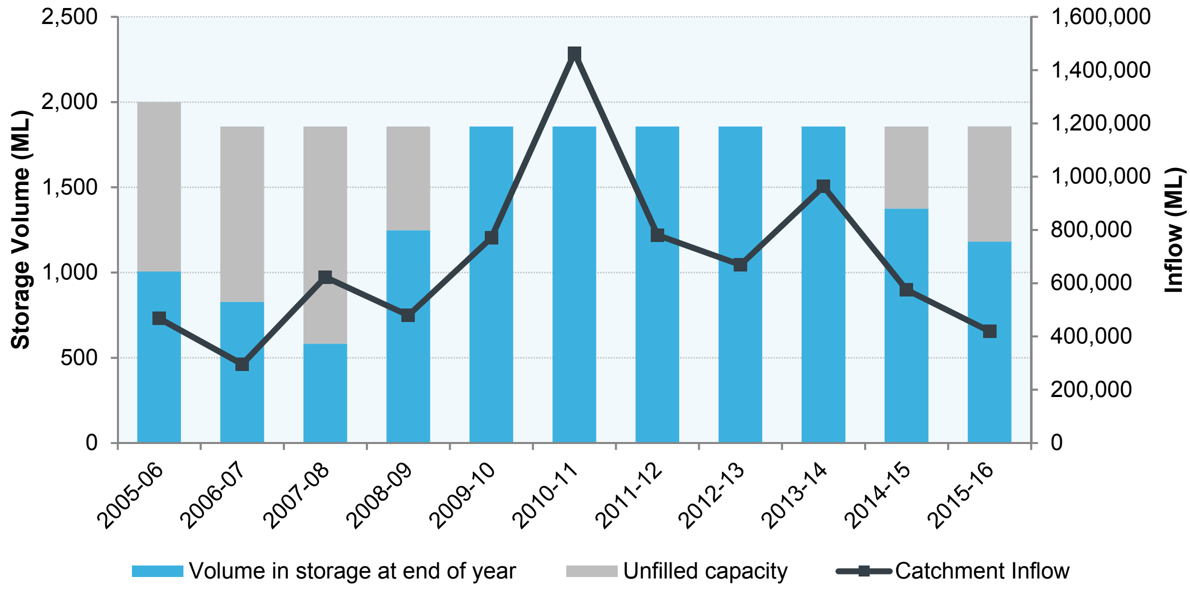
Note:

(1) Major storages are greater than 1,000 ML.

Catchment inflows in the Otway Coast basin in 2015–16 were 47% of the long-term average of 884,000 ML, compared to 65% in 2014–15 (Figure 6-44).

The amount of water flowing from the Otway Coast basin into Bass Strait decreased to 384,801 ML in 2015–16. This represented 92% of the catchment inflows into the basin, compared to 95% in 2014–15.

Figure 6-44 Storage volumes and catchment inflows



6.23.2.3 Entitlement volumes and diversions

In the Otway Coast basin, surface water is diverted by Barwon Water, Wannon Water and licensed diverters. Surface water is also harvested in small catchment dams.

Entitlements in the Otway Coast basin include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Otway Coast basin are outlined in Table 6-149.

Table 6-149 Entitlement volumes in the Otway Coast basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Aireys Inlet) Conversion Order 1997	317
Bulk Entitlement (Apollo Bay) Order 2010	800
Bulk Entitlement (Colac) Amendment Order 2003	5,400
Bulk Entitlement (Gellibrand) Conversion Order 1997	60
Bulk Entitlement (Lorne) Conversion Order 1997	510
Bulk Entitlement (Otway Coast) Conversion Order 1998	12,580
Take and use licences – unregulated surface water	6,704
Total volume of water entitlements in Otway Coast basin	**26,371**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-150. The volume of water diverted from unregulated streams by licence holders in the Otway Coast basin was more in 2015–16 than the volume (691 ML) reported in the *Victorian Water Accounts 2014–15*.

Table 6-150 Allocation account balance summary for the Otway Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Aireys Inlet	317	0	209	108
Apollo Bay	800	0	429	371
Colac	5,400	0	3,800	1,600
Gellibrand	60	0	22	38
Lorne	510	0	432	78
Otway system	12,580	0	8,972	3,608
Take and use licences – unregulated surface water	6,704	0	855	5,850

The estimated volume of water harvested from small catchment dams represents a significant portion of the total diversions in the Otway Coast basin (Table 6-151).

The capacity of small catchment dams for Otway Coast basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 4,776 ML more for small catchment dam capacity and an increase of 2,829 ML usage. For more information, see Appendix E.

6.23 Otway Coast basin

Table 6-151 Estimated small catchment dam information for the Otway Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	14,217	7,109	n/a
Registered commercial and irrigation	10,057	8,448	n/a
Total	**24,274**	**15,556**	**20,147**

n/a: information not available.

6.23.3 Recycled water

Barwon Water and Wannon Water operate treatment plants within the Otway Coast basin. Overall, 20% of wastewater was recycled in 2015–16, a decrease from 24% in 2014–15.

Table 6-152 highlights the volumes of water recycled in the Otway Coast basin in 2015–16.

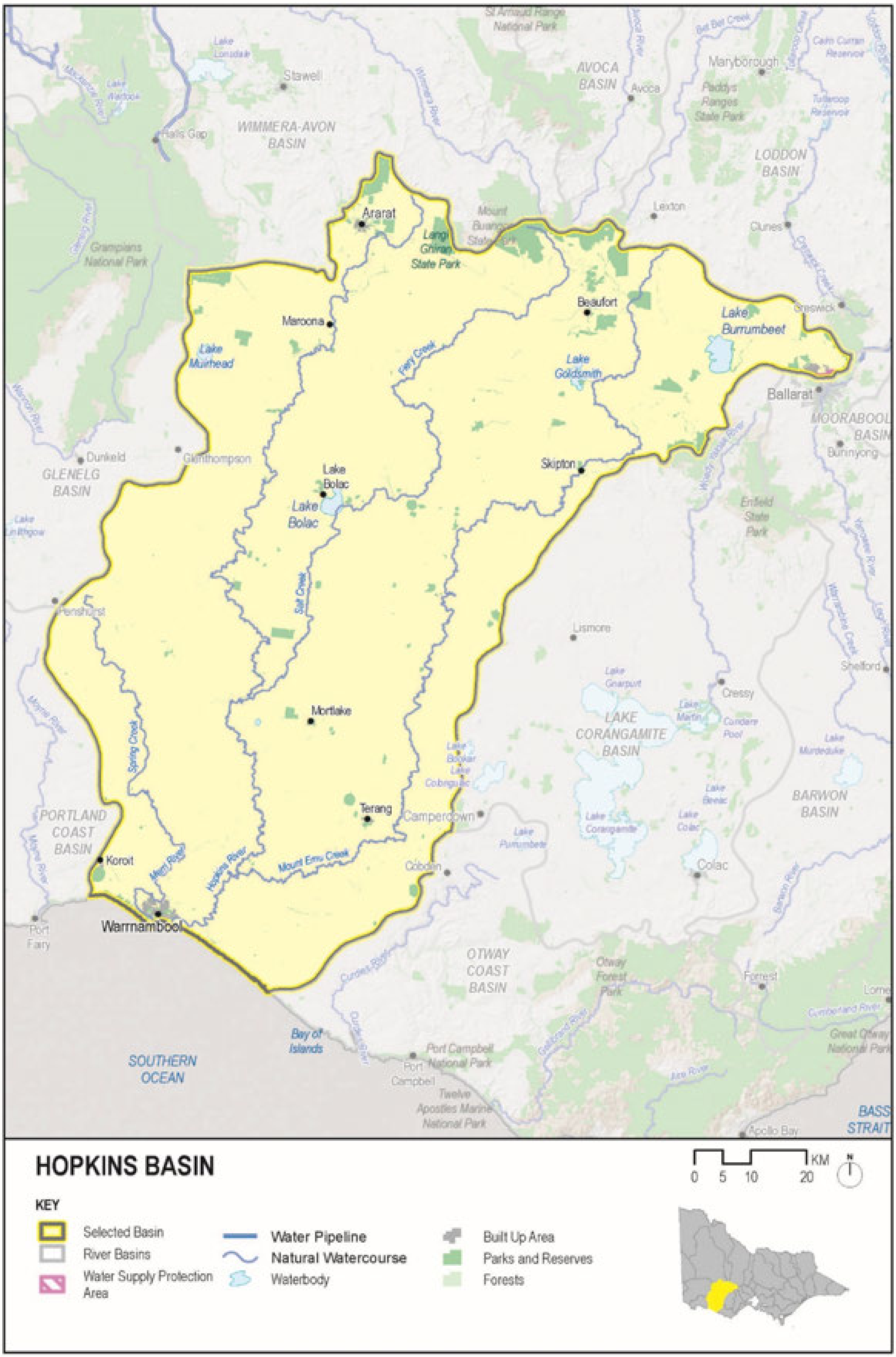
Table 6-152 Volume and use of recycled water in the Otway Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aireys Inlet	104	104	0%	0	0	0	104	0	0
Anglesea	306	96	28%	0	86	0	10	0	209
Apollo Bay	376	15	0%	0	0	0	15	0	361
Cobden	125	100	80%	0	100	0	0	25	0
Lorne	284	15	0%	0	0	0	15	0	269
Peterborough	0	0	0%	0	0	0	0	0	0
Port Campbell	24	24	100%	0	24	0	0	0	0
Simpson	3	0	0%	0	0	0	0	3	0
Timboon	38	38	100%	0	38	0	0	0	0
Total 2015–16	**1,260**	**392**	**20%**	**0**	**248**	**0**	**144**	**28**	**839**
Total 2014–15	1,245	347	24%	0	293	0	54	88	810

6.24 Hopkins basin

The Hopkins basin (Figure 6-45) is located in south-west Victoria. The two major rivers within the basin are the Merri River and Hopkins River.

Figure 6-45 Map of the Hopkins basin



6.24 Hopkins basin

6.24.1 Water resources overview

Rainfall throughout most of the Hopkins basin in 2015–16 was between 60% and 80% of the long-term average. A large area in the south and a small pocket in the north reached between 80% and 100% of the long-term average rainfall.

Catchment inflows in 2015–16 were 13% of the long-term average, less than in 2014–15 which saw inflow volumes at 35% of the long-term average. The volume of water flowing from the Hopkins basin into Bass Strait represented 48% of the catchment inflows, compared to 56% in 2014–15.

Licensed diversions were on stage 1 restrictions from July 2015 on the Hopkins River, Mt Emu Creek and Merri River. The Hopkins River increased restrictions on licensed diversions to stage 3 in December through to June 2016. In November 2015, Mt Emu Creek increased restrictions on licensed diversions to stage 2, then had an irrigation ban from December 2015 to June 2016. Licensed diversions on the Merri River were subject to stage 1 restrictions from July to October 2015, which increased to stage 6 restrictions in November and increased again to stage 8 restrictions from December 2015 to June 2016.

In Mach 2016, Lake Bolac, Willaura and Wickliffe in the Hopkins basin were placed on stage 2 urban water use restrictions until June 2016 when they were removed. All other towns in the basin remained on permanent water savings rules throughout the year.

Table 6-153 shows the responsibilities of the authorities within the Hopkins basin.

Table 6-153 Responsibilities for water resources management in the Hopkins basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages groundwater and surface water licensed diversions (except Loddon Highlands WSPA, which is managed by Goulburn–Murray Water)		
Wannon Water		Supplies towns in the south of the basin including Warrnambool	
Grampians Wimmera Mallee Water		Supplies towns in the north of the basin including Ararat	
Central Highlands Water		Supplies towns in the north-east of the basin including Beaufort and Skipton	Obliged to meet passing flow requirements
Glenelg Hopkins Catchment Management Authority			Manages waterways in the whole of the Hopkins basin

Water for the environment

Important environmental assets (such as the coastal salt marsh wetlands and the wetlands associated with the Merri River estuary) depend on water in the Hopkins basin.

In 2015–16, water for the environment in the Hopkins basin comprised:

- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Central Highlands Water
- water set aside for the environment through the operation of licensed diversions in passing flow conditions, particularly for Cudgee and Mt Emu creeks
- all other water in the basin not allocated for consumptive use.

6.24.2 Surface water resources

6.24.1 Water balance

The total volumes of water available and supplied from water resources in the Hopkins basin in 2015–16 are shown in Table 6-154. No storage information is recorded in the water balance as there are no major on-stream storages in the basin. Small catchment dams harvest most of the water used for consumptive purposes.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Hopkins basin, the water balance shows catchment inflows in 2015–16 were 142,083 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 167,420 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 86,575 ML less (rather than 142,083 ML). For more information, see Appendix E.

Table 6-154 Balance of surface water in the Hopkins basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows [(1)]	80,845	222,928
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**80,845**	**222,928**
Outflows		
Diversions		
Urban diversions	206	399
Licensed diversions from unregulated streams	2,458	2,751
Usage from small catchment dams [(2)]	21,446	64,538
Total diversions	***24,110***	***67,688***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams [(2)]	17,749	30,166
In-stream infiltration to groundwater, flows to floodplain and evaporation [(3)]	n/a	n/a
Total losses	***17,749***	***30,166***
Water passed at outlet of basin		
River outflows to the ocean	38,985	125,075
Total water passed at outlet of basin	***38,985***	***125,075***
Total outflows	**80,845**	**222,929**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

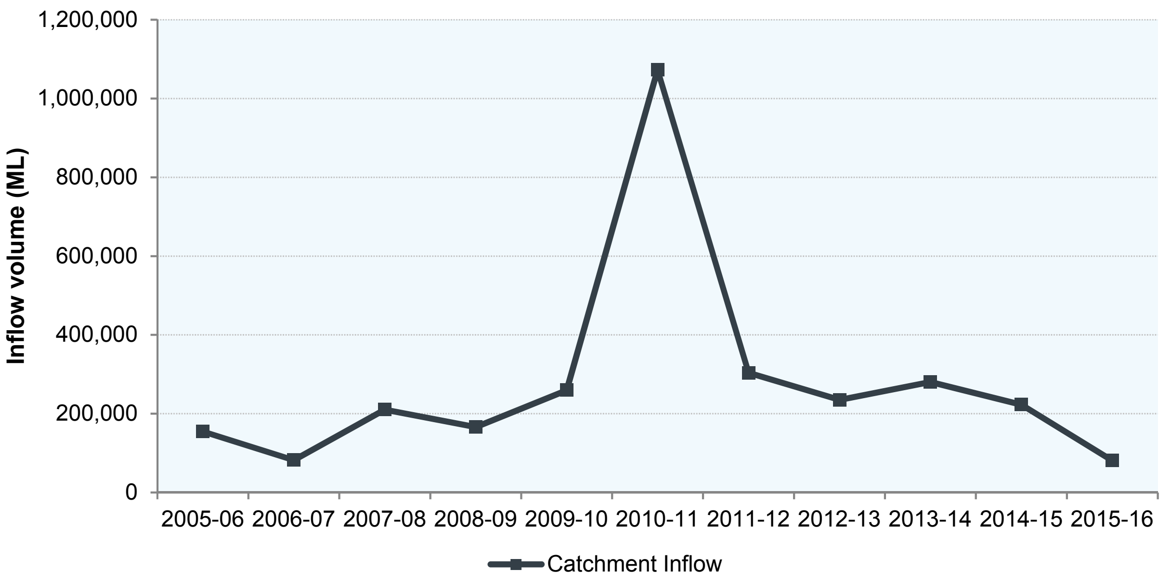
6.24.2.2 Storages and flows

Catchment inflows in 2015–16 were 13% of the long-term average (of 635,000 ML), compared to 35% in 2014–15 (Figure 6-46).

The volume of water flowing from the Hopkins basin into Bass Strait was 38,985 ML in 2015–16, which represented 48% of the catchment inflows. This is a decrease from 125,075 ML in 2014–15, which represented 56% of catchment inflows.

There are no major storages in the Hopkins basin (storages greater than 1,000 ML).

Figure 6-46 Catchment inflows in the Hopkins basin



6.24.2.3 Entitlement volumes and diversions

In the Hopkins basin, bulk entitlements to surface water are held by Central Highlands Water, Grampians Wimmera Mallee Water and licensed diverters. Surface water is diverted by licensed diverters and is also harvested into small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations). Rights to water in the Hopkins basin are outlined in Table 6-155.

Grampians Wimmera Mallee Water's bulk entitlement to the Hopkins basin (Willarua, Elmhurst and Buangor) is reported in the Wimmera basin, as it covers water sourced from both basins, most of which are located in the Wimmera.

Table 6-155 Entitlement volumes in the Hopkins basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Beaufort) Conversion Order 2005	419
Bulk Entitlement (Skipton) Conversion Order 2005	210
Take and use licences – unregulated surface water	11,084
Total volume of water entitlements in the Hopkins basin	**11,713**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-156.

The volume of water diverted from unregulated streams by licence holders in the Hopkins basin was 2,458 ML, which was lower than the 2014–15 volume of 2,751 ML (Table 6-156).

Table 6-156 Allocation account balance summary for the Hopkins basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Beaufort	419	0	206	213
Skipton	210	0	0	210
Take and use licences – unregulated surface water	11,084	0	2,458	8,626

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Hopkins basin (Table 6-157).

The capacity of small catchment dams for Hopkins basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 52,366 ML less for small catchment dam capacity and a decrease of 43,092 ML usage. For more information, see Appendix E.

Table 6-157 Estimated small catchment dam information for the Hopkins basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	28,278	14,139	n/a
Registered commercial and irrigation	8,699	7,307	n/a
Total	**36,977**	**21,446**	**39,196**

n/a: information not available.

6.24.3 Recycled water

Grampians Wimmera Mallee Water, Central Highlands Water and Wannon Water operate treatment plants within the Hopkins basin. Overall, 14% of wastewater was recycled in 2015–16, a slight increase on 12% from 2014–15.

Table 6-158 highlights the volumes of water recycled in the Hopkins basin in 2015–16.

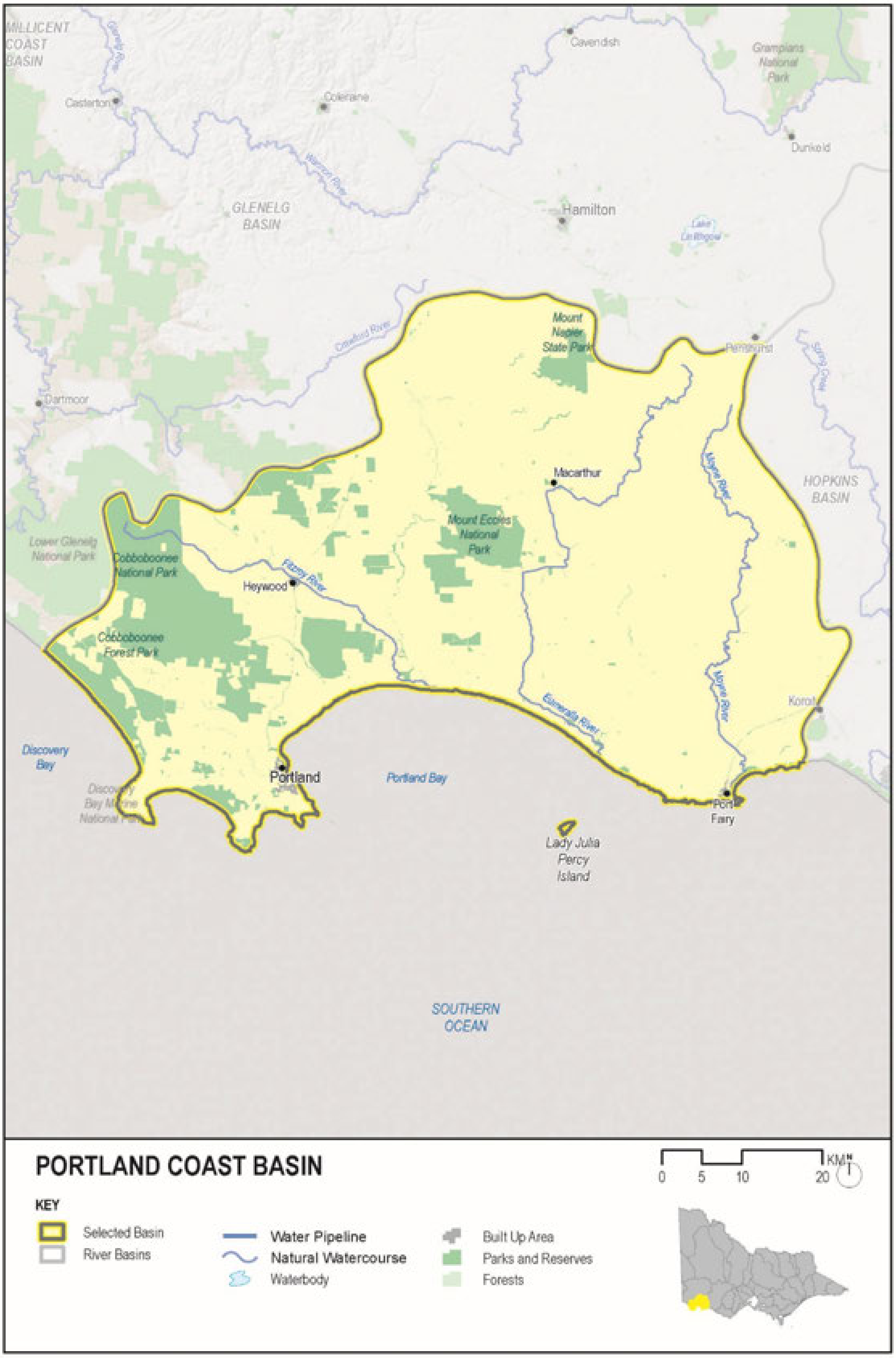
Table 6-158 Volume and use of recycled water in the Hopkins basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ararat	494	494	98%	114	370	0	10	0	0
Beaufort	72	72	100%	0	72	0	0	0	0
Cardigan Village	0	0	0%	0	0	0	0	0	0
Mortlake	48	48	100%	4	45	0	0	0	0
Skipton	0	0	0%	0	0	0	0	0	0
Terang	170	170	100%	0	170	0	0	0	0
Warrnambool	5,236	224	2%	81	0	0	143	0	5,012
Willaura	8	8	100%	8	0	0	0	0	0
Total 2015–16	**6,028**	**1,016**	**14%**	**207**	**657**	**0**	**153**	**0**	**5,012**
Total 2014–15	6,380	1,037	12%	223	552	0	262	0	5,343

6.25 Portland Coast basin

The Portland Coast basin (Figure 6-47) is in south-west Victoria. Major rivers in the basin include the Moyne, Eumeralla, Fitzroy and Surrey rivers.

Figure 6-47 Map of the Portland Coast basin



6.25.1 Water resources overview

Rainfall throughout much of the Portland Coast basin in 2015–16 was between 60% and 80% of the long-term average, with a small area in the west receiving between 80% and 100%. Catchment inflows in 2015–16 were 29% of the long-term average, compared to 76% in 2014–15. The amount of water flowing from the Portland Coast basin into Bass Strait represented 93% of the catchment inflows in the basin in 2015–16.

Irrigation bans were in place for licensed diversions between October 2015 and June 2016 on the Moyne and Fitzroy rivers, and from November to June 2016 on the Eumeralla and Surry rivers. No urban water use restrictions applied in the Portland Coast basin in 2015–16, with all towns remaining on permanent water saving rules throughout the year.

Table 6-159 shows the responsibilities of the authorities within the Portland Coast basin.

Table 6-159 Responsibilities for water resources management in the Portland Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions		
Wannon Water		Supplies groundwater to Koroit, Port Fairy, Heywood and Portland	
Glenelg Hopkins Catchment Management Authority			Manages waterways in the whole Portland Coast basin

Water for the environment

In 2015–16, water for the environment in the Portland Coast basin comprised:

- water in the basin not otherwise allocated for consumptive use
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, particularly for Condah Drain, Darlot Creek and the Fitzroy, Moyne and Surrey rivers.

6.25.2 Surface water resources

6.25.2.1 Water balance

The total volumes of water available and supplied from water resources in the Portland Coast basin in 2015–16 are shown in Table 6-160. Of the total inflows, about 14% were diverted for consumptive use, mainly from small catchment dams. All towns serviced by Wannon Water in this basin are either supplied by groundwater or directly from other river basins. No storage information is recorded in the water balance as there are no major on-stream storages in the Portland Coast basin.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Portland Coast basin, the water balance shows catchment inflows in 2015–16 were 168,698 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 259,521 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 155,199 ML less (rather than 168,698 ML). For more information, see Appendix E.

Table 6-160 Balance of surface water in the Portland Coast basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows (1)	104,323	273,021
Rainfall on major storages	-	-
Treated wastewater discharged back to river	98	184
Total inflows	**104,421**	**273,205**
Outflows		
Diversions		
Licensed diversions from unregulated streams	4	2
Usage from small catchment dams (2)	3,847	16,135
Total diversions	***3,851***	***16,137***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams (2)	3,273	4,484
In-stream infiltration to groundwater, flows to floodplain and evaporation (3)	n/a	n/a
Total losses	***3,273***	***4,484***

6.25 Portland Coast basin

Water passed at outlet of basin		
River outflows to the ocean	97,297	252,584
Total water passed at outlet of basin	***97,297***	***252,584***
Total outflows	**104,421**	**273,205**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) No suitable model is available to make an estimate of in-stream losses.

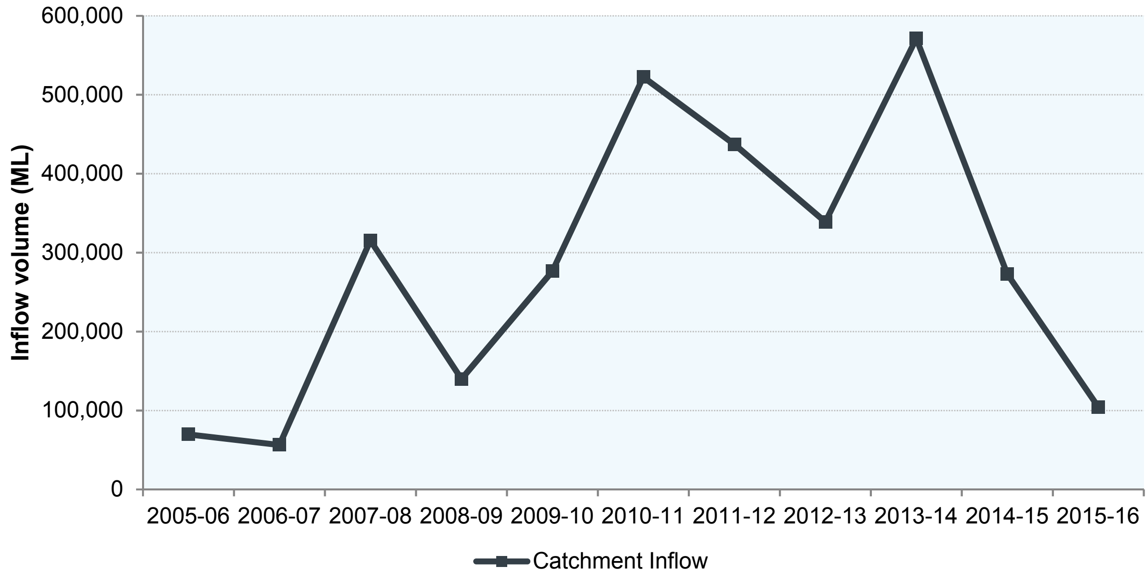
6.25.2.2 Storages and flows

There are no major storages in the Portland Coast basin.

Catchment inflows in 2015–16 were 29% of the long-term average of 361,000 ML, compared to 76% in 2014–15 (Figure 6-48).

The amount of water flowing from the Portland Coast basin into Bass Strait was 97,297 ML in 2015–16, a significant decrease from the previous year. This represents 93% of catchment inflows.

Figure 6-48 Catchment inflows in the Portland Coast basin



6.25.3 Entitlement volumes and diversions

In the Portland Coast basin, surface water is diverted from unregulated streams by licence holders and harvested in small catchment dams. No water corporations divert surface water in this basin.

Entitlements in Portland Coast include rights granted to individuals (take and use licences). Rights to water in the Portland Coast basin are outlined in Table 6-161.

Table 6-161 Entitlement volumes in the Portland Coast basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	1,078
Total volume of water entitlements in the Portland Coast basin	**1,078**

Allocation available under licences for 2015–16 is presented in Table 6-162. In 2015–16, out of a total licence volume of 1,078 ML, about 4 ML was diverted for use in the basin, similar to the amount reported in the *Victorian Water Accounts 2014–15*.

Table 6-162 Allocation account balance summary for the Portland Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences – unregulated surface water	1,078	0	4	1,074

The estimated volume of water harvested from small catchment dams represents the largest diversion of surface water in the Portland Coast basin (Table 6-163).

The capacity of small catchment dams for Portland Coast basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 13,775 ML less for small catchment dam capacity and a decrease of 12,288 ML usage. For more information, see Appendix E.

Table 6-163 Estimated small catchment dam information for the Portland Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,634	3,317	n/a
Registered commercial and irrigation	631	530	n/a
Total	**7,265**	**3,847**	**7,120**

n/a: information not available.

6.25.3 Recycled water

Wannon Water operates all treatment plants within the Portland Coast basin. Overall, 5% of wastewater was recycled in 2015–16, the same as in 2014–15. Recycled water at the Heywood treatment plant was reused for wood-lot irrigation.

Table 6-164 highlights the volumes of water recycled in the Portland Coast basin in 2015–16.

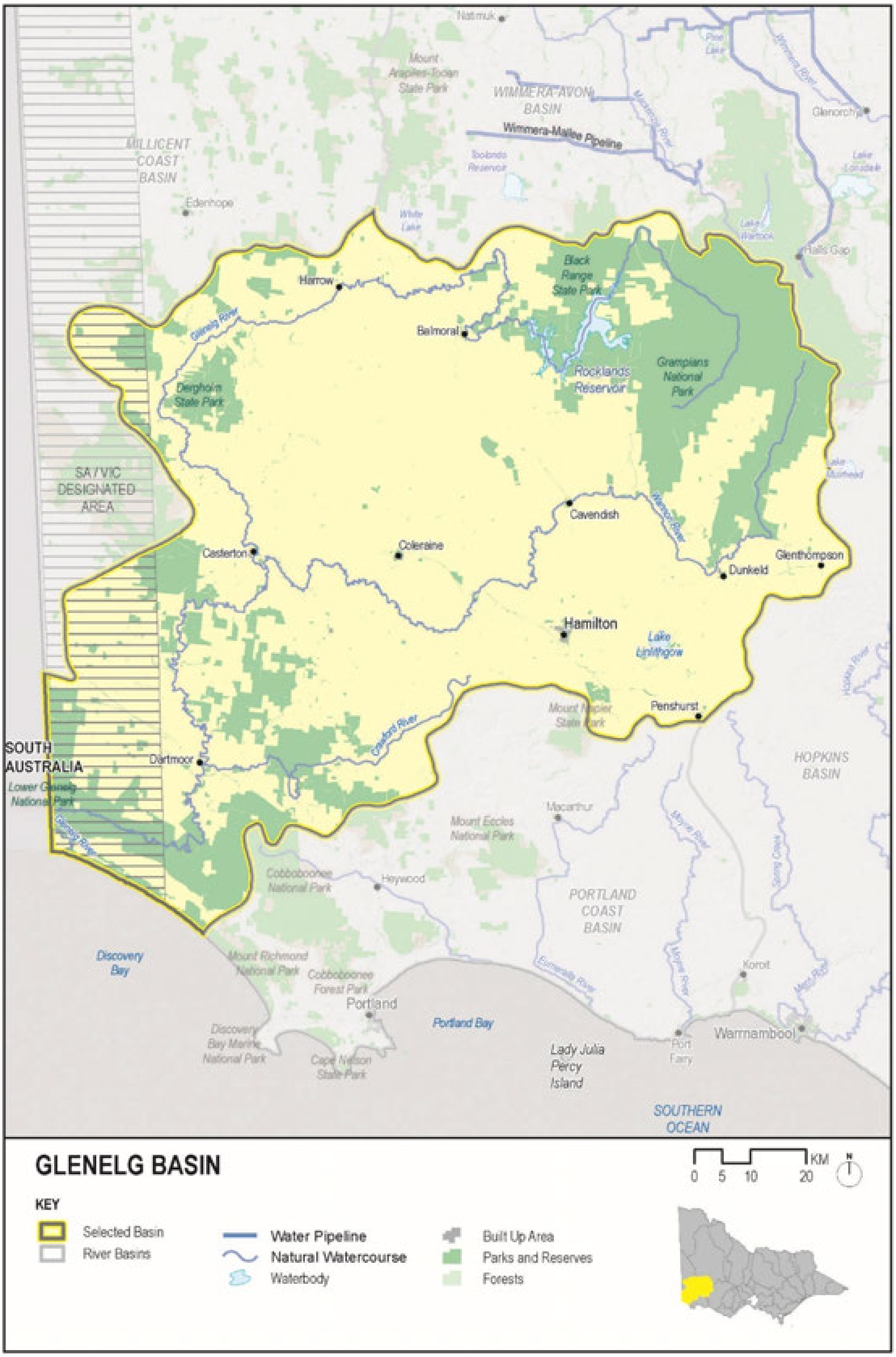
Table 6-164 Volume and use of recycled water in the Portland Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heywood	218	120	55%	0	120	0	0	98	0
Port Fairy Domestic	778	0	0%	0	0	0	0	0	778
Port Fairy Industrial	168	0	0%	0	0	0	0	0	168
Portland	1,121	0	0%	0	0	0	0	0	1,121
Total 2015–16	**2,285**	**120**	**5%**	**0**	**120**	**0**	**0**	**98**	**2,067**
Total 2014–15	2,461	129	5%	0	129	0	0	184	2,148

6.26 Glenelg basin

The Glenelg basin (Figure 6-49) is in the far west of Victoria. It has four on-stream storages, the largest of which is Rocklands Reservoir.

Figure 6-49 Map of the Glenelg basin



6.26.1 Water resources overview

Most of the Glenelg basin received between 60% and 80% of the long-term average rainfall in 2015–16. An area in the west of the basin and a large pocket in midsection received higher rainfall of between 80% and 100%.

Catchment inflows in the Glenelg basin in 2015–16 were about 12% of the long-term average, compared to 36% in 2014–15. The basin's largest water storage, Rocklands Reservoir, started the year at 20% of capacity and was at 15% by the end of June 2016.

All streams in the Glenelg basin remained unrestricted until October 2015 when the Crawford, Glenelg and Wannon rivers were placed on irrigation bans. The Grange Burn was also subject to an irrigation ban in December 2015. The restrictions remained on these rivers until June 2016. All towns remained on permanent water savings rules throughout the year.

Table 6-165 shows the responsibilities of the authorities within the Glenelg basin.

Table 6-165 Responsibilities for water resources management in the Glenelg basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Southern Rural Water	Manages licensed diversions for the entire basin except the Glenelg River north of the bridge on the Casterton–Harrow Road		
Grampians Wimmera Mallee Water	Manages licensed diversions for the Glenelg River north of the bridge on the Casterton–Harrow Road	Supplies Harrow	Operates the Wimmera–Glenelg system which includes Rocklands and Moora Moora reservoirs, and several other small diversion weirs in the upper Glenelg and Wannon rivers Obliged to meet passing flow requirements
Wannon Water		Supplies all other towns in the basin	Operates reservoirs in the Hamilton supply system Obliged to meet passing flow requirements
Victorian Environmental Water Holder			Holds and manages environmental entitlements in the basin
Glenelg Hopkins Catchment Management Authority			Manages waterways in the Glenelg basin

Water for the environment

The lower Glenelg River is a heritage river and depends on water for the environment in the Glenelg basin to function ecologically. Other important environmental assets that also rely on water for the environment in this basin are:

- Glenelg spiny crayfish (listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* and only found in the Glenelg basin)
- Yarra and Ewens pygmy perch (listed as vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and threatened under the *Flora and Fauna Guarantee Act 1988)*
- variegated pygmy perch (listed as vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* and threatened under the *Flora and Fauna Guarantee Act* 1988)
- a new subspecies of the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*) discovered on the Glenelg River. This species appears to have similar characteristics to the Wimmera subspecies, which is very dependent on flows. This species is listed as threatened under the *Flora and Fauna Guarantee Act 1988* and has been nominated for listing under the *Environmental Protection and Biodiversity Conservation Act 1999*.

In 2015–16, water for the environment in the Glenelg basin comprised:

- a share of water available under the *Wimmera and Glenelg Rivers Environmental Entitlement 2010* which includes 41,560 ML of high-reliability entitlement; water available under this entitlement is shared with the Wimmera basin
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Grampians Wimmera Mallee Water and Wannon Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, particularly Crawford River, Glenelg River, Grange Burn and Wannon River
- all other water in the basin not allocated for consumptive use.

In 2015–16, a total of 2,970 ML of environmental water was used in the Glenelg basin. This was all delivered in-stream for the Glenelg River.

6.26.2 Surface water resources

6.26.2.1 Water balance

The total volumes of water available and supplied from water resources in the Glenelg basin in 2015–16 are shown in Table 6-166. A volume of 14,576 ML was diverted to the Wimmera system in 2015–16.

The volume of water flowing from the Glenelg basin into Bass Strait was 55,089 ML in 2015–16, which is significantly less than the previous year when 225,540 ML flowed out of the basin (Table 6-166).

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Glenelg basin, the water balance shows catchment inflows in 2015–16 were 232,529 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 307,143 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 190,348 ML (rather than 168,698 ML). For more information, see Appendix E.

Table 6-166 Balance of surface water in the Glenelg basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	62,675	92,041
Volume in storage at end of year	48,165	62,675
Change in storage	**(14,510)**	**(29,366)**
Inflows		
Catchment inflows (1)	116,795	349,324
Rainfall on major storages	7,625	8,258
Treated wastewater discharged back to river	0	131
Total inflows	**124,420**	**357,713**
Outflows		
Diversions		
Urban diversions	1,743	1,279
Transfers to the Wimmera basin (2)	14,576	21,336
Licensed diversions from unregulated streams	74	234
Usage from small catchment dams (3)	18,899	55,483
Total diversions	***35,292***	***78,332***
Losses		
Evaporation losses from major storages	19,603	18,293
Losses from small catchment dams (3)	19,024	24,622
In-stream infiltration to groundwater, flows to floodplain and evaporation	9,921	40,294
Total losses	***48,548***	***83,209***
Water passed at outlet of basin		
River outflows to the ocean	55,089	225,540
Total water passed at outlet of basin	***55,089***	***225,540***
Total outflows	**138,930**	**387,081**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) Transfers from the Glenelg basin to the Brimpaen storages in the Wimmera basin, via the Moora Channel, Wannon Creek and transfer from Rocklands Reservoir via Rocklands Channel.

(3) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in Appendix E for further detail.

6.26.2.2 Storages and flows

Four major storages are located within the basin. Rocklands Reservoir, which accounts for 97% of the total capacity of Glenelg basin storages, was holding 15% of capacity at the end of 2015–16. The volume reported in the 'Catchment inflows less regulated releases' column of Table 6-167 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

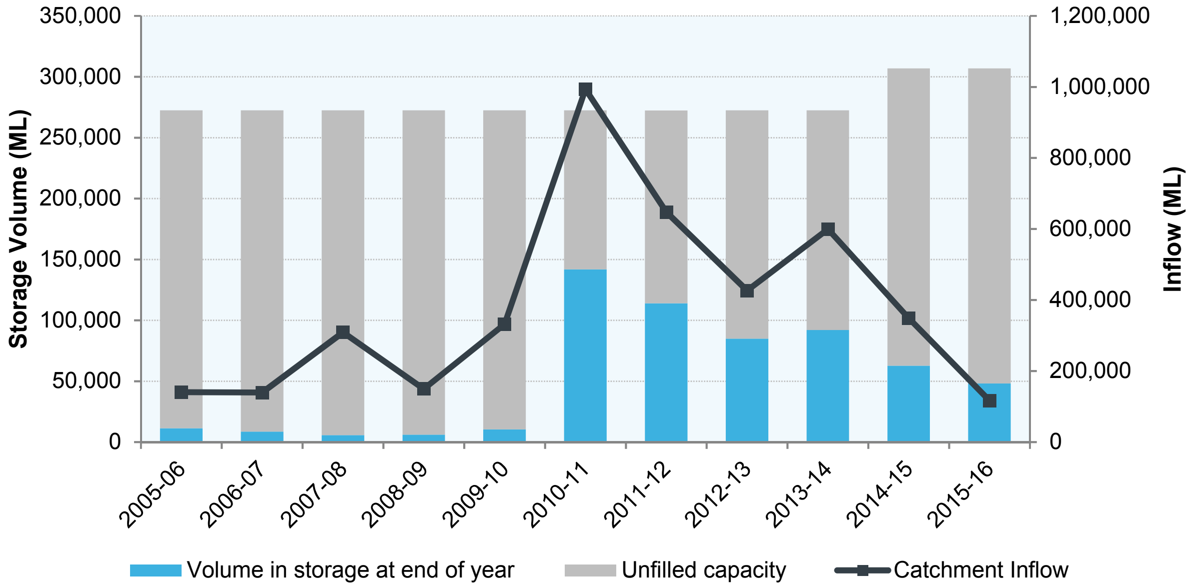
Table 6-167 Storage volumes in the Glenelg basin

Storage	Total capacity (ML) (1)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Hamilton system reservoirs	2,654	1,998	214	415	(17)	1,780
Konongwootong Reservoir	1,920	1,652	361	682	83	1,415
Moora Moora Reservoir	6,300	1,190	692	1,727	751	906
Rocklands Reservoir	296,000	57,835	6,358	16,779	(3,349)	44,065
Total storage volumes	**306,874**	**62,675**	**7,625**	**19,603**	**(2,532)**	**48,166**

Note:
(1) Volumes provided are the maximum operating capacities of storages.

Catchment inflows across the basin were 116,795 ML. This was 12% of the long-term average of 964,000 ML, less than the volume of inflows in 2014–15 (Figure 6-50).

Figure 6-50 Storage volumes and catchment inflows in the Glenelg basin (1)



Note:
(1) The maximum operating capacity of Rocklands Reservoir was changed in 2014–15 from 261,510 ML to 296,000 ML. The full capacity of Rocklands Reservoir is 348,300 ML.

6.26.2.3 Entitlement volumes and diversions

In the Glenelg basin, bulk entitlements to surface water are held by Grampians Wimmera Mallee Water, Central Highlands Water, Coliban Water and Wannon Water. Surface water is also diverted by licensed diverters, and surface water is harvested in small catchment dams.

Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Glenelg basin are outlined in Table 6-168.

Under Grampians Wimmera Mallee Water's Wimmera and Glenelg Rivers bulk entitlement, the water corporation operates the Wimmera–Glenelg system headworks to supply water to towns and customers connected to the Wimmera–Mallee Pipeline. It also supplies entitlements held by Coliban Water, Wannon Water and the VEWH.

The Wimmera–Glenelg system is unique because the headworks harvest water from both the Glenelg and Wimmera river systems and the volumes supplied to entitlement holders cannot be disaggregated between the two basins. Therefore, the entitlement volumes and diversions are presented in the Wimmera basin chapter in Table 6-168.

Wannon Water also holds four other bulk entitlements for supply to towns within the Glenelg basin, shown in Table 6-168.

6.26 Glenelg basin

Table 6-168 Entitlement volumes in the Glenelg basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Coleraine, Casterton, Sandford) Conversion Order 1997	855
Bulk Entitlement (Dunkeld System) Conversion Order 1997	170
Bulk Entitlement (Glenthompson) Conversion Order 1997	94
Bulk Entitlement (Hamilton) Conversion Order 1997	3,435
Take and use licences – unregulated surface water	1,044
Total volume of water entitlements in Glenelg basin	**5,598**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-169.

The volume of water diverted from unregulated streams by licence holders in the Glenelg basin in 2015–16 was lower than the volume (234 ML) reported in the *Victorian Water Accounts 2014–15*.

The *Wimmera and Glenelg Rivers Environmental Entitlement 2010* provides the VEWH with water from the Wimmera–Glenelg system headworks to provide environmental benefits in both the Wimmera and Glenelg basins. In the Glenelg basin, water available under the environmental entitlement is used to support streamflows and is not diverted out of waterways. The allocation available for use under this entitlement for 2015–16 is presented in the Wimmera basin chapter in Table 6-169.

Table 6-169 Allocation account balance summary for the Glenelg basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Coleraine, Casterton, Sandford	855	0	230	625
Dunkeld system	170	0	0	170
Glenthompson	94	0	9	85
Hamilton	3,435	0	1,504	1,931
Take and use licences – unregulated surface water	1,044	0	74	970

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Glenelg basin (Table 6-170).

The capacity of small catchment dams for Glenelg basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 40,559 ML less for small catchment dam capacity and a decrease of 36,584 ML usage. For more information, see Appendix E.

Table 6-170 Estimated small catchment dam information for the Glenelg basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	34,504	17,252	n/a
Registered commercial and irrigation	1,961	1,647	n/a
Total	**36,465**	**18,899**	**37,924**

n/a: information not available.

6.26.3 Recycled water

Wannon Water operates all treatment plants within the Glenelg basin. Overall, 100% of wastewater was recycled in 2015–16, an increase from 86% in 2014–15.

Table 6-171 highlights the volumes of water recycled in the Glenelg basin in 2015–16.

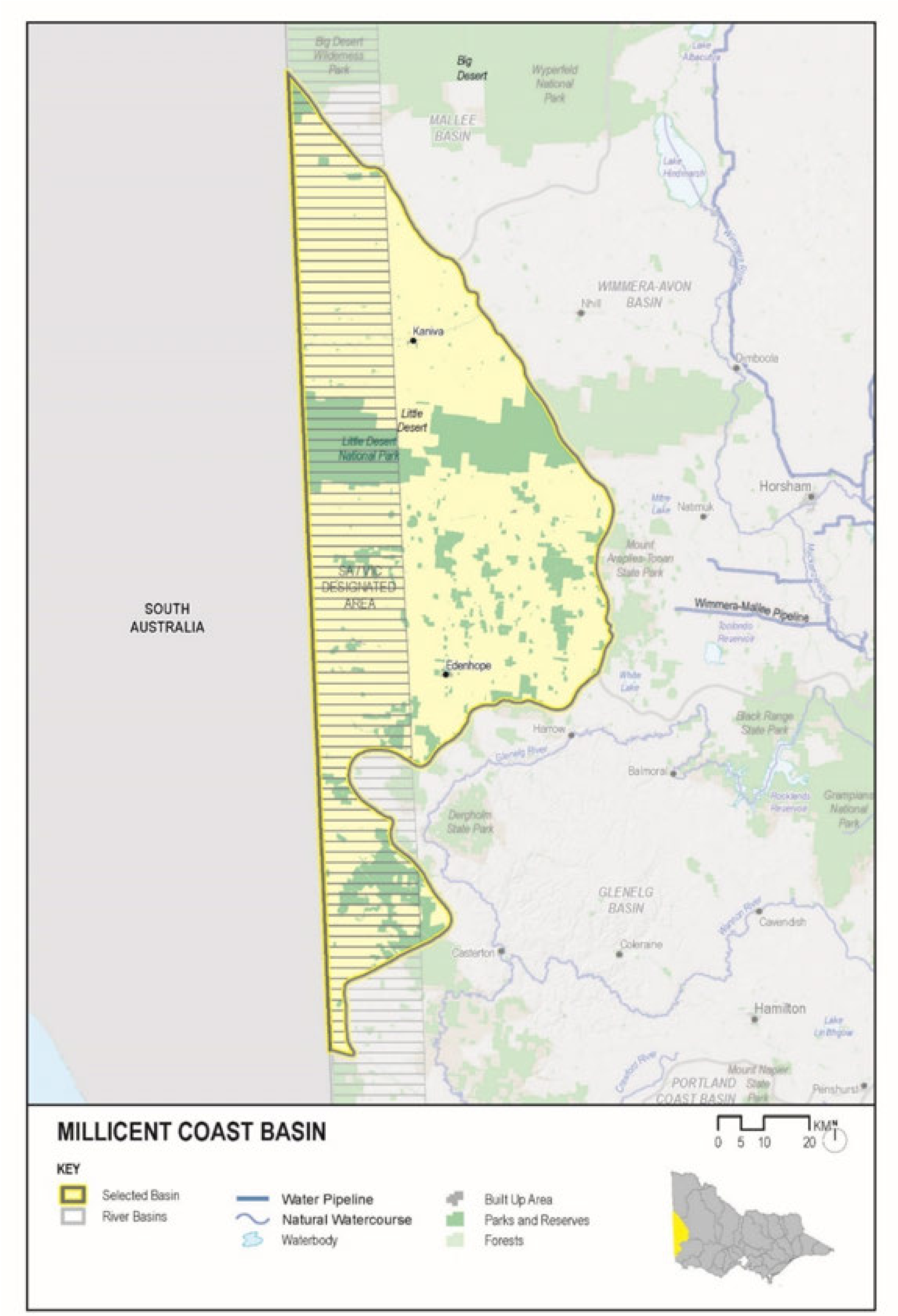
Table 6-171 Volume and use of recycled water in the Glenelg basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Casterton	50	50	100%	0	50	0	0	0	0
Coleraine	20	20	100%	0	20	0	0	0	0
Dunkeld	23	23	100%	23	0	0	0	0	0
Hamilton	653	653	100%	131	522	0	0	0	0
Total 2015–16	**746**	**746**	**100%**	**154**	**592**	**0**	**0**	**0**	**0**
Total 2014–15	906	782	86%	128	654	0	0	131	(7)

6.27 Millicent Coast basin

The Millicent Coast basin (Figure 6-51) spans parts of both Victoria and South Australia. The Victorian section of the basin comprises numerous internally draining interdune wetlands located mainly in the south and several minor waterways which flow intermittently and continue into South Australia. Groundwater is the most significant resource in the basin.

Figure 6-51 Map of the Millicent Coast basin



6.27 Millicent Coast basin

6.27.1 Water resources overview

In 2015–16, rainfall throughout most of the Millicent Coast basin was between 60% and 80% of the long-term average, with areas in the north and south of the basin receiving 80% to 100%.

Groundwater is the main source of water supply in the Millicent Coast basin and this is covered by the West Wimmera groundwater management area. Section 7.6.1 has information about groundwater licences and use in this area.

Licensed diversions from unregulated streams were unrestricted throughout the year. No urban water use restrictions applied in the Millicent Coast basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-172 shows the responsibilities of the authorities within the Millicent Coast basin.

Table 6-172 Responsibilities for water resources management in the Millicent Coast basin

Authority	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Grampians Wimmera Mallee Water	Manages licensed diversions in the Millicent Coast basin	Supplies all towns including Kaniva and Edenhope	
Wimmera Catchment Management Authority			Manages waterways in the whole of the Millicent Coast basin

Water for the environment

The Millicent Coast basin contains numerous wetlands that depend on water. The largest waterway in the basin, the ephemeral Mosquito Creek, provides streamflows to support Ramsar-listed wetlands in South Australia including Bool and Hacks lagoons.

In 2015–16, water for the environment in the Millicent Coast basin comprised all water in the basin not allocated for consumptive use.

6.27.2 Surface water resources

6.27.2.1 Water balance

Limited information is currently available for surface water availability and use, so a water balance has not been included for the Millicent Coast basin.

6.27.2.2 Storages and flows

No reliable streamflow data exists for the Millicent Coast basin. As such, an estimate of the volume of water leaving the basin was not made. Any surface water not diverted flows to South Australia.

6.27.2.3 Entitlement volume and diversions

There are no bulk entitlements to surface water in the Millicent Coast basin. All water is diverted from unregulated streams under licences. At the end of 2015–16, the licensed volume totalled 4 ML and use was estimated to be 4 ML.

Entitlements in Millicent Coast include rights granted to individuals (take and use licences). Rights to water in the Millicent Coast basin are outlined in Table 6-173.

Table 6-173 Entitlement volumes in the Millicent Coast basin

Water entitlements	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	4
Total volume of water entitlements in the Millicent Coast basin	**4**

Allocation available under licences in the Millicent Coast basin for 2015–16 is presented in Table 6-174.

Table 6-174 Allocation account balance summary for the Millicent Coast basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Take and use licences – unregulated surface water	4	0	4	0

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Millicent Coast basin (Table 6-175). In previous years, information was not readily available within the Millicent Coast basin and therefore not reported on. The GIS data used to derive the capacity values for small catchment dams has been updated to provide a more accurate measure.

Table 6-175 Estimated small catchment dam information for the Millicent Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,789	895	n/a
Registered commercial and irrigation	5,612	4,714	n/a
Total	**7,401**	**5,609**	**8,067**

n/a: information not available.

6.27.3 Recycled water

Grampians Wimmera Mallee Water operates treatment plants within the Millicent Coast basin. As with 2014–15, 100% of wastewater was recycled in 2015–16. Wastewater from Edenhope was reused for a variety of urban and industrial purposes including pasture improvement and watering recreational facilities and parks. However, wastewater produced at Kaniva and Serviceton treatment plants was evaporated on-site and is not included in the table.

Table 6-176 highlights the volumes of water recycled in the Millicent Coast basin in 2015–16.

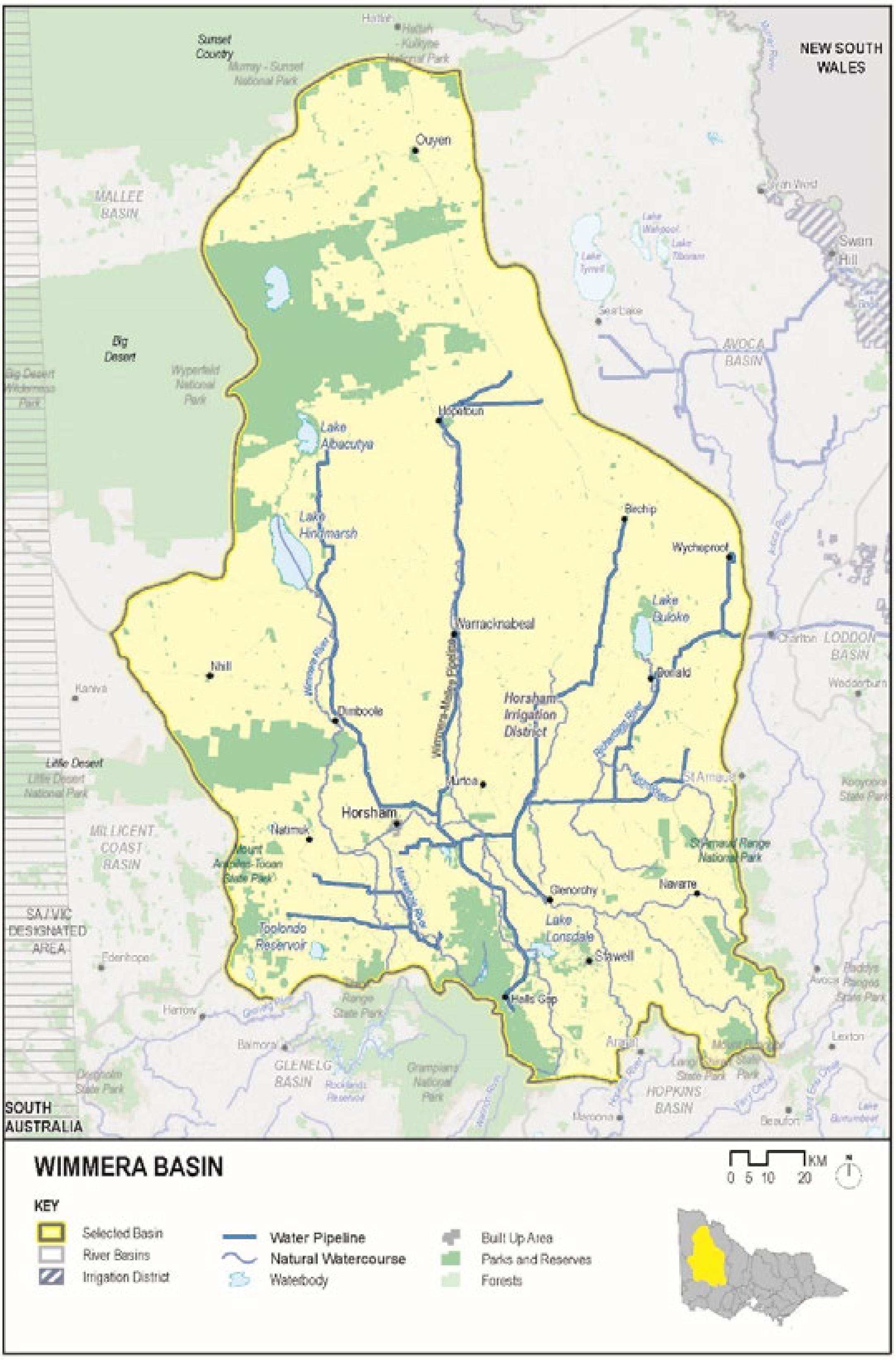
Table 6-176 Volume and use of recycled water in the Millicent Coast basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Edenhope	36	36	100%	36	0	0	0	0	0
Total 2015–16	**36**	**36**	**100%**	**36**	**0**	**0**	**0**	**0**	**0**
Total 2014–15	51	51	100%	51	0	0	0	0	0

6.28 Wimmera basin

The Wimmera basin (Figure 6-52) is the largest landlocked river basin in Victoria. The Wimmera River's headwaters are near Mt Cole in the Pyrenees Ranges. It flows westwards across the foothills of the Grampians and at Horsham it turns north and flows for about 150 km, terminating at Lake Hindmarsh.

Figure 6-52 Map of the Wimmera basin



6.28.1 Water resources overview

In 2015–16, rainfall across the Wimmera basin was generally between 60% and 80% of the long-term average. A small pocket in the south-east received 80% to 100% of the long-term average, and a pocket in the north received just 40% to 60%. Catchment inflows in the Wimmera basin in 2015–16 were 14% of the long-term average, which is the same as 2014–15. Storage levels in the Wimmera basin started the year at 37% and ended the year at 31% of total capacity.

Between August 2015 and June 2016, there was an irrigation ban on the Wimmera River. In March 2016, the towns of Stawell and Moyston within the Wimmera basin were placed on stage 2 water restrictions. Restrictions in Stawell were lifted in May 2016 and in Moyston in June 2016. All other towns within the basin remained on permanent water savings rules.

Table 6-177 shows the responsibilities of the authorities within the Wimmera basin.

Table 6-177 Responsibilities for water resources management in the Wimmera basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Grampians Wimmera Mallee Water	Manages the Wimmera–Glenelg supply system which delivers water to farms in the Wimmera basin (1)	Manages licensed diversions	Supplies most towns in the Wimmera basin (1) Provides bulk supply to some of Coliban Water's towns in the Loddon basin	Operates the Wimmera-Mallee water supply system Obliged to meet passing flow requirements
Central Highlands Water			Supplies Landsborough and Navarre	Obliged to meet passing flow requirements
Coliban Water			Supplies Borung, Korong Vale, Wedderburn and Wychitella	
Goulburn–Murray Water	Provides Grampians Wimmera Mallee Water with bulk supplies for domestic and stock use from the Goulburn system via the Waranga Main Channel			
Victorian Environmental Water Holder				Holds and manages environmental entitlements in the basin
Wimmera Catchment Management Authority				Manages waterways in the Wimmera River catchment
North Central Catchment Management Authority				Manages waterways in the east of the basin, including the Avon and Richardson rivers

Note:

(1) Also supplies farms and towns located in the Avoca and Mallee basins.

Water for the environment

The Wimmera River is a heritage river that depends on water for the environment. Important environmental assets in the Wimmera basin include platypus, freshwater catfish and river blackfish. Several priority river reaches have been identified and include:

- MacKenzie River reach 2, which contains regionally threatened populations of native fish (river blackfish, southern pygmy perch and mountain galaxias) and platypus (of which there are believed to be less than 10, with this the only population in the catchment)
- MacKenzie River reach 3, which contains the only known population of the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*) which has recently been classified under the Victorian *Flora and Fauna Guarantee Act 1988*. This species depends on flows in the MacKenzie River for its survival and recruitment
- lower Wimmera River, which is listed under the Heritage River Act and which flows into Lake Hindmarsh (listed as a nationally significant wetland) and Lake Albacutya (a Ramsar-listed wetland). It contains Victoria's only self-sustaining population of freshwater catfish (which is an FFG-Act-listed species). The Wimmera River also contains stocked populations of Murray cod and silver perch which are both FFG-Act-listed species.

In 2015–16, water for the environment in the Wimmera basin contained:

- the *Wimmera and Glenelg Rivers Environmental Entitlement 2010* comprising 41,560 ML of high-reliability entitlement held by the VEWH, which includes 1,000 ML of Wimmera–Mallee wetlands entitlement; the Wimmera and Glenelg Rivers Environmental Entitlement is shared with the Glenelg basin
- water set aside for the environment through the operation of passing flows released as a condition of consumptive bulk entitlements held by Grampians Wimmera Mallee Water and conditions on licensed diversions
- a supply by agreement under Grampians Wimmera Mallee Water's bulk entitlement with the Commonwealth Environmental Water Holder comprising 28,000 ML of low-reliability entitlement
- all other water in the basin not allocated for consumptive use.

A total of 5,142 ML of environmental water was used in the Wimmera basin in 2015–16; 142 ML of this was diverted off-stream while the remaining 5,000 ML was delivered in-stream.

6.28.2 Surface water resources

6.28.2.1 Water balance

The total volumes of water available and supplied from water resources in the Wimmera basin in 2015–16 are shown in Table 6-178.

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Wimmera basin, the water balance shows catchment inflows in 2015–16 were 612 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 54,420 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 10,042 ML less (rather than 612 ML). For more information, see Appendix E.

Table 6-178 Balance of surface water in the Wimmera basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	102,464	126,040
Volume in storage at end of year	85,800	102,464
Change in storage	**(16,664)**	**(23,576)**
Inflows		
Catchment inflows (1)	44,378	44,990
Rainfall on major storages	11,445	14,734
Transfer from Glenelg basin	14,576	21,336
Treated wastewater discharged back to river	0	0
Total inflows	**70,399**	**81,060**
Outflows		
Diversions		
Urban diversions and domestic and stock use	16,462	15,557
Diversions for irrigation	0	0
Licensed diversions from unregulated streams	387	186
Environmental water diversions to wetlands (2)	142	112
Supply to designated recreational lakes (3)	2,504	3,104
Usage from small catchment dams (4)	18,310	14,337
Total diversions	***37,805***	***33,296***
Losses		
Evaporation losses from major storages	29,973	35,269
Losses from small catchment dams (4)	14,099	8,642
In-stream infiltration to groundwater, flows to floodplain and evaporation	2,040	14,149
Total losses	***46,112***	***58,060***
Water passed at outlet of basin		
River outflows to Lake Buloke	0	0
River outflows to Lake Hindmarsh (measured at Tarranyurk)	3,146	13,280
Total water passed at outlet of basin	***3,146***	***13,280***
Total outflows	**87,063**	**104,636**

Note:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows, and the known inflows and net change in storage volume.

(2) The *Environmental Entitlement (Wimmera and Glenelg Rivers) 2010* provides the VEWH with up to 1,000 ML for wetlands supplied from the Wimmera–Mallee Pipeline each year. It supplies wetlands throughout the region that historically received water from the channel system before it was decommissioned.

(3) The *Bulk Entitlement (Wimmera and Glenelg Rivers) Conversion Order 2010* provides a 3,090 ML entitlement to supply 11 recreational lakes and weir pools from the Wimmera–Mallee Pipeline each year. It supplies recreational lakes throughout the region that historically received water from the channel system before it was decommissioned.

(4) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

6.28.2.2 Storages and flows

Levels for all major storages in the basin started the year at 102,464 ML and finished at 85,800 ML (26% of capacity) at the end of June 2016 (Table 6-179). The volume reported in the 'Catchment inflows less regulated releases' column in Table 6-179 is the balancing item for each storage. It represents the flows of water in or out of the storage that is not shown as rainfall or evaporation, and may include other minor components influencing the change in storage during the year.

Table 6-179 Storage volumes in the Wimmera basin

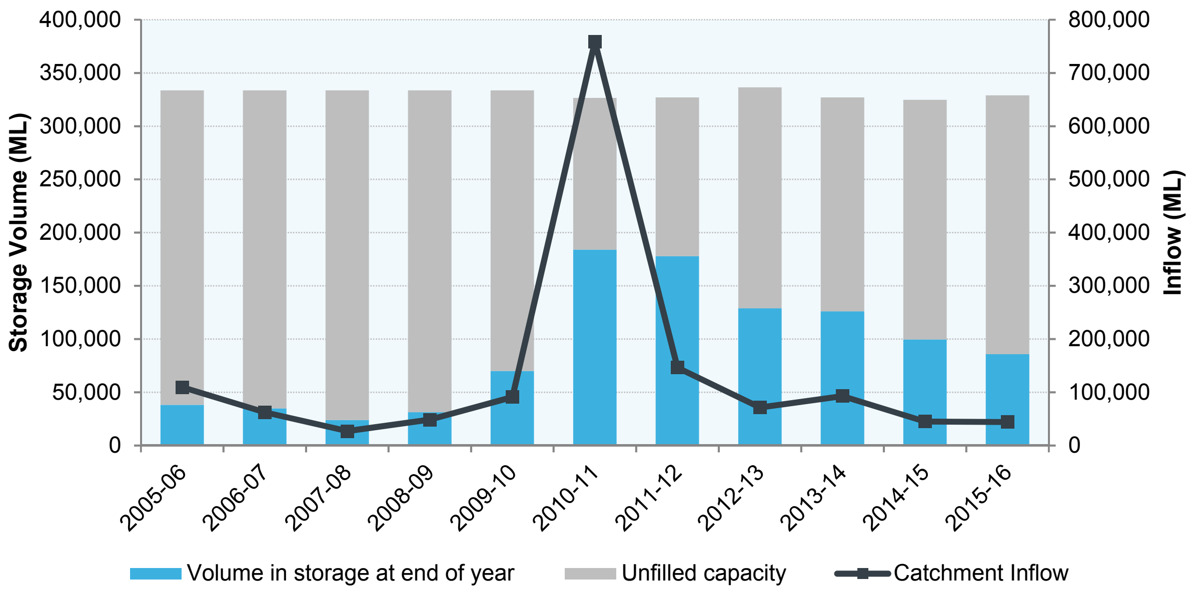
Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Dock Lake (1)	4,420	0	0	0	0	0
Fyans Lake	18,460	12,377	1,415	4,478	490	9,804
Green Lake	5,350	2,048	328	1,506	(396)	474
Lake Bellfield	78,560	51,168	2,188	3,987	(5,404)	43,965
Lake Lonsdale	53,300	333	402	145	(590)	0
Pine Lake (1)	62,000	0	0	0	0	0
Taylors Lake	27,060	9,140	920	4,209	6,696	12,547
Toolondo Reservoir	50,530	9,378	1,739	7,367	(370)	3,380
Wartook Reservoir	29,300	18,020	4,453	8,281	1,438	15,630
Total storage volumes	**328,980**	**102,464**	**11,445**	**29,973**	**1,864**	**85,800**

Notes:

(1) Dock Lake and Pine Lake are no longer operational storages and are only used in accordance with the storage management rules for flood mitigation purposes. Batyo Lake has been removed from this list as it is no longer an operational storage.

Catchment inflows were 14% of the long-term average of 316,400 ML. This is the same as 2014–15 (Figure 6-53). The volume of water flowing from the Wimmera basin into the terminal lakes in 2015–16 was 3,146 ML.

Figure 6-53 Storage volumes and catchment inflows in the Wimmera basin



Note:

(1) In earlier editions of the Victorian water accounts, the full capacities of Lake Lonsdale (65,480 ML) and Toolondo Reservoir (92,430 ML) were reported. The *Victorian Water Accounts 2015–16* use the operating capacities of these reservoirs.

6.28.2.3 Entitlement volumes and diversions

In the Wimmera basin, surface water is diverted by Central Highlands Water, Coliban Water, Grampians Wimmera Mallee Water, Wannon Water and licensed diverters, and is also harvested in small catchment dams. Entitlements in the Wimmera basin include rights granted to individuals (for example, water allowances and take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Wimmera basin are outlined in Table 6-180.

Under Grampians Wimmera Mallee Water's Wimmera and Glenelg rivers bulk entitlement, the water corporation operates the Wimmera–Mallee system headworks to supply water to towns and customers connected to the Wimmera–Mallee Pipeline and to supply entitlements held by Coliban Water, Wannon Water and the VEWH.

Under Grampians Wimmera Mallee Water's Willaura system bulk entitlement, the water corporation operates the Mt William system in the Wimmera basin to supply water to Willaura and to supply water to Wannon Water for Glenthompson.

Table 6-180 Entitlement volumes in the Wimmera basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Landsborough – Navarre) Conversion Order 2003	60
Bulk Entitlement (Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water) Conversion Order 2012 (1)	
Urban commitments – Grampians Wimmera Mallee Water	408
Bulk Entitlement (Willaura system – Wannon Water) Conversion Order 2012	58
Subtotal: Bulk Entitlement (Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water) Conversion Order 2012	**466**
Bulk Entitlement (Wimmera and Glenelg Rivers – Grampians Wimmera Mallee Water) Conversion Order 2010 (2)	
Water allowances	6,327
Urban commitments – Grampians Wimmera Mallee Water	26,392
Supply by agreements – pipeline	12,000
Supply by agreement – CEWH	28,000
Glenelg compensation flow	3,300
Recreation	3,090
Pipeline loss provision	2,960
Bulk Entitlement (Wimmera and Glenelg Rivers – Coliban Water) Conversion Order 2010	300
Bulk Entitlement (Wimmera and Glenelg Rivers – Wannon Water) Conversion Order 2010	2,120
Wimmera and Glenelg Rivers Environmental Entitlement 2010(3)	41,560
Subtotal: Bulk Entitlement (Wimmera and Glenelg Rivers – Grampians Wimmera Mallee Water) Conversion Order 2010	**126,050**
Take and use licences – unregulated surface water (4)	2,234
Total volume of water entitlements in the Wimmera basin	**128,810**

Notes:

(1) Under Grampians Wimmera Mallee Water's Willaura system bulk entitlement, the water corporation operates the Mt William system in the Wimmera basin to supply water to Willaura and to supply water to Wannon Water for Glenthompson. This bulk entitlement also includes the Elmhurst and Buangor systems, which are physically located in the Hopkins basin.

(2) Under Grampians Wimmera Mallee Water's Wimmera and Glenelg rivers bulk entitlement, the water corporation operates the Wimmera–Mallee system headworks to supply its own customers and the entitlements held by Coliban Water, Wannon Water, the VEWH and CEWH.

(3) The Wimmera and Glenelg Rivers Environmental Entitlement 2010 provides the VEWH with a 40,560 ML entitlement for rivers in the Wimmera and Glenelg basins and an entitlement of 1,000 ML for wetlands in the Wimmera and Mallee basins supplied via the Wimmera–Mallee Pipeline. The 1,000 ML entitlement supplies water to wetlands in the region that historically received water from the channel system before it was decommissioned.

(4) The total volume of licences in the Wimmera basin includes licences for irrigation as well as for domestic and stock purposes.

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-181. There were no irrigation diversions from unregulated streams in 2015–16; the diversion reported is an estimate of licensed domestic and stock use.

Table 6-181 Allocation account balance summary for the Wimmera basin

Water entitlement	Opening carryover (ML)	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)	Carryover carried forward (ML)
Landsborough – Navarre	-	60	0	0	60	-
Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water						
Urban commitments – Grampians Wimmera Mallee Water	-	408	0	195	213	-
Willaura system – Wannon Water	-	58	0	47	11	-
Diversion: Willaura, Elmhurst and Buangor systems – Grampians Wimmera Mallee Water				**242**		
Wimmera and Glenelg rivers – Grampians Wimmera Mallee Water						
Water allowances	-	6,327	0	2,237	4,091	-
Urban commitments – Grampians Wimmera Mallee Water [(1)]	75,711	6,035	(2,504)	12,532	11,960	54,749
Supply by agreements – pipeline	14,105	1,120	0	12	2,282	12,931
Supply by agreement - CEWH	0	0	0	0	0	0
Glenelg compensation flow	92	17	0	80	4	24
Recreation [(1)]	0	0	2,504	2,504		0
Pipeline loss provision	6,354	2,960	0	1,060	2,914	5,340
Wimmera and Glenelg Rivers – Coliban Water	185	48	100	226	16	91
Wimmera and Glenelg Rivers – Wannon Water	4,972	339	(100)	73	771	4,368
Wimmera and Glenelg Rivers Environmental Entitlement [(2)]	9,883	6,490	0	8,112	1,239	7,022
Diversion: Wimmera and Glenelg rivers [(3)]				**26,836**		
Take and use licences – unregulated surface water	-	2,234	0	387	1,847	-

Notes:

(1) In 2014–15, Grampians Wimmera Mallee Water traded 2,504 ML from its urban commitments to its recreation entitlement to support the supply of water to the ten nominated recreation lakes.

(2) Use against this environmental entitlement included 5,000 ML of water delivered instream in the Wimmera basin, 142 ML diverted to off-stream wetlands in the Wimmera and Mallee basins and 2,970 ML delivered in the Glenelg basin. The 5,000 ML delivered instream in the Wimmera basin is not included in the water balance in Table 6-178 as it does not reflect an actual diversion from the waterway.

(3) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Wimmera and Glenelg rivers system source bulk entitlement, excluding the environmental entitlement.

The estimated volume of water harvested from small catchment dams makes up a significant portion of total surface water diversions in the Wimmera basin (Table 6-182).

The capacity of small catchment dams for Wimmera basin is estimated based on GIS mapping. Estimated capacity values have been improved, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 9,155 ML more for small catchment dam capacity and an increase of 3,973 ML usage. For more information, see Appendix E.

Table 6-182 Estimated small catchment dam information for the Wimmera basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,883	11,942	n/a
Registered commercial and irrigation	7,582	6,369	n/a
Total	**31,465**	**18,310**	**32,409**

n/a: information not available.

6.28.3 Recycled water

Grampians Wimmera Mallee Water operates all treatment plants within the Wimmera basin. As with 2014–15, all wastewater was recycled in 2015–16. The nine plants that produced wastewater within the basin reused it for purposes including irrigation of pasture, horticulture and vineyards, and for urban and industrial uses.

Table 6-183 highlights the volumes of water recycled in the Wimmera basin in 2015–16.

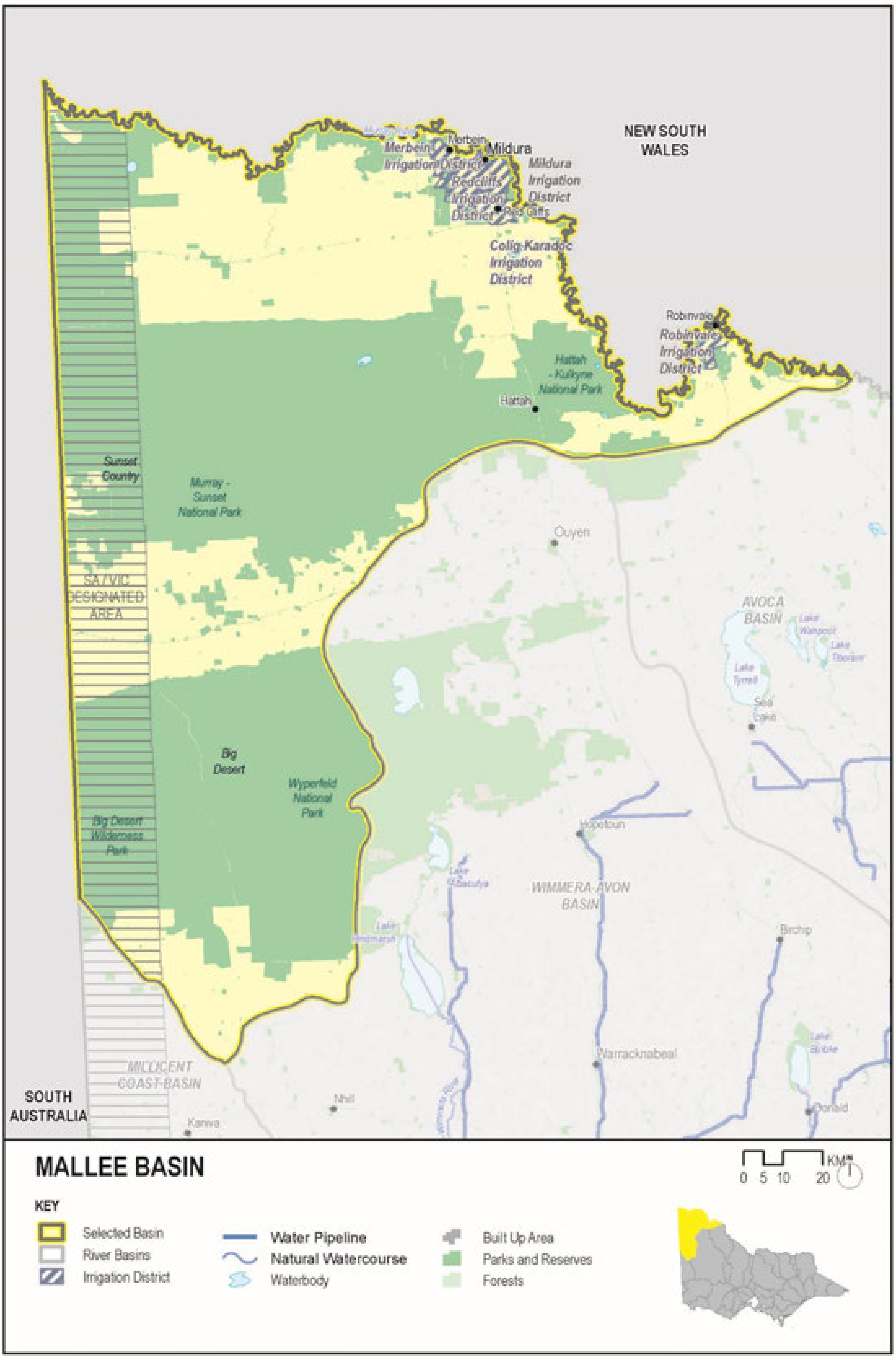
Table 6-183 Volume and use of recycled water in the Wimmera basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Birchip	31	31	100%	0	31	0	0	0	0
Dimboola	0	0	0%	0	0	0	0	0	0
Donald	45	45	100%	0	45	0	0	0	0
Halls Gap	67	67	100%	9	58	0	0	0	0
Hopetoun	0	0	0%	0	0	0	0	0	0
Horsham	774	774	100%	165	608	0	0	0	0
Jeparit	0	0	0%	0	0	0	0	0	0
Minyip	0	0	0%	0	0	0	0	0	0
Murtoa	25	25	100%	0	25	0	0	0	0
Natimuk	0	0	0%	0	0	0	0	0	0
Nhill	89	89	100%	0	89	0	0	0	0
Ouyen	0	0	0%	0	0	0	0	0	0
Rainbow	0	0	0%	0	0	0	0	0	0
Stawell	360	360	100%	250	109	0	0	0	0
Warracknabeal	46	46	100%	46	0	0	0	0	0
Wycheproof	20	20	100%	0	20	0	0	0	0
Total 2015–16	**1,457**	**1,457**	**100%**	**470**	**985**	**0**	**0**	**0**	**0**
Total 2014–15	1,475	1,475	100%	481	994	0	0	0	0

6.29 Mallee basin

The Mallee basin (Figure 6-54) has few well-defined waterways. While the Murray River runs along the northern boundary of the basin, for water accounting purposes it is only included in the water balance of the Murray basin (chapter 6.2).

Figure 6-54 Map of the Mallee basin



6.29 Mallee basin

6.29.1 Water resources overview

In 2015–16, most of the Mallee basin received between 60% and 80% of long-term average rainfall. A small area in the north-east received between 40% and 60%, and a pocket in the southern part of the basin received between 80% and 100% rainfall.

Almost all surface water used in the Mallee basin is sourced from other basins.

Between August 2015 and June 2016, there was an irrigation ban on the Avoca River. No urban water use restrictions applied in the Mallee basin in 2015–16, with all towns remaining on permanent water savings rules throughout the year.

Table 6-184 shows the responsibilities of the authorities within the Mallee basin.

Table 6-184 Responsibilities for water resources management in the Mallee basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Grampians Wimmera Mallee Water			Supplies water to Murrayville and Cowangie	
Lower Murray Water	Supplies water from the Murray River to the Millewa waterworks district, Carwarp and Yelta		Supplies Mildura and surrounding towns	
Mallee Catchment Management Authority				Manages waterways in the whole Mallee basin

Water for the environment

In 2015–16, water for the environment in the Mallee basin comprised all water in the basin not allocated for consumptive use.

Environmental water for wetlands in the Mallee basin including Living Murray icon sites is delivered through River Murray environmental entitlements and the Wimmera–Glenelg wetlands entitlement. Some wetlands in the Mallee source water from VEWH bulk entitlements in the Wimmera and Glenelg, via the Wimmera–Mallee Pipeline.

6.29.2 Surface water resources

6.29.2.1 Water balance

A water balance for the Mallee basin has not been presented. All surface water supplies are sourced from outside the basin.

6.29.2.2 Storages and flows

The Mallee basin has no well-defined streams other than the Murray River, which runs along the entire northern edge of the basin and has only a few small tributaries at various points close to the Murray. Since the Murray surface water reporting is covered in chapter 6.2, there is no surface water resource information presented for the Mallee basin.

There is no reliable estimate of surface flows in the Mallee basin to estimate the volume of water leaving the basin.

6.29.2.3 Entitlement volumes and diversions

No bulk entitlements are supplied from surface water sourced from within the Mallee basin. The volume diverted under bulk entitlements for water supplied to the Mallee basin is presented in the water accounts for adjacent river basins.

6.29.4 Small catchment dams

While there are some small catchment dams in the Mallee basin, no information about them is available and they are not a significant source of water in the basin. Given the lack of information, the capacity of small catchment dams is assumed to be zero.

6.29.3 Recycled water

There are no wastewater treatment plants within the Mallee basin.

6.30 Avoca basin

The Avoca basin (Figure 6-55) includes the Avoca River, small tributaries (such as Strathfillan Creek and Cherry Tree Creek) and minor watercourses which drain internally (such as Tyrrell Creek, which terminates in Lake Tyrrell). The Avoca River flows into the Kerang Lakes at Lake Bael Bael.

Figure 6-55 Map of the Avoca basin

6.30 Avoca basin

6.30.1 Water resources overview

Rainfall across the Avoca basin in 2015–16 was between 60% and 80% of the long-term average, with a small area in the middle of the basin receiving between 80% and 100% of average rainfall. Catchment inflows were 13% of the long-term average of 136,200 ML, which is slightly lower than the 16.5% reported in 2014–15. In the north of the basin, no outflows into the terminal lakes were recorded in 2015–16.

Between August 2015 and June 2016, there was an irrigation ban in the Avoca River. Towns in the Avoca basin are predominantly supplied by groundwater or by surface water from the Wimmera, Glenelg and Murray basins. Therefore, only a limited volume of surface water from within the basin is used for urban supply. In March, Grampians Wimmera Mallee Water applied stage 4 restrictions on 10 towns to restrict demand due to water quality issues resulting from a blue-green algae bloom on the Murray River. Stage 4 restrictions were in place for two weeks. All other towns in the basin remained on permanent water saving rules throughout the year. Licensed surface water users were unrestricted during the year.

Table 6-185 shows the responsibilities of the authorities within the Avoca basin.

Table 6-185 Responsibilities for water resources management in the Avoca basin

Authority	Irrigation and rural water supply	Licensing	Urban water supply	Storage management; waterway management; environmental obligations
Central Highlands Water			Supplies towns in the southern part of the Avoca basin including Avoca and Redbank	Obliged to meet passing flow requirements
Grampians Wimmera Mallee Water	Provides domestic and stock supplies to farms via the Wimmera–Mallee Channel system, the Northern Mallee Pipeline, the western end of the Waranga Western Channel and diversions from rivers	Manages licensing	Supplies towns in the northern part of the Avoca basin including Quambatook, St Arnaud, Charlton and Sea Lake (1)	
Goulburn–Murray Water	Supplies water from the Goulburn basin in bulk to Grampians Wimmera Mallee Water for domestic and stock use via the Waranga Main Channel		Supplies water from the Goulburn basin in bulk to Grampians Wimmera Mallee Water for towns via the Waranga Main Channel and to Quambatook via the Normanville supply system	
North Central CMA				Manages waterways in the Avoca basin

Note:

(1) Water for these towns is sourced from outside the Avoca basin.

Water for the environment

In 2015–16, water for the environment in the Avoca basin comprised:

- water set aside for the environment through flow-sharing arrangements set out in consumptive bulk entitlements held by Central Highlands Water
- water set aside for the environment through the operation of passing flow conditions on licensed diversions
- all other water in the basin not allocated for consumptive use.

6.30.2 Surface water resources

6.30.2.1 Water balance

The total volumes of water available and supplied from water resources in the Avoca basin in 2015–16 are shown in Table 6-186. No storage information is recorded in the water balance as there are no major on-stream storages in the Avoca basin.

There are no known inflows into the Avoca basin; the total inflows reported is an assumed amount equal to the sum of known and estimated outflows. Urban diversion and licensed diversion volumes were similar to 2014–15 volumes and represent a small proportion of the total water consumption in the basin. Volumes recorded for surface water availability and usage in 2015–16 remained similar to 2014–15 (Table 6-186).

Due to updated data for small catchment dam capacity values, the change in catchment inflow volume in the water balance compared to the previous year may be exaggerated. This change reflects both the improved estimation of small catchment dams and the decreased catchment inflow overall within the basin. In the Avoca basin, the water balance shows catchment inflows in 2015–16 were 4,130 ML less than in 2014–15. If the updated small catchment dam capacity values were applied to the 2014–15 water balance, catchment inflow would have been reported as 18,357 ML. Therefore, a more comparable indication of the difference in water availability from 2014–15 to 2015–16 is 21 ML less (rather than 4,130 ML). For more information, see Appendix E.

Table 6-186 Balance of surface water in the Avoca basin

Water account component	2015–16 (ML)	2014–15 (ML)
Major on-stream storage		
Volume in storage at start of year	-	-
Volume in storage at end of year	-	-
Change in storage	**-**	**-**
Inflows		
Catchment inflows [(1)]	18,377	22,507
Rainfall on major storages	-	-
Treated wastewater discharged back to river	0	0
Total inflows	**18,377**	**22,507**
Outflows		
Diversions		
Urban diversions	23	34
Licensed diversions from unregulated streams	40	9
Usage from small catchment dams [(2)]	9,765	12,693
Total diversions	***9,828***	***12,736***
Losses		
Evaporation losses from major storages	-	-
Losses from small catchment dams [(2)]	8,549	9,772
In-stream infiltration to groundwater, flows to floodplain and evaporation [(3)]	n/a	n/a
Total losses	***8,549***	***9,772***
Water passed at outlet of basin		
Avoca River flows at Sandhill Lake Road (outflows to terminal lakes)	0	0
Avoca River overflows from the terminal lakes to the Kerang Lakes	0	0
Total water passed at outlet of basin	***0***	***0***
Total outflows	**18,377**	**22,508**

Notes:

(1) Catchment inflows is the balancing item in this water balance. It is the difference between the total outflows and the known inflows.

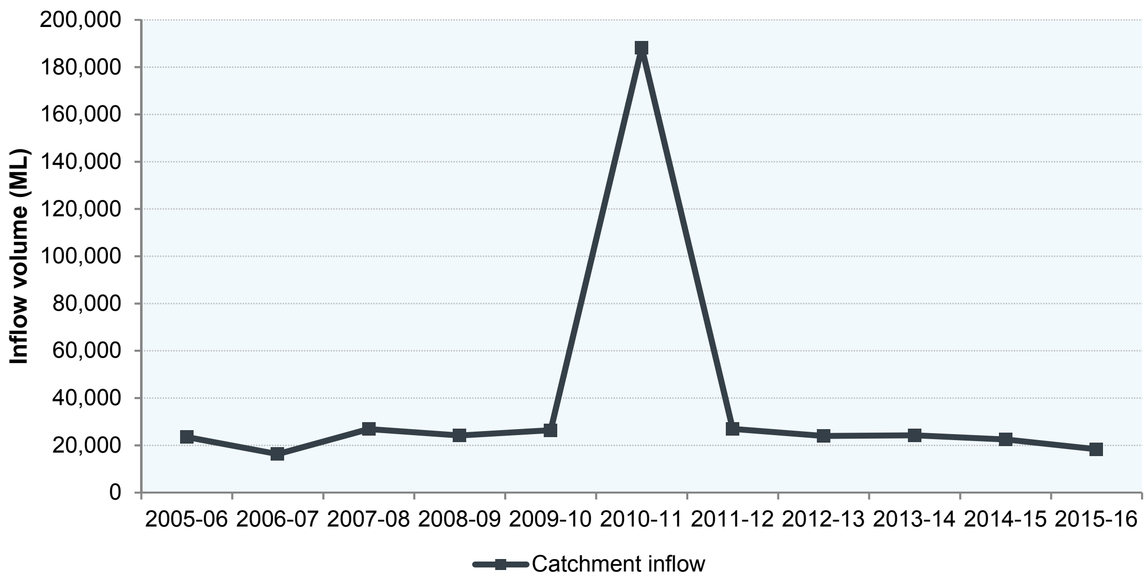
(2) GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. This has resulted in changes to the amount used and losses associated with small catchment dams in this year's accounts compared to last year's accounts. See Appendix E for further detail.

(3) In-stream infiltration not available due to poor-quality water flow data.

6.30.2.2 Storages and flows

Catchment inflows were 13% of the long-term average of 136,200 ML, which is slightly lower than in 2014–15. This is similar to the previous year's inflows (Figure 6-56). As with the previous year, no water flowed into the terminal lakes (Lake Bael Bael and The Marsh). There are no major storages in the Avoca basin.

Figure 6-56 Catchment inflows in the Avoca basin



6.30.2.3 Entitlement volumes and diversions

In the Avoca basin, water is diverted by Central Highlands Water and licensed diverters, and harvested in small catchment dams. The total volume of take and use licences in the Avoca basin includes licences for irrigation as well as for domestic and stock purposes. Entitlements include rights granted to individuals (take and use licences) and rights granted to authorities (for example, bulk entitlements granted to water corporations or environmental entitlements granted to the VEWH). Rights to water in the Avoca basin are outlined in Table 6-187.

Table 6-187 Entitlement volumes in the Avoca basin

Water entitlements	Annual entitlement volume (ML)
Bulk Entitlement (Amphitheatre) Conversion Order 2003	25
Bulk Entitlement (Avoca) Conversion Order 2003	233
Bulk Entitlement (Redbank) Conversion Order 2003	20
Take and use licences – unregulated surface water	2,689
Total volume of water entitlements in the Avoca basin	**2,967**

Allocation available under bulk entitlements and licences for 2015–16 is presented in Table 6-188. There were no diversions for irrigation in 2015–16; the water use reported for take and use licences is an estimate of licensed domestic and stock use (Table 6-188).

Table 6-188 Allocation account balance summary for the Avoca basin

Water entitlement	Allocation issued (ML)	Net trade in / (out) (ML)	Water use (ML)	End of season forfeitures (ML)
Amphitheatre	25	0	8	17
Avoca	233	0	16	218
Redbank	20	0	0	20
Take and use licences – unregulated surface water	2,689	0	40	2,649

The estimated volume of water harvested from small catchment dams represents the largest diversion of water in the Avoca basin (Table 6-189).

The capacity of small catchment dams for Avoca basin is estimated based on GIS mapping. Estimated capacity values have been updated, providing a more accurate measure of usage and harvested volumes for the 2015–16 reporting period. This has resulted in a reporting change of 3,578 ML less for small catchment dam capacity and a decrease of 2,928 ML usage. For more information, see Appendix E.

Table 6-189 Estimated small catchment dam information for the Avoca basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,285	5,143	n/a
Registered commercial and irrigation	5,503	4,623	n/a
Total	**15,788**	**9,765**	**18,314**

n/a: information not available.

6.30.3 Recycled water

Grampians Wimmera Mallee Water and Central Highlands Water operate treatment plants within the Avoca basin. As with 2014–15, 100% of wastewater was recycled in 2015–16. The recycled water was used for urban, industrial and agricultural purposes.

Table 6-190 highlights the volumes of water recycled in the Avoca basin in 2015–16.

Table 6-190 Volume and use of recycled water in the Avoca basin

Wastewater treatment plant	Volume produced (ML)	Volume recycled (ML)	Percent recycled	Type of end use (ML)				Volume discharged to the environment (ML)	Volume of other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Avoca	37	37	100%	0	37	0	0	0	0
Charlton	0	0	0%	0	0	0	0	0	0
Sea Lake	0	0	0%	0	0	0	0	0	0
St Arnaud	96	96	100%	47	48	0	0	0	0
Total 2015–16	**133**	**133**	**100%**	**47**	**85**	**0**	**0**	**0**	**0**
Total 2014–15	157	157	100%	38	119	0	0	0	0

7 Groundwater catchment accounts

7.1 Overview of methodology

7.1.1 Introduction

This methodology section outlines the basis for the information presented in the groundwater catchment accounts. As it explains some assumptions and limitations of the data in the accounts, it should be read in conjunction with the information in the catchment accounts.

Historically, information about groundwater resources in the Victorian water accounts was presented together with surface water resources according to river basin boundaries. In most cases, these boundaries did not properly align with the underlying groundwater systems and the assigned groundwater management units (GMUs). This presented some reporting difficulties. Groundwater volumes were apportioned according to the surface area of the GMU in a given basin. As the concentration of bores and groundwater use varies considerably in each GMU, apportioning groundwater entitlements and use by surface area is unlikely to be an accurate reflection of groundwater availability and use in particular areas.

In 2012, the Victorian Government developed a new framework for the management and reporting of groundwater resources. The framework comprises the groundwater basins and catchments that cover all groundwater resources in Victoria, as shown in Figure 1-3 in chapter 1. It aligns groundwater management boundaries with groundwater catchments, to enable management of connected groundwater resources and to reflect the geology beneath the ground. The framework was developed in collaboration with rural water corporations and stakeholders to enable consistent management of groundwater resources across the state.

Under the new framework, the boundaries for groundwater catchments, GMUs and groundwater systems are aligned. This allows the entitlements and use of groundwater in each GMU to be more accurately managed and reported. The *Victorian Water Accounts 2015–16* present the groundwater accounts by these groundwater catchment boundaries, consistent with Victoria's current approach to groundwater management.

The groundwater catchment accounts are compiled from information obtained from:

- responses to requests for data from water corporations, catchment management authorities, Department of Environment, Land, Water and Planning and major users of water
- hydrogeologic information from selected groundwater monitoring sites
- water corporations' groundwater catchment statements, annual reports and related documents.

7.1.2 Groundwater resources

Victoria's groundwater resources are contained in five major groundwater basins, and each groundwater basin has several groundwater catchments which are:

- Goulburn–Murray basin, which covers the Loddon, Campaspe, Goulburn–Broken, Ovens and Upper Murray groundwater catchments
- Wimmera–Mallee basin, which covers the Wimmera–Mallee, West Wimmera and Avoca groundwater catchments
- Otway–Torquay basin, which covers the Glenelg, Portland, Hopkins–Corangamite and Otway–Torquay groundwater catchments
- Central basins, several basins grouped for management purposes which cover the West Port Phillip Bay, East Port Phillip Bay, Westernport and Tarwin groundwater catchments
- Gippsland basin, which covers the East Gippsland, Central Gippsland, Moe and Seaspray groundwater catchments.

Groundwater in Victoria is managed through GMUs. A GMU may be classified as either a WSPA or a GMA. Areas that do not fall into these units are referred to as unincorporated areas (UAs) (as outlined in chapter 1).

Licensing is the fundamental basis for allocating groundwater. The total volume of groundwater that may be licensed in a GMU is referred to as the 'permissible consumptive volume' (PCV). PCVs are declared by the Minister for Water through an order published in the government gazette. Adaptive management occurs through groundwater management instruments including statutory groundwater management plans, local management plans, groundwater strategies, single-source urban water bulk entitlements and groundwater licences. All management instruments are developed in consultation with local stakeholders including customer groups, environmental representatives and relevant government agencies.

Further details about the groundwater management framework in Victoria is at www.delwp.vic.gov.au (search 'DELWP Managing groundwater').

7.1.2.1 Licensed groundwater volumes and use

This table reports the total volume of take and use licences held by individual customers in the catchment, which represents the total volume of water that could be extracted for the water year plus all licensed use. This total includes urban use and domestic and stock use where such use is included in a groundwater licence.

7.1.2.2 Number of domestic and stock bores and estimated use

This table presents the number of bores used for domestic and stock purposes in each GMU, together with the estimated groundwater use for this purpose. This use is permitted under section 8 of the Water Act, which grants private rights to take a small volume of water for domestic household and stock watering purposes from surface and groundwater under certain circumstances without a licence. Where domestic and stock use forms part of a groundwater licence, the estimated use is not presented in this table: it has been accounted for in the total licensed groundwater use (see chapter 7.1.2.1).

Estimated use has been calculated based on an assumption of 2 ML per bore per year in groundwater areas managed by Goulburn–Murray Water and Grampians Wimmera Mallee Water and 1.5 ML per bore per year in groundwater areas managed by Southern Rural Water (except for the Nepean GMA, which was estimated at 1 ML per bore per year).

The number of domestic and stock bores recorded for each GMU includes all bores registered in the groundwater management system that are less than 30 years old, as this is the expected average life of a bore. Bore depths (where recorded) have been taken into account to ensure that domestic and stock bores are assigned appropriately where GMUs overlap. To better account for domestic and stock bores in unincorporated areas, bores that are located spatially within a GMU, but which do not have a constructed depth within the GMU's depth range, are allocated to an unincorporated area.

7.1.2.3 Urban groundwater volumes and metered use

This table reports on take and use licences held by urban water corporations to supply towns within their service area. The volumes and metered use reported in this table reflect the portion of total groundwater volumes and use stated in chapter 7.1.2.1 that is attributable to urban supply. The volumes are not an additional resource or use in the catchment.

7.2 Goulburn–Murray groundwater basin

The Goulburn–Murray basin is located in north-east Victoria. It borders the Gippsland basin to the south-east, the Central and Otway–Torquay basins to the south and the Wimmera–Mallee basin to the west. The basin also forms part of the Murray River basin in Victoria.

The hydrogeology of the region can be broadly subdivided into two distinct geological regions: southern highlands of bedrock with sedimentary valleys and the northern plains with layers of sedimentary aquifers.

In the south, the highlands feature exposed bedrock and valleys of eroded material that form the Quaternary Aquifer. This thin, shallow aquifer is comprised of sand, colluvium, fluvial sands, gravels, clay and silts and is found in upland valleys such as Alexandra, Yea and Flowerdale. Water is also held in the mesozoic and palaeozoic basement rock, which is comprised of sedimentary fractured rock. Basement rock is close to the surface near Jamieson, Mansfield, Marysville, Kilmore and Seymour and to the east is increasingly buried deeper. These groundwater resources are generally low-yielding.

In the north, the plain of the Goulburn–Murray basin gradually thickens into several geological layers.

- The Upper Tertiary Quaternary Aquifer (UTQA) of the Shepparton formation is made of layered clay, sands and silt. It appears north of Seymour and runs to Nathalia, Barmah and Numurkah. Along the Murray, the UTQA overlies the Calvil Formation Upper Tertiary Aquifer fluvial, containing fluvial sand, gravel and clay. These are major groundwater resources in the region.
- The Lower Tertiary Aquifers of the Renmark formation appear in pockets to the north, near Nathalia and Barmah. They comprise sand, gravel, clay, silt and minor coal. These are major groundwater resources in the region.
- Cretaceous Permian sediments made of fractured rock, sand and minor coal. They appear from Shepparton to parts of the north near Nathalia and Numurkah.
- Mesozoic and palaeozoic basement rock, which comprises sedimentary fractured rock.

7.2 Goulburn–Murray groundwater basin

7.2.1 Upper Murray groundwater catchment

The Upper Murray groundwater catchment is located in north-east Victoria (Figure 7-1) and lies within part of the Murray River basin. The Upper Murray groundwater catchment extends from the Victorian Alps to the Murray River. Major rural centres in the catchment include Omeo, Tallangatta and Corryong.

Figure 7-1 Map of the Upper Murray groundwater catchment

7.2.1.1 Groundwater resources overview

Groundwater resources in the Upper Murray groundwater catchment are managed by Goulburn–Murray Water, which carries out the development and implementation of groundwater management plans. Goulburn–Murray Water also issues licences for groundwater use and bore construction. The Upper Murray catchment is part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Upper Murray groundwater catchment contains the Upper Murray and Kiewa GMAs (for which plans were approved in June 2014), a small part of the Upper Ovens WSPA. Groundwater resources supply licence entitlements, domestic and stock use and the town of Dinner Plain.

The groundwater level trend in Upper Ovens WSPA was categorised as declining for the first nine months and was stable towards the end of 2015–16. Insufficient observation bores were available to obtain a trend for the Kiewa and Upper Murray GMAs.

7.2.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-1. Groundwater use slightly increased in 2015–16, compared to 2014–15.

Table 7-1 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Kiewa GMA	<= 200 m	3,101	391	74
Upper Murray GMA	<= 200 m	3,403	511	449
Unincorporated area	-	0	0	79
Total		**6,504**	**902**	**602**

An estimate of domestic and stock groundwater use is provided in Table 7-2. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-1.

Table 7-2 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Kiewa GMA	292	584
Upper Murray GMA	205	410
Unincorporated area	0	0
Total	**497**	**994**

Groundwater is used to provide urban water supply to Dinner Plains. The licensed entitlements and metered use for these supplies are presented in Table 7-3.

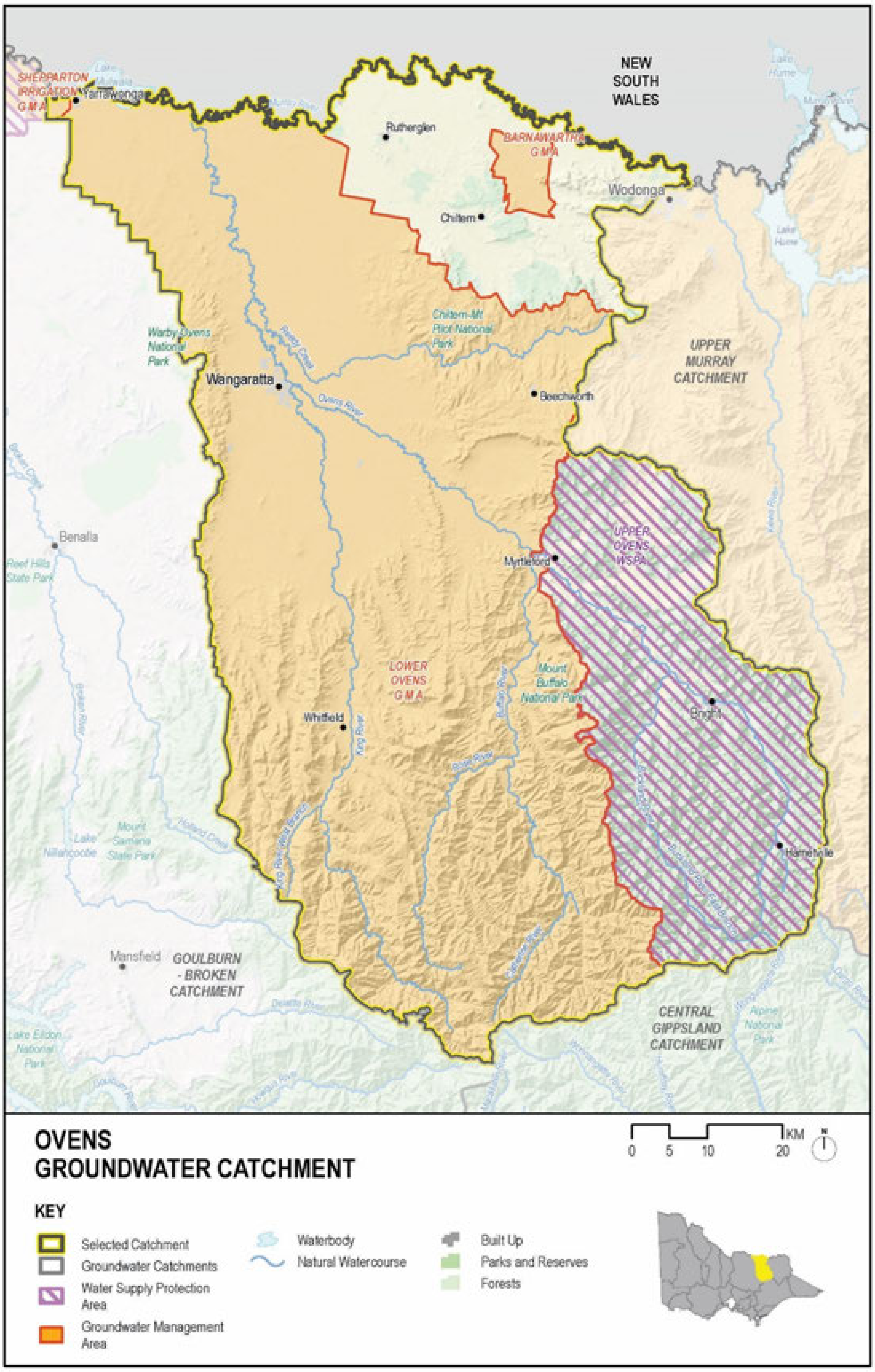
Table 7-3 Urban groundwater use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Dinner Plains	120	47	0
Total	**120**	**0**	**0**

7.2.2 Ovens groundwater catchment

The Ovens groundwater catchment is located in northern Victoria (Figure 7-2). It extends from the Murray River in the north to the Great Dividing Range in the south, and contains the Kiewa and Ovens river basins.

Figure 7-2 Map of the Ovens groundwater catchment



7.2.2.1 Groundwater resources overview

Groundwater resources in the Ovens groundwater catchment are managed by Goulburn–Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn–Murray Water also issues licences for groundwater use and bore construction. The Ovens groundwater catchment is part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Ovens groundwater catchment contains the Barnawartha GMA, Lower Ovens GMA, Upper Ovens WSPA and unincorporated areas. The *Upper Ovens WSPA Management Plan* manages groundwater in the unconsolidated sedimentary aquifer as a connected system with surface water. Groundwater resources supply licence entitlements and domestic and stock use. Groundwater is also used as a backup supply for Wangaratta and six other towns in the area.

In 2015–16, the groundwater level trend in the Lower Ovens GMA was classified as declining and Upper Ovens WSPA was categorised as declining-to-stable. Insufficient observation bores were available to determine a trend for Barnawartha GMA.

7.2.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-4. Groundwater use increased by about 10% in 2015–16, compared to the previous year.

Table 7-4 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits(m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Barnawartha GMA	All depths	375	9	0
Lower Ovens GMA	All depths	19,905	5,494	4,722
Upper Ovens WSPA	All depths	3,764	973	674
Unincorporated area	-	2,298	905	1,153
Total		**26,342**	**7,381**	**6,549**

An estimate of domestic and stock groundwater use is provided in Table 7-5. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-4.

Table 7-5 Number of domestic and stock bores and estimated use

WSPA/GMA (1)	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Barnawartha GMA	23	46
Lower Ovens GMA	1,534	3,068
Upper Ovens WSPA	264	528
Unincorporated area	125	250
Total	**1,946**	**3,892**

Notes:
(1) Although a very small portion of the Shepparton Irrigation GMA is located in the north-west of the Ovens catchment, no domestic and stock bores were reported to have been in this area in 2015–16.

Groundwater in the Ovens groundwater catchment is an available urban water option supply for Barnawartha and as a backup urban water supply for Bright, Chiltern, Moyhu, Myrtleford, Springhurst and Wangaratta. North East Water has a licence to supply Bright with a permanent entitlement volume of zero. This license enables temporary (seasonal allocation) trades for emergency supplies when required. In 2015–16, trading was used to secure 75 ML for use in Bright. The volume of licensed entitlements and metered use for these groundwater supplies are provided in Table 7-6.

In 2015–16, no groundwater was supplied to Barnawartha, Chiltern and Springhurst. Urban groundwater supply to Moyhu and Wangaratta in 2015–16 increased from the previous year, while decreasing by a third in Bright.

Table 7-6 Urban groundwater volumes and metered use

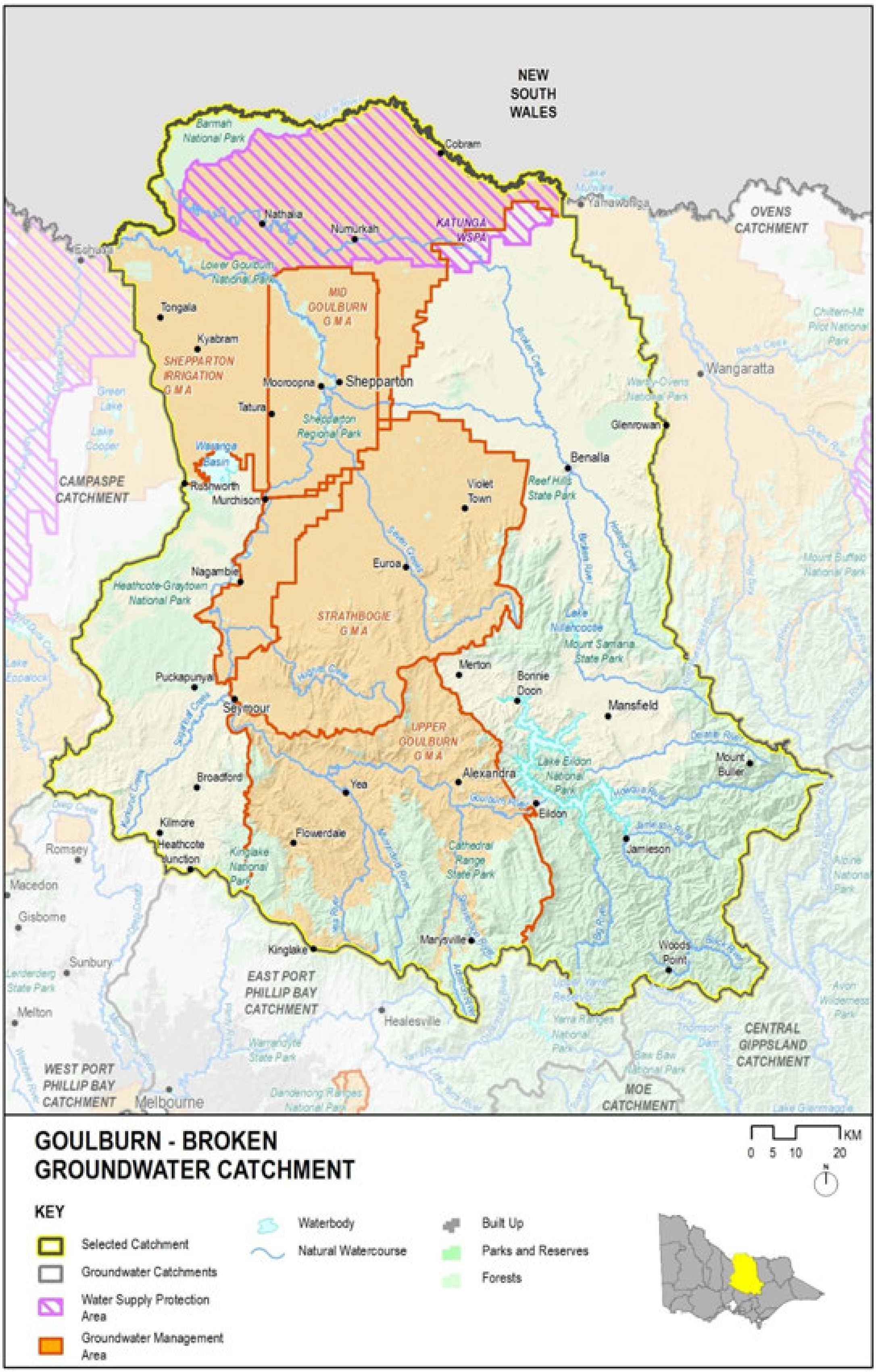
Town supplied (1)	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Barnawartha	293	0	0
Bright	0 (2)	9	27
Chiltern	25	0	0
Moyhu	15	15	0
Springhurst	20	0	0
Wangaratta	665	69	46
Total	**1,018**	**93**	**73**

Notes:
(1) The licence for Myrtleford was surrendered during the year before any water was used under the licence.
(2) A trade of 75 ML of seasonal allocation occurred to enable metered water use.

7.2.3 Goulburn–Broken groundwater catchment

The Goulburn–Broken groundwater catchment is located in northern Victoria (Figure 7-3) and contains the Goulburn and Broken river basins. The hydrogeology of this groundwater catchment includes two distinct geological regions — the highlands of bedrock with sedimentary valleys in the south and the plains with layers of sedimentary aquifers in the north.

Figure 7-3 Map of the Goulburn–Broken groundwater catchment



7.2.3.1 Groundwater resources overview

Groundwater resources in the Goulburn–Broken groundwater catchment are managed by Goulburn–Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn–Murray Water also issues licences for groundwater use and bore construction, as well as for surface water diversions. The Goulburn–Broken groundwater catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Goulburn–Broken groundwater catchment contains the Mid-Goulburn GMA, most of the Shepparton Irrigation GMA (which also extends into the Campaspe groundwater catchment), the Strathbogie GMA, the Upper Goulburn GMA, the Katunga WSPA and unincorporated areas. The management plan for the Shepparton Irrigation GMA was approved in June 2015.

Groundwater resources supply irrigation, domestic and stock use, and urban use in Goorambat, Katunga and Strathmerton.

In 2015–16, the groundwater level trends in the Mid-Goulburn GMA were categorised as stable-to-declining, the Shepparton Irrigation GMA alternated between declining and rising but was stable at June 2016, and Katunga WSPA was categorised as declining. Insufficient observation bores were available to determine a trend for the Strathbogie and Upper Goulburn GMAs.

7.2.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-7. Extractions from the Katunga WSPA were limited to 70% of licensed entitlement volume in 2015–16.

Groundwater use was more than 50% lower in 2015–16 than in 2014–15, with the largest decrease in extraction in the Shepparton Irrigation GMA.

Table 7-7 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Mid-Goulburn GMA	Zone 1070: > 25 Zone 1071: All depths	12,470	4,214	2,682
Shepparton Irrigation GMA	<= 25	175,195	77,858	64,170
Strathbogie GMA	<= 200 m	1,463	556	169
Upper Goulburn GMA	<= 200 m	6,057	1,087	424
Katunga WSPA	> 25	60,405	34,566	26,598
Unincorporated area	-	6,262	2,796	3,273
Total		**261,852**	**121,077**	**97,316**

An estimate of domestic and stock groundwater use is provided in Table 7-8. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-7.

Table 7-8 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Mid-Goulburn GMA	121	242
Shepparton Irrigation GMA	1,242	2,484
Strathbogie GMA	275	550
Upper Goulburn GMA	532	1,064
Katunga WSPA	752	1,504
Unincorporated area	937	1,874
Total	**3,859**	**7,718**

Notes:

(1) The management plan for the Shepparton Irrigation GMA was approved on 3 June 2015.

Groundwater is used to provide urban water supply to Goorambat, Katunga and Strathmerton. The licensed entitlements and metered use for these supplies are presented in Table 7-9. Groundwater use for all towns increased in 2015–16, compared to 2014–15.

Table 7-9 Urban groundwater volumes and metered use

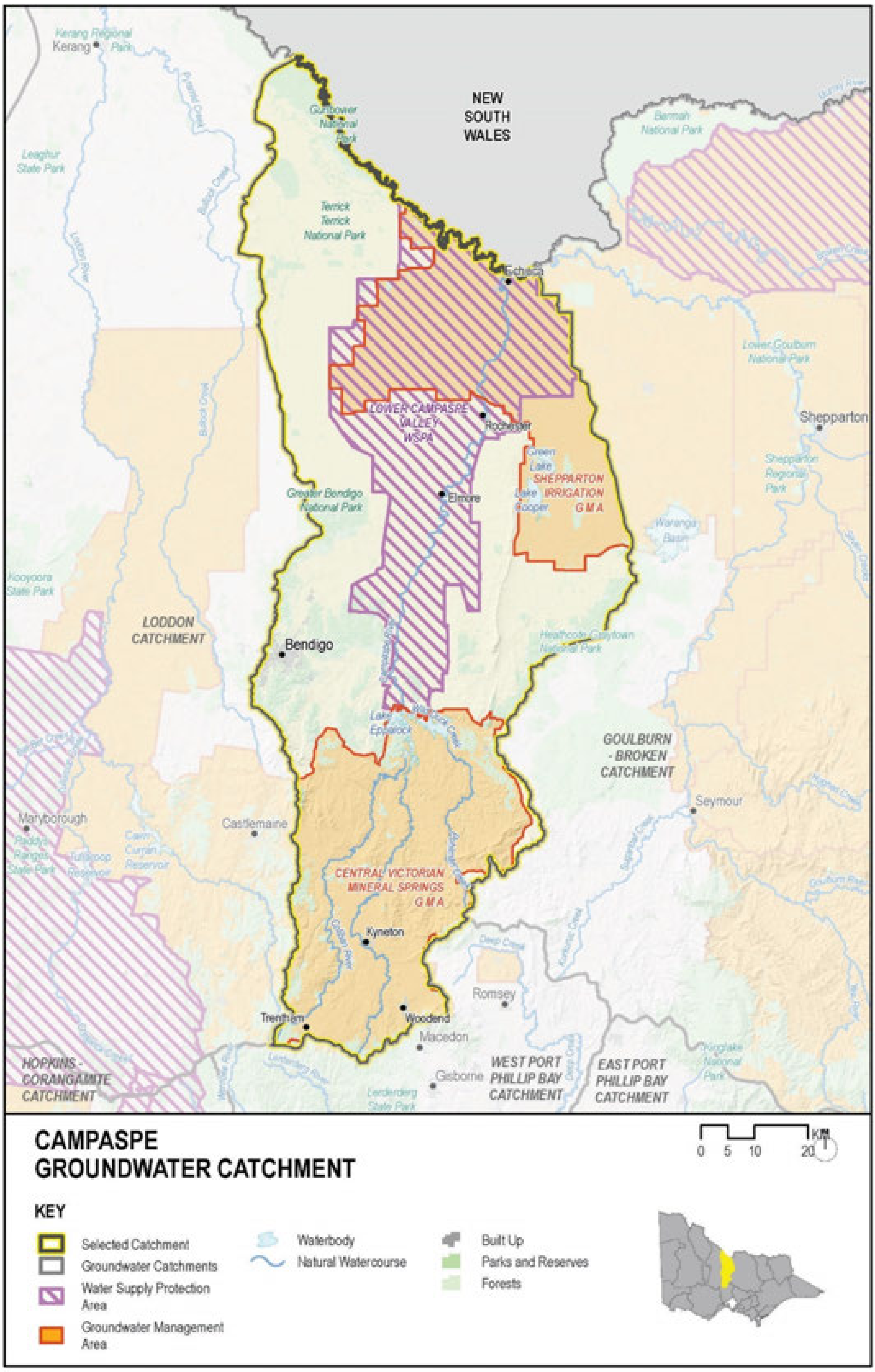
Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Goorambat	24	13	11
Katunga	110	55	42
Strathmerton	730	55	0
Total	**864**	**122**	**53**

7.2 Goulburn–Murray groundwater basin

7.2.4 Campaspe groundwater catchment

The Campaspe groundwater catchment is located in northern Victoria (Figure 7-4) and corresponds with the Campaspe river basin. The catchment extends from the Murray River near Echuca in the north to the Great Dividing Range at Woodend and Trentham in the south.

Figure 7-4 Map of the Campaspe groundwater catchment



7.2.4.1 Groundwater resources overview

Groundwater resources in the Campaspe groundwater catchment are managed by Goulburn–Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn–Murray Water also issues licences for groundwater use and bore construction, as well as for surface water diversions. The Campaspe groundwater catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

A local management plan (approved by Goulburn–Murray Water) applies to the Central Mineral Springs GMA and the Shepparton Irrigation Region GMA. The *Lower Campaspe Valley WSPA Management Plan* (approved by the Minister for Water) operates in the Campaspe groundwater catchment.

The Campaspe groundwater catchment contains the Lower Campaspe Valley WSPA, part of the Shepparton Irrigation GMA (which extends into the Goulburn–Broken catchment), part of the Central Victorian Mineral Springs GMA (which extends into the Loddon catchment), and unincorporated areas. Groundwater resources supply irrigation, domestic and stock use and the towns of Elmore and Trentham. The management plan for the Shepparton Irrigation GMA was approved in June 2015.

In 2015–16, the groundwater level trend in the Lower Campaspe Valley WSPA was categorised as declining, while insufficient observation bores were available to determine a trend for Central Victorian Mineral Springs GMA. The trend in the Shepparton Irrigation GMA alternated between declining and rising, but was stable at June 2016.

7.2.4.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the Campaspe catchment are presented in Table 7-10. Groundwater use in 2015–16 was similar to 2014–15.

Table 7-10 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Central Victorian Mineral Springs GMA	See note 1	2,237	535	0
Lower Campaspe Valley WSPA	All depths	55,860	44,994	36,057
Shepparton Irrigation GMA	<= 25	16,507	1,590	7,886
Unincorporated area	-	4,637	880	1,746
Total		**79,241**	**47,999**	**45,688**

Notes:
(1) All formations to 200 m below the surface, or 50 m below the base of the basalt or deep lead, whichever is the greater.

An estimate of domestic and stock groundwater use is provided in Table 7-11. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-10.

Table 7-11 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Central Victorian Mineral Springs GMA	939	1,878
Lower Campaspe Valley WSPA	535	1,070
Shepparton Irrigation GMA	125	250
Unincorporated area	261	522
Total	**1,860**	**3,720**

Note:
(1) The management plan for the Shepparton Irrigation GMA was approved on 3 June 2015.

In the Campaspe catchment, groundwater is an option for urban water supply to Elmore and Trentham. Urban groundwater use in the catchment increased in 2015–16, compared to 2014–15. The licensed entitlements and metered use for this supply are provided in Table 7-12.

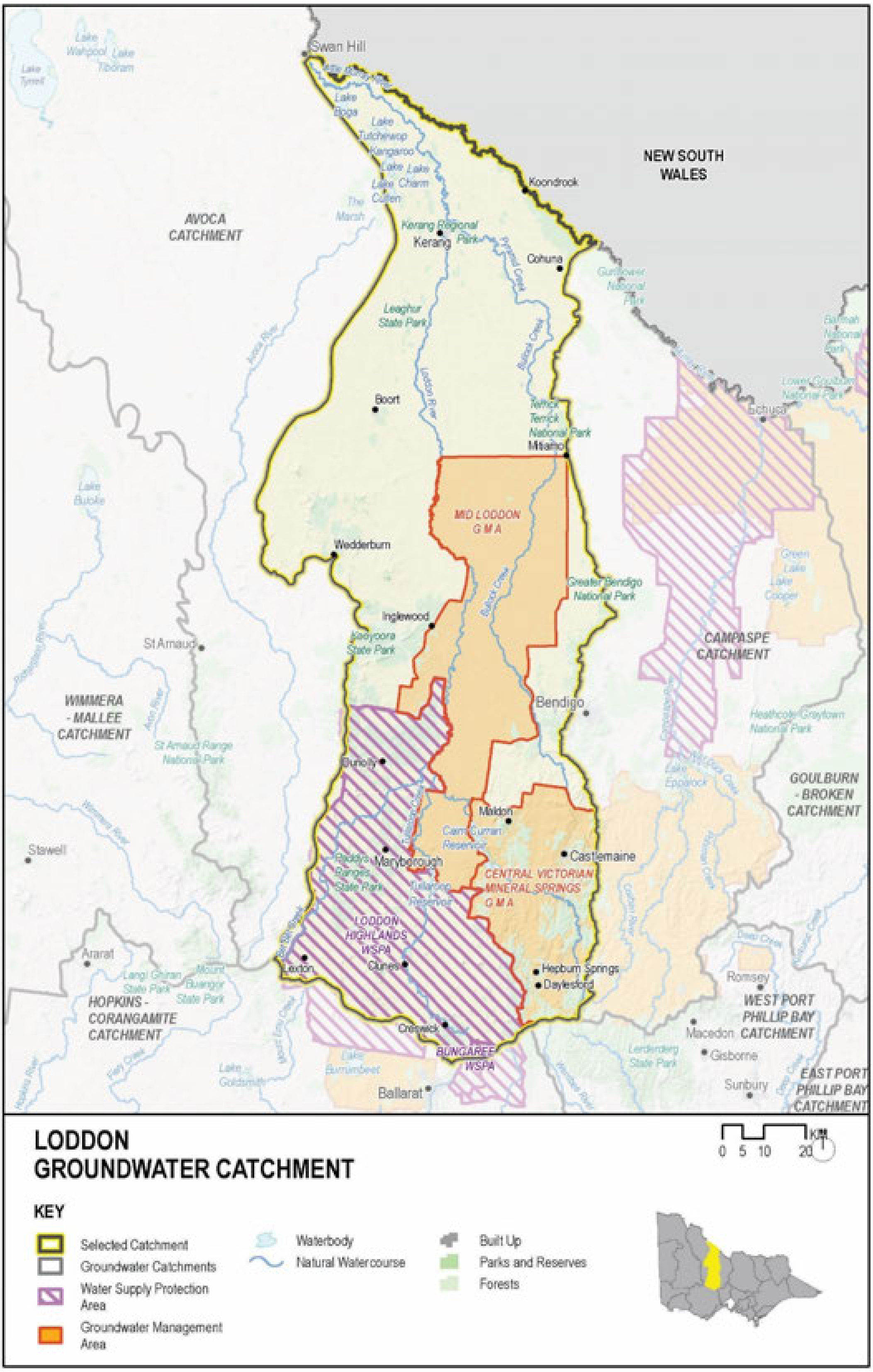
Table 7-12 Urban groundwater use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Elmore	284	148	122
Trentham	48	42	20
Total	**332**	**190**	**142**

7.2.5 Loddon groundwater catchment

The Loddon groundwater catchment is located in northern Victoria (Figure 7-5) and broadly corresponds with the Loddon river basin. The catchment covers an area between Creswick and Swan Hill. Neighbouring groundwater catchments are Avoca to the west, Hopkins–Corangamite and West Port Phillip to the south and Campaspe to the east.

Figure 7-5 Map of the Loddon groundwater catchment



7.2.5.1 Groundwater resources overview

Groundwater resources in the Loddon groundwater catchment are managed by Goulburn–Murray Water, which is responsible for developing and implementing groundwater management plans. Goulburn–Murray Water also issues licences for groundwater use and bore construction, as well as for surface water licensed diversions. The Loddon catchment is part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Loddon groundwater catchment contains all of the Mid-Loddon GMA, most of Loddon Highlands WSPA (which extends into the Hopkins–Corangamite catchment), part of the Central Victorian Mineral Springs GMA (which extends into the Campaspe catchment), and unincorporated areas. Groundwater resources supply licence entitlements, domestic and stock use and six towns in the area.

The groundwater level trend in 2015–16 was categorised as declining for the Mid-Loddon GMA and Loddon Highlands WSPA. Insufficient observation bores were available to determine a trend in the Central Victorian Mineral Springs GMA.

7.2.5.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-13. Groundwater use in the catchment was about 45% lower in 2015–16 than it was in the previous year.

Table 7-13 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Central Victorian Mineral Springs GMA	See note 1	2,739	534	395
Mid-Loddon GMA	All depths	33,927	25,249	17,165
Loddon Highlands WSPA	All depths	20,667	10,149	6,904
Unincorporated areas	-	4,569	64	339
Total		**61,902**	**35,996**	**24,803**

Note:

(1) All formations to 200 m below the surface, or 50 m below the base of the basalt or deep lead, whichever is the greater.

An estimate of domestic and stock groundwater use is provided in Table 7-14. A number of groundwater licences also incorporate domestic and stock use: in these cases, the use from these bores is reported in the licensed volume in Table 7-13.

Table 7-14 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Bungaree GMA	7	11
Central Victorian Mineral Springs GMA	505	1,010
Mid-Loddon GMA	326	652
Loddon Highlands WSPA	518	1,036
Unincorporated areas	107	214
Total	**1,463**	**2,923**

Note:

(1) Estimated domestic and stock use for Bungaree GMA is calculated using a factor of 1.5 ML per bore.

Groundwater is an urban water supply option for six towns within the catchment, though only about one-third of the licensed volume was used in 2015–16. The metered use was similar to the previous year. The licensed entitlements and metered use for urban groundwater supplies in the Loddon groundwater catchment are provided in Table 7-15.

Table 7-15 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Clunes	353	228	209
Daylesford	273	67	.01
Forest Hill	350	160	165
Learmonth	100	58	46
Maryborough (1)	565	32	122
Waubra	70	31	30
Total	**1,711**	**575**	**572**

Note:

(1) The licensed volume for Maryborough excludes a temporary trade of 506 ML.

7.3 Gippsland groundwater basin

The Gippsland groundwater basin is located in eastern Victoria and contains the East Gippsland, Central Gippsland, Seaspray and Moe groundwater catchments. It is a large sedimentary basin which extends offshore beneath Bass Strait.

The upper aquifers of the Gippsland basin occur along the river valleys, floodplains and near the coast. They consist of coarse sand and thick gravel sediments at shallow depths. They also feature the clay aquitard of the Haunted Hill Formation, which overlies most of the sedimentary basin. The upper aquifers occur at or near the ground surface, so they receive recharge directly from rainfall or floods, and they discharge to streams and lakes.

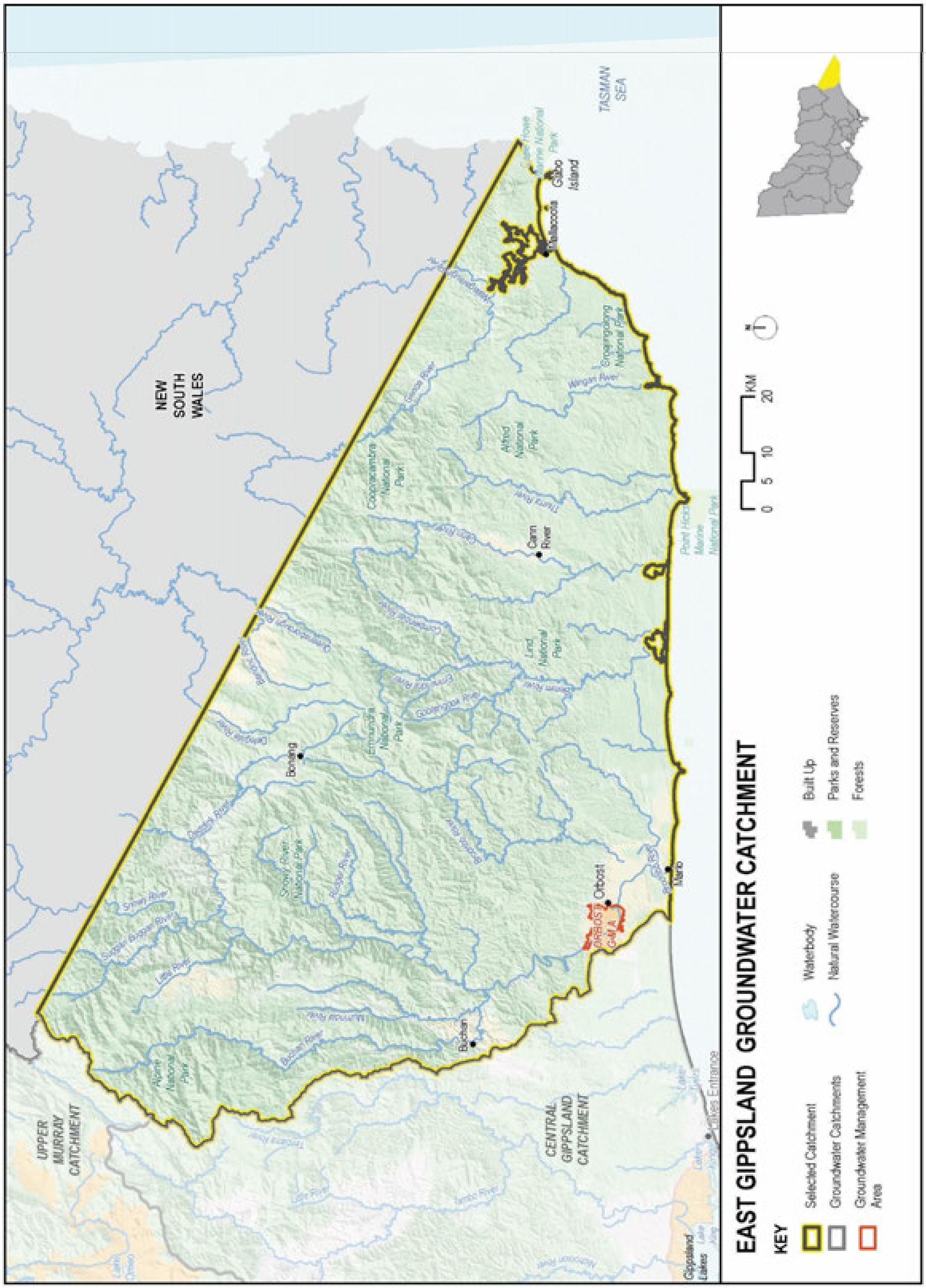
Middle aquifers cover a large part of the Gippsland groundwater basin from Moe to Bairnsdale. They comprise thick seams of sand aquifers separated by aquitards. The aquitards are generally clay or coal seams in the north-west of the Gippsland groundwater basin, and limestone in the east and centre of the basin. Recharge occurs from leakage through the overlying and surrounding sediments, and discharge is to the limestone aquitards to the east of the basin and along the coast.

Lower aquifers extend across the Gippsland basin and well offshore. They comprise thick sand sediments that rise to the surface in the west and along the basin margin, but are very deep along the coast and offshore. These aquifers are overlain by the upper and middle aquifers together with thick silt, clay, coal and limestone aquitards, and are underlain by basement rock. Where the lower aquifers occur at or near the surface, they receive direct recharge from rainfall and river leakage: in the deeper basin, recharge occurs by downward leakage. Discharge occurs offshore in Bass Strait.

7.3.1 East Gippsland groundwater catchment

The East Gippsland groundwater catchment (Figure 7-6) is located in the Gippsland basin in eastern Victoria and encompasses the rivers of the East Gippsland and Snowy basins. Neighbouring groundwater catchments are Central Gippsland to the west and Upper Murray to the north-west.

Figure 7-6 Map of the East Gippsland groundwater catchment



7.3 Gippsland groundwater basin

7.3.1.1 Groundwater resources overview

Groundwater resources in the East Gippsland groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licenses and licensing groundwater extractions under take and use licences.

The East Gippsland groundwater catchment contains the Orbost GMA and an unincorporated area. Groundwater supplies irrigation, domestic and stock use and Mallacoota.

The groundwater level trend in the Orbost GMA was categorised as alternating between stable and rising throughout 2015–16, but was categorised as declining in June 2016.

7.3.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use for the Orbost GMA and UAs are shown in Table 7-16. Groundwater use in 2015–16 increase by about 60%, compared to 2014–15.

Table 7-16 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Orbost GMA	20–45	1,217	154	150
Unincorporated area	-	587	95	8
Total		**1,804**	**249**	**158**

An estimate of domestic and stock groundwater use is provided in Table 7-17. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-16.

Table 7-17 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Orbost GMA	2	3
Unincorporated area	63	95
Total	**65**	**98**

Within the East Gippsland catchment, groundwater is available for urban water supply to Mallacoota. Urban groundwater use in the East Gippsland catchment increased in 2015–16, compared to 2014–15. The licensed entitlements and metered use for this supply are provided in Table 7-18.

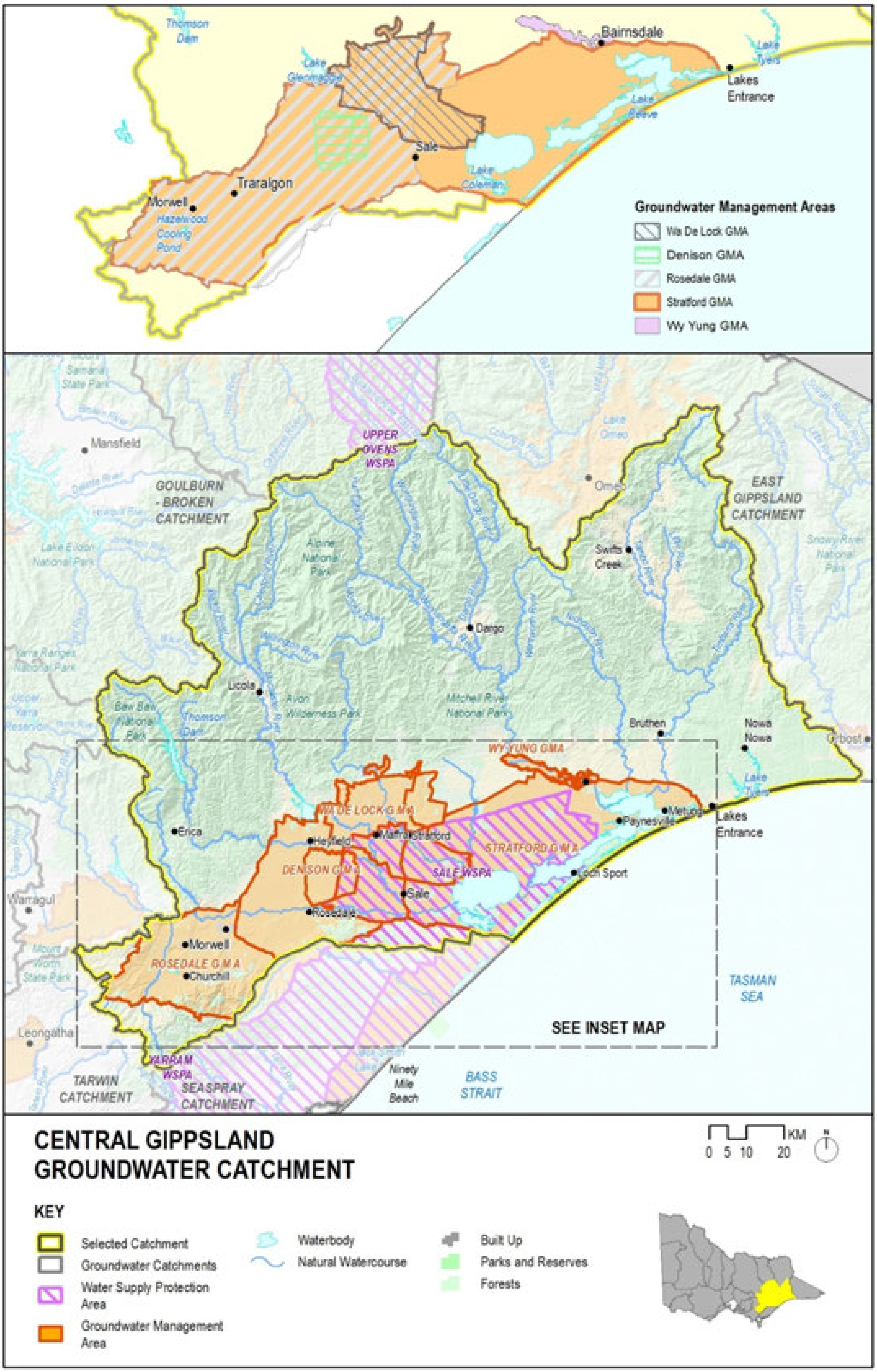
Table 7-18 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Mallacoota	220	92	8
Total	**220**	**92**	**8**

7.3.2 Central Gippsland groundwater catchment

The Central Gippsland groundwater catchment (Figure 7-7) is located in the Gippsland groundwater basin in eastern Victoria. It encompasses the major systems of the Gippsland Lakes and contains the Tambo, Mitchell and Thomson basins and parts of the Latrobe and Snowy basins. Neighbouring groundwater catchments are the Goulburn–Broken and Moe to the north-west and west, the Ovens and Upper Murray to the north, the Tarwin and Seaspray to the south-west and south and East Gippsland to the east.

Figure 7-7 Map of the Central Gippsland groundwater catchment



7.3 Gippsland groundwater basin

7.3.2.1 Groundwater resources overview

Groundwater resources in the Central Gippsland groundwater catchment are managed by Southern Rural Water which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The Central Gippsland groundwater catchment contains the Rosedale GMA, Wa De Lock GMA, Denison GMA, Sale WSPA, Wy Yung WSPA and unincorporated areas. It also contains most of the Stratford GMA (which also extends into the Seaspray groundwater catchment), and a small part of both the Moe GMA (the majority of which is in the Moe groundwater catchment) and Yarram WSPA (the majority of which is in the Seaspray groundwater catchment).

Groundwater resources supply licence entitlements, domestic and stock use and also some urban use. While the majority of groundwater use in the Central Gippsland groundwater catchment is for irrigation purposes, groundwater resources also supply four towns in the area as well as the power generators in the Latrobe Valley.

Throughout 2015–16, the groundwater level trends in the Wa De Lock GMA and Wy Yung WSPA were generally stable, while levels were declining-to-rising in the Rosedale GMA, declining in Moe GMA and Yarram WSPA and declining-to-stable in the Stratford GMA.

7.3.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMAs in the Central Gippsland catchment are shown in Table 7-19. Groundwater use in the Central Gippsland groundwater catchment slightly increased in 2015–16, compared to 2014–15.

Table 7-19 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Moe GMA	> 25	33	11	10
Rosedale GMA (1)	Zone 1: 50–150 Zone 2: 25–350 Zone 3: 200–300	22,073	11,401	10,303
Stratford GMA (1)	Zone 1: > 150 Zone 2: > 350	36,273	21,803	21,524
Wa De Lock GMA (2)	<= 25	29,286	7,201	6,098
Denison GMA (2)	<= 25	18,501	8,741	8,509
Sale WSPA	25–200	21,218	10,172	8,762
Wy Yung WSPA	<= 25	7,462	414	528
Yarram WSPA	Zone 1: > 200 Zone 2: All depths	6,889	3,901	3,864
Unincorporated areas	–	20,162	2,312	1,963
Total		**161,897**	**65,956**	**61,560**

Notes:

(1) The use volume reported in Rosedale GMA and Stratford GMA includes reported extractions from Latrobe Valley mines (Rosedale GMA 5,203 ML and Stratford GMA 21,801 ML).

(2) The volume of use in Wa De Lock GMA and Denison WSPA includes metered extractions for salinity control (Wa De Lock GMA 712 ML and Denison WSPA 1,701 ML).

An estimate of domestic and stock groundwater use is provided in Table 7-20. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-19.

Table 7-20 Number of domestic and stock bores and estimated use

WSPA/GMA (1)	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Rosedale GMA	80	120
Stratford GMA	0	0
Wa De Lock GMA	426	639
Denison GMA	206	309
Sale WSPA	435	653
Wy Yung WSPA	34	51
Yarram WSPA	88	132
Unincorporated areas	619	929
Total	**1,888**	**2,833**

Note:

(1) The differences between 2014–15 and 2015–16 numbers between the GMUs in the Central Gippsland groundwater catchment are due to improved spatial datasets.

Groundwater is used to provide urban water supply for Boisdale, Briagolong, Lindenow and Sale. The licensed entitlements and metered use for these supplies are presented in Table 7-21.

Table 7-21 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Boisdale	37	0	0
Briagolong	160	63	91
Lindenow	171	0	0
Sale	3,480	1,850	1,705
Total	**3,848**	**1,913**	**1,796**

7.3 Gippsland groundwater basin

7.3.3 Seaspray groundwater catchment

The Seaspray groundwater catchment (Figure 7-8) is located in the Gippsland groundwater basin in Victoria's south-east, and falls within the South Gippsland river basin. Neighbouring groundwater catchments are Central Gippsland to the north and Tarwin to the west.

Figure 7-8 Map of the Seaspray groundwater catchment

7.3.3.1 Groundwater resources overview

Groundwater resources in the Seaspray groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The catchment contains the Giffard GMA, most of the Yarram WSPA (which also extends into the Central Gippsland catchment), part of the Stratford GMA and an unincorporated area. Groundwater resources supply licence entitlements, domestic and stock use and urban water to Yarram. Groundwater use in the Seaspray catchment is predominantly for irrigation.

For 2015–16, groundwater level trends were categorised as declining in the Giffard GMA and Yarram WSPA and declining-to-stable for the Stratford GMA. Groundwater in the Yarram WSPA is affected by offshore oil and gas extraction, leading to long-term decline in levels.

7.3.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs in the Seaspray catchment are shown in Table 7-22. Groundwater use increased by about 60% in 2015–16, compared to 2014–15.

Table 7-22 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Giffard GMA	50–200	5,689	2,312	877
Stratford GMA	Zone 1: > 150 Zone 2: > 350	362	21	1
Yarram WSPA	Zone 1: > 200 Zone 2: All depths	18,800	11,040	7,445
Unincorporated area	–	518	272	115
Total		**25,369**	**13,645**	**8,438**

An estimate of domestic and stock groundwater use is provided in Table 7-23. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-22.

Table 7-23 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Giffard GMA	95	143
Rosedale GMA	0	0
Yarram WSPA	184	276
Unincorporated area	74	111
Total	**353**	**530**

Groundwater supplies are available for Yarram. The licensed entitlements and metered use for urban supply are presented in Table 7-24.

Table 7-24 Urban groundwater volumes and metered use

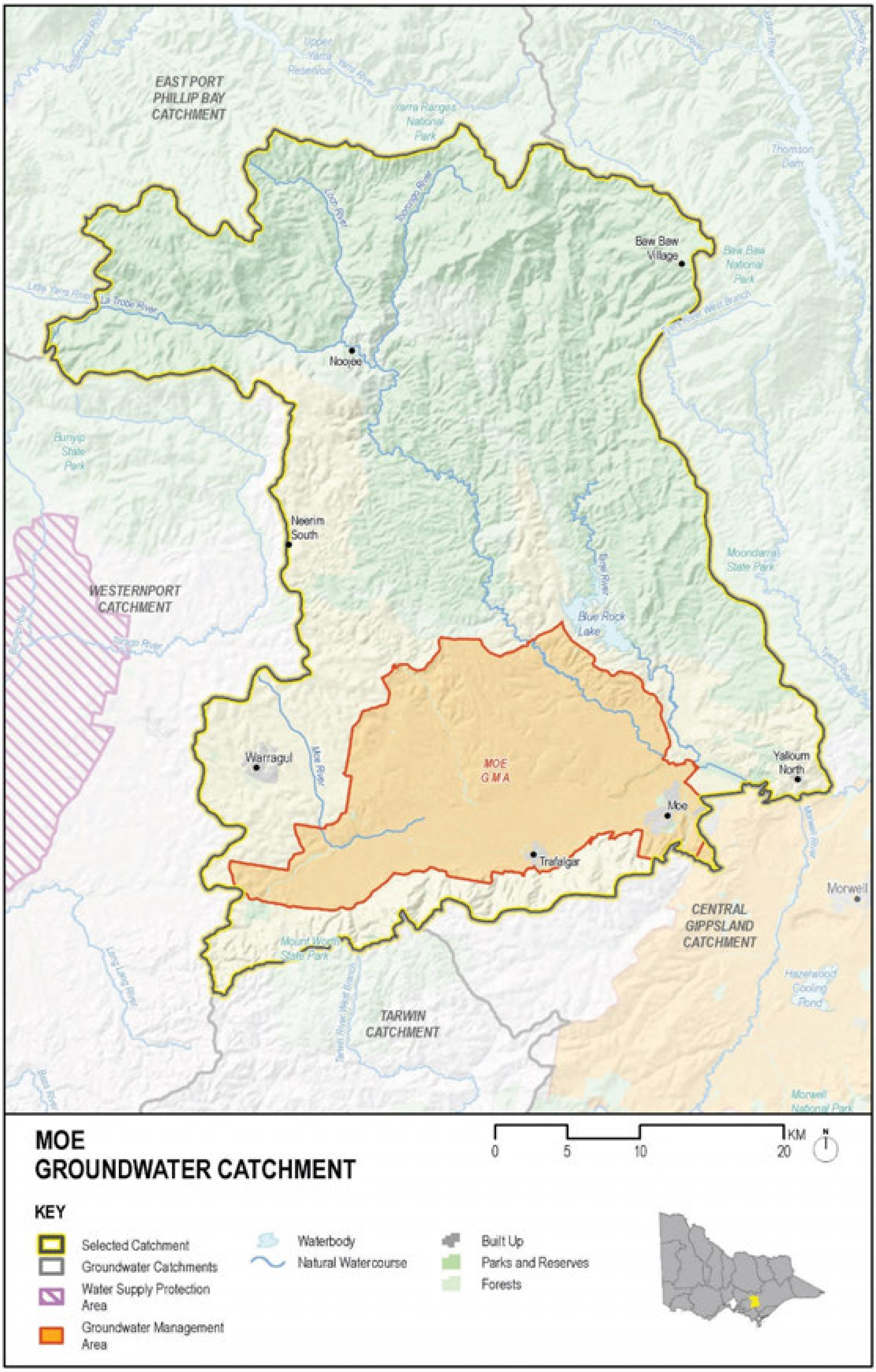
Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Yarram	214	115	44
Total	**214**	**115**	**44**

7.3 Gippsland groundwater basin

7.3.4 Moe groundwater catchment

The Moe groundwater catchment (Figure 7-9) is located in the Gippsland groundwater basin in eastern Victoria and falls within the Latrobe river basin. Neighbouring groundwater catchments are Central Gippsland to the east and south-east, East Port Phillip Bay and Westernport to the west and Tarwin to the south.

Figure 7-9 Map of the Moe groundwater catchment



7.3.4.1 Groundwater resources overview

Groundwater resources in the Moe groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing groundwater extractions under take and use licences.

The Moe groundwater catchment contains the Moe GMA and an unincorporated area. Groundwater resources supply licence entitlements, domestic and stock use and Trafalgar. While most groundwater licensed in the Moe GMA is used for irrigation purposes, some is also used for dairy wash-down.

The groundwater level trend in the Moe GMA was categorised as declining throughout 2015–16.

7.3.4.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-25. Groundwater use in 2015–16 doubled since 2014, primarily due to increased use in the Moe GMA.

Table 7-25 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Moe GMA	> 25	3,856	1,211	436
Unincorporated areas	–	1,361	360	321
Total		**5,217**	**1,571**	**757**

An estimate of domestic and stock groundwater use is provided in Table 7-26. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-25.

Table 7-26 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Moe GMA	112	168
Unincorporated areas	100	150
Total	**212**	**318**

Groundwater supplies are available for Yarragon. The licensed entitlements and metered use for urban supply are presented in (Table 7-27).

Table 7-27 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Yarragon	100	0	0
Total	**100**	**0**	**0**

7.4 Central groundwater basins

The Central groundwater basins comprise the Port Phillip, Westernport and Tarwin groundwater basins, which are grouped for management purposes. These basins are located in south-central Victoria and encompass area around Port Phillip Bay and extending into South Gippsland. Groundwater catchments in the Central groundwater basins are Tarwin, Westernport, East Port Phillip Bay and West Port Phillip Bay.

The upper aquifers of the Central groundwater basins occur along the river valleys, near the coast and on the plains west of Melbourne. Sand and gravel aquifers underlie productive farmland along the river valleys and flood plains of Bacchus Marsh, Werribee and near Yarra Glen. Near Koo Wee Rup, the upper aquifer is mostly formed of clay and generally acts as an aquitard except in the south-eastern area where it occurs at the surface. Recharge to the upper aquifers occurs directly from rainfall and discharge is to streams and the bays.

The middle aquifers of the Central groundwater basins cover a large part of the area. They are made up of several formations, which are connected and act as one aquifer in each basin. These aquifers vary in composition and include fine sands, coarse sand and gravel, clay and limestone. These aquifers are partially underlain by the middle aquitard, which mainly consists of coal and silt. The middle aquifers are mostly buried and confined by the upper aquifer: however, they are at the surface and unconfined on the eastern side of Port Phillip Bay. Recharge occurs from leakage through the overlying sediments or from direct rainfall recharge where the aquifers are near the surface.

Lower aquifers extend across the region. They lie very deep along the coast or in some areas at or close to the surface. The aquifers comprise largely sand, sandstone and basalt, and some also contain clay and coal layers that act as aquitards. The basement rock is buried by the lower aquifers where they are deepest along the coast, but it reaches the surface in the highlands, where it forms the Great Dividing Range, Mornington Peninsula Highlands and Strzelecki Ranges. In the ranges, the basement rock acts as a low-yielding fractured rock aquifer and, where it is buried, it acts as an aquitard. Direct rainfall recharge occurs where the aquifers and basement rock are at the surface; elsewhere recharge occurs as leakage.

7.4.1 Tarwin groundwater catchment

The Tarwin groundwater catchment is located in south-eastern Victoria (Figure 7-10) and overlaps part of the South Gippsland river basin. Neighbouring groundwater catchments are Westernport to the west, Central Gippsland and Seaspray to the east and Moe to the north. Bass Strait forms the catchment's southern boundary.

Figure 7-10 Map of the Tarwin groundwater catchment

7.4 Central groundwater basins

7.4.1.1 Groundwater resources overview

Groundwater resources in the Tarwin groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing groundwater extractions under take and use licences.

The Tarwin groundwater catchment contains the Leongatha GMA, Tarwin GMA and unincorporated areas. Groundwater resources supply licence entitlements, domestic and stock use and Leongatha.

Throughout 2015–16, the groundwater level trend in the Tarwin GMA was stable while levels in the Leongatha GMA were generally declining.

7.4.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-28. Groundwater use was slightly higher 2015–16 than in 2014–15.

Table 7-28 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Leongatha GMA	All depths	1,803	206	128
Tarwin GMA	<= 25	38	7	8
Unincorporated areas	–	344	37	59
Total		**2,185**	**250**	**195**

An estimate of domestic and stock groundwater use is provided in Table 7-29. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-28.

Table 7-29 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Leongatha GMA	72	108
Tarwin GMA	541	812
Unincorporated areas	274	411
Total	**887**	**1,331**

Groundwater supply is available for Leongatha, but there was no metered use of groundwater for urban supply in 2015–16 (Table 7-30).

Table 7-30 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Leongatha	715	0	.4
Total	**715**	**0**	**.4**

7.4.2 Westernport groundwater catchment

The Westernport groundwater catchment is located in southern Victoria (Figure 7-11) and contains much of the Bunyip river basin. Neighbouring groundwater catchments are East Port Phillip Bay to the west, Moe to the north-east and Tarwin to the south-east.

Figure 7-11 Map of the Westernport groundwater catchment

7.4 Central groundwater basins

7.4.2.1 Groundwater resources overview

Groundwater resources in the Westernport groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The Westernport groundwater catchment contains the Corinella GMA, most of the Koo Wee Rup WSPA (which extends into the East Port Phillip Bay groundwater catchment) and an unincorporated area. Groundwater resources supply license entitlements, domestic and stock use and the towns of Corinella, Grantville and Lang Lang.

In 2015–16, the groundwater level trend for both Corinella GMA and Koo Wee Rup WSPA was categorised as stable-to-declining.

7.4.2.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the Westernport catchment are presented in Table 7-31. Total groundwater use increased by about 15% in 2015–16, compared to 2014–15. Extraction increased in all areas in the groundwater catchment.

Table 7-31 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Corinella GMA	All depths	662	72	49
Koo Wee Rup WSPA	All depths	12,468	4,348	3,693
Unincorporated areas	–	4,233	578	561
Total		**17,363**	**4,998**	**4,303**

An estimate of domestic and stock groundwater use is provided in Table 7-32. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-31.

Table 7-32 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Corinella GMA	56	84
Koo Wee Rup WSPA	996	1,494
Unincorporated area	452	678
Total	**1,504**	**2,256**

Groundwater is available as an urban water supply to Corinella and Grantville as well as Lang Lang. There was no metered use of groundwater for urban supply in 2015–16 (Table 7-33).

Table 7-33 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Corinella and Grantville	490	0	.1
Lang Lang	119	0	0
Total	**609**	**0**	**.1**

7.4.3 East Port Phillip Bay groundwater catchment

The East Port Phillip Bay groundwater catchment is located in southern Victoria (Figure 7-12) and overlaps parts of the Yarra and Bunyip river basins. Neighbouring groundwater catchments are West Port Phillip Bay to the west, Goulburn–Broken to the north and Westernport and Moe to the east.

Figure 7-12 Map of the East Port Phillip Bay groundwater catchment

7.4.3.1 Groundwater resources overview

Groundwater resources in the East Port Phillip Bay groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The East Port Phillip Bay groundwater catchment contains the Frankston GMA, Moorabbin GMA, Nepean GMA, a small part of Koo Wee Rup WSPA (which is mainly within the Westernport groundwater catchment) and an unincorporated area. Wandin Yallock GMA (which had its WSPA status revoked by the Minister for Water in December 2016) is also located in this groundwater catchment.

Groundwater resources supply licence entitlements, and domestic and stock use. Groundwater in the East Port Phillip Bay groundwater catchment is mainly used for irrigation, with some bores licensed for industrial and commercial purposes. Groundwater resources are not used for urban supply in the East Port Phillip Bay groundwater catchment.

In 2015–16, the trends for groundwater levels for the Frankston GMA, Nepean GMA and Koo Wee Rup WSPA were generally categorised as stable-to-declining, while the Wandin Yallock GMA was classified as declining. Insufficient observation bores were available to determine trends for the Moorabbin GMA.

7.4.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-34. Groundwater use across the East Port Phillip Bay groundwater catchment increased by about 20% in 2015–16, compared to 2014–15. All areas except Koo Wee Rup increased.

Table 7-34 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Frankston GMA	50–200	2,229	302	50
Moorabbin GMA	All depths	2,581	1,293	1,171
Nepean GMA	All depths	6,110	2,961	2,418
Wandin Yallock GMA	All depths	2,995	743	509
Koo Wee Rup WSPA	All depths	111	0	0
Unincorporated area	–	12,961	2,450	2,322
Total		**26,987**	**7,749**	**6,470**

An estimate of domestic and stock groundwater use is provided in Table 7-35. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-34.

Table 7-35 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Frankston GMA	93	140
Moorabbin GMA	197	296
Nepean GMA (1)	1,843	1,843
Wandin Yallock GMA	53	80
Koo Wee Rup WSPA	0	0
Unincorporated area	1,122	1,683
Total	**3,308**	**4,042**

Note:
(1) Estimated stock and domestic use in Nepean GMA is calculated using a factor 1 ML per bore.

7.4.4 West Port Phillip Bay groundwater catchment

The West Port Phillip Bay groundwater catchment is located in the Port Phillip groundwater basin in southern Victoria (Figure 7-13). Neighbouring groundwater catchments are Hopkins–Corangamite to the west; Loddon, Campaspe and Goulburn–Broken to the north; and East Port Phillip Bay to the east.

Figure 7-13 Map of the West Port Phillip Bay groundwater catchment

7.4.4.1 Groundwater resources overview

Groundwater resources in the West Port Phillip Bay groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The catchment contains the Cut Paw Paw GMA, Lancefield GMA, Merrimu GMA, Deutgam WSPA and an unincorporated area. A very small portion of the Central Victorian Mineral Springs GMA is also contained in the very north of the West Port Phillip Bay groundwater catchment, but the majority is contained within the Campaspe and Loddon groundwater catchments. Groundwater resources supply licence entitlements and domestic and stock use in the area and are also available to supply Blackwood, Lancefield and Romsey.

Groundwater level trends in 2015–16 were categorised as stable-to-declining in the Lancefield GMA and declining in both the Deutgam WSPA and the Merrimu GMA. Insufficient observation bores were available to determine a trend for Cut Paw Paw GMA.

7.4.4.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are presented in Table 7-36. Groundwater use across the West Port Phillip Bay groundwater catchment decreased in 2015–16, compared to 2014–15.

Groundwater use across the West Port Phillip Bay catchment was less in 2015–16 than the year before.

Table 7-36 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Cut Paw Paw GMA	> 50	514	12	246
Lancefield GMA	All depths	1,378	80	269
Merrimu GMA	<= 30	691	319	343
Deutgam WSPA [(1)]	<= 30	5,082	1,278	1,406
Unincorporated area	–	10,487	2,015	1,920
Total		**18,152**	**3,704**	**4,184**

Note:
(1) The seasonal allocation in Deutgam WSPA for 2015–16 was 50% of licensed entitlement.

An estimate of domestic and stock groundwater use is provided in Table 7-37. Use of domestic and stock bores across the West Port Phillip Bay groundwater catchment decreased in 2015–16, compared to 2014–15.

Table 7-37 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Cut Paw Paw GMA	4	6
Lancefield GMA	57	86
Merrimu GMA	12	18
Deutgam WSPA	37	56
Unincorporated area	1,231	1,847
Total	**1,341**	**2,013**

Within the West Port Phillip Bay groundwater catchment, groundwater is an urban water supply option for Blackwood, Lancefield and Romsey. As shown in Table 7-38, only Blackwood drew on groundwater for urban use in 2015–16.

Table 7-38 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Blackwood	50	6	0
Lancefield	294	0	26
Romsey	600	0	0
Total	**944**	**6**	**26**

7.5 Otway–Torquay groundwater basin

The Otway–Torquay groundwater basin is located in south-western Victoria and extends offshore along the southern margin of Victoria and South Australia to the north-west of Tasmania. It borders the Goulburn–Murray groundwater basin and the Wimmera–Mallee groundwater basin to the north and the Central basins to the east.

The upper aquifers of the Otway–Torquay groundwater basin are found extensively across the south-west of the basin and include volcanic aquifers, a significant sand and limestone aquifer and some older sand aquifers. The unconfined volcanic aquifers stretch from Ballarat to Portland and consist of scoria and fractured basalt. They are thickest near Ballarat, Colac, Portland and south of Hamilton. The unconfined sand and limestone aquifer occurs along the South Australian border. In the places where these aquifers are at the ground surface, they can receive recharge directly from rainfall. Discharge is mainly by leakage from the upper aquifer to the middle aquifer and also occurs through baseflows to streams. The upper aquifers interact closely with surface water (such as rivers, creeks, drainage lines, wetlands, swamps and lakes).

Middle aquifers occur across the southern part of the basin, stretching from the South Australian border near the Grampians across to Port Campbell. There are two main levels of middle aquifers — known as the upper middle aquifers and lower middle aquifers — which are separated by a thick aquitard of impermeable silts and clays. The upper middle aquifer largely comprises Port Campbell limestone and is located close to the surface. It is semi-confined by the upper aquifer and receives recharge mainly from rainfall. It sometimes acts as one unit with the overlying sand and limestone aquifer.

Most of the lower middle aquifer is confined by overlying layers and below by thick marl aquitards; the exception is the region along its northern reaches where it connects to the lower aquifers. The lower middle aquifer relies on upward and downward leakage from adjacent formations for recharge. Discharge for both the upper middle and lower middle aquifers is most likely to occur along the coastline or into other formations. There is also some surface discharge to swamps and leakage in low-lying areas.

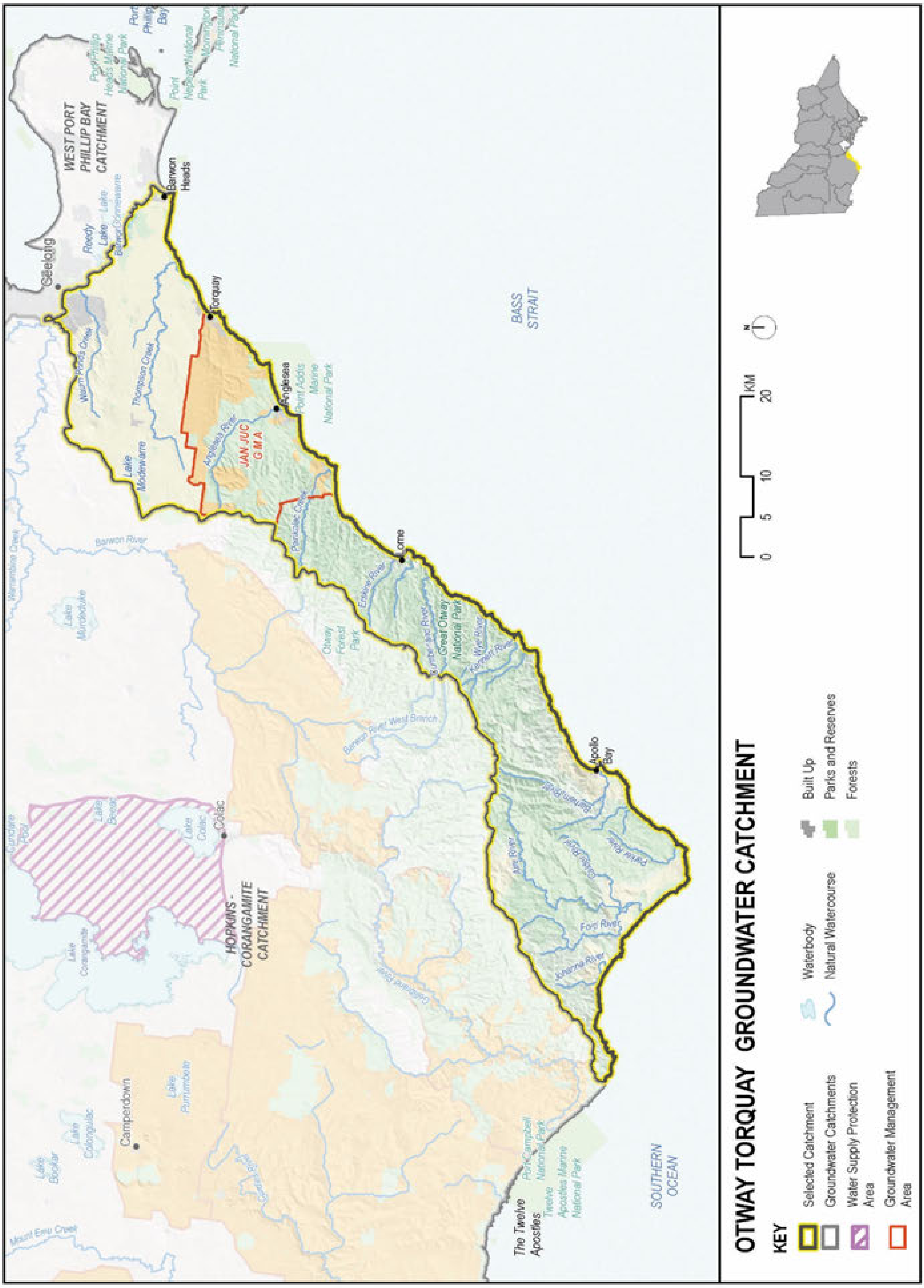
The lower aquifers occur across the south of the basin, stretching from the South Australian border south of the Grampians across to Port Phillip Bay. In many parts of the basin, they are overlain by hundreds of metres of sediment, but in the basin's north and around the Otway Ranges they occur at or near the surface as unconfined aquifers. The lower aquifers mainly comprise alternating layers of sand and clay, but some are sand aquifers with minor amounts of silt and brown coal. Near the coast, the aquifers are under pressure and groundwater from these aquifers can reach temperatures of 50–60°C. The lower aquifers are underlain by basement rock comprised mainly of siltstone, which reaches the surface around the basin margin to form the Grampians, the Otway Ranges and the Central Highlands.

7.5 Otway –Torquay groundwater basin

7.5.1 Otway–Torquay groundwater catchment

The Otway–Torquay groundwater catchment (Figure 7-14) is located in the Otway–Torquay groundwater basin in south-west Victoria and falls within the Otway Coast river basin. Much of the catchment boundary is along the coastline. Neighbouring groundwater catchments are Hopkins–Corangamite to the north-west and West Port Phillip Bay to the north-east.

Figure 7-14 Map of the Otway–Torquay groundwater catchment



7.5.1.1 Groundwater resources overview

Groundwater resources in the Otway–Torquay groundwater catchment are managed by Southern Rural Water which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing bore construction licences and for the licensing of groundwater extractions under take and use licences.

The Otway–Torquay catchment contains the Jan Juc GMA and an unincorporated area. Groundwater resources supply licence entitlements and domestic and stock use and Geelong.

The groundwater level trend in the Jan Juc GMA was categorised as declining throughout 2015–16.

7.5.1.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs within the Otway–Torquay groundwater catchment are presented in Table 7-39. Total groundwater use for 2015–16 decreased by more than half, compared to 2014–15. The majority of use was attributable to the Alcoa mine at Anglesea.

Table 7-39 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Jan Juc GMA	All depths	11,250	1,341	3,877
Unincorporated area	All depths	89	0	0
Total		**11,339**	**1,341**	**3,877**

An estimate of domestic and stock groundwater use is provided in Table 7-40. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-39.

Table 7-40 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Jan Juc GMA	3	5
Unincorporated area	30	45
Total	**33**	**50**

In the Otway–Torquay groundwater catchment, groundwater is used for urban water supply for greater Geelong. The licensed entitlements and metered use for these groundwater supplies are provided in Table 7-41.

The first groundwater bulk entitlement was granted to Barwon Water on 1 July 2009. The *Bulk Entitlement (Anglesea Groundwater) Order 2009* allows Barwon Water to extract a maximum of 10,000 ML of groundwater in any given year, but it cannot exceed an average 7,000 ML per year in any five-year period. The bulk entitlement supplements supply to homes and businesses in greater Geelong including Anglesea, Torquay and Lorne. No groundwater was extracted under this bulk entitlement in 2015–16.

Barwon Water also hold a groundwater licence for the Barwon Downs borefield, located near Colac in the Hopkins-Corangamite groundwater catchment for urban water supply in greater Geelong. This use is reported for that catchment in Table 7-44.

Table 7-41 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Greater Geelong (Anglesea borefield) (1)	10,000	0	0
Total	**10,000**	**0**	**0**

Note:

(1) Use over the last five years was 4,019 ML in 2011-12 and zero each year since.

7.5 Otway –Torquay groundwater basin

7.5.2 Hopkins–Corangamite groundwater catchment

The Hopkins–Corangamite groundwater catchment (Figure 7-15) is located in the Otway–Torquay groundwater basin in south-western Victoria. Neighbouring groundwater catchments are Portland and Glenelg to the west; Wimmera–Mallee, Avoca and Loddon to the north; West Port Phillip Bay to the east; and Otway–Torquay to the south-east.

Figure 7-15 Map of the Hopkins–Corangamite groundwater catchment

7.5.2.1 Groundwater resources overview

Groundwater resources in the Hopkins–Corangamite groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing licenses for groundwater use and bore construction.

The Hopkins–Corangamite groundwater catchment contains the Cardigan GMA, Colongulac GMA, Gellibrand GMA, Gerangamete GMA, Glenormiston GMA, Newlingrook GMA, Paaratte GMA and Warrion WSPA groundwater management units. Bungaree GMA (which had its WSPA status revoked by the Minister for Water in December 2016) is also located in this groundwater catchment.

In May 2015, the newly defined South West Limestone GMA was established and is partly contained within the Hopkins–Corangamite groundwater catchment area. This new GMA replaced the Nullaware and Yangery WSPAs and the Hawkesdale and Heywood GMAs, which were revoked during 2014–15. Of these four revoked GMUs, Nullawarre WSPA occurred in this groundwater catchment. It also contains a small part of the Loddon Highlands WSPA, most of which is in the Loddon groundwater catchment.

Groundwater resources in the Hopkins–Corangamite groundwater catchment are mainly used for urban supply and irrigation.

In 2015–16, the groundwater level trends for the Cardigan, Gellibrand and Newlingrook GMAs were generally categorised as stable-to-declining. The Gerangamete GMA was categorised as rising-to-declining and the Paaratte GMA as stable-to-rising. The groundwater level trends for the Bungaree GMA and Warrion WSPAs were categorised as declining. Insufficient observation bores were available to determine trends for the Colongulac and Glenormiston and South West Limestone GMAs.

7.5.2.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are shown in Table 7-42. Total groundwater use for 2015–16 doubled, compared to 2014–15, with increased extraction from all but two GMAs.

Table 7-42 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Bungaree GMA (1)	All depths	5,293	3,053	2,262
Cardigan GMA	All depths	3,878	934	784
Colongulac GMA	All depths	4,406	1,735	1,459
Gerangamete GMA (2)	> 60	20,000	1,846	0
Glenormiston GMA	<= 60	2,636	1,148	1,459
Newlingrook GMA	All depths	1,958	60	738
Paaratte GMA	> 120	3,212	367	340
Warrion WSPA	All depths	14,081	5,348	5,261
South West Limestone GMA (3), Hopkins–Corangamite section	See note 4	27,272	17,827	-
Unincorporated area	–	12,042	4,613	5,508
Total		**82,778**	**36,931**	**17,811**

Notes:

(1) The licensed entitlement volume for Bungaree GMA includes a 55 ML mineral water licence.

(2) This entitlement is held by Barwon Water and has the following limits: 20,000 ML in one year, 80,000 ML over 10 years and 400,000 ML over 100 years. The entitlement limit in Table 7-42 represents the single-year limit, but compliance is also assessed at the 10-year and 100-year level.

(3) The South West Limestone GMA depth range is from the top of the upper mid-tertiary limestone down to 50 m below the top of the underlying upper mid-tertiary aquitard, except where the aquitard is thin or absent, in which case the depth limit is the base of the aquitard or base of the limestone.

An estimate of domestic and stock groundwater use is provided in Table 7-43. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed use in Table 7-42.

7.5 Otway –Torquay groundwater basin

Table 7-43 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Bungaree GMA (1)	170	266
Cardigan GMA	83	125
Colongulac GMA	103	155
Gellibrand GMA	1	2
Gerangamete GMA	3	5
Glenormiston GMA	73	110
Newlingrook GMA	2	3
Paaratte GMA	2	3
Loddon Highlands WSPA (2)	88	176
Warrion WSPA	261	392
South West Limestone GMA	1,322	1,983
Unincorporated area	835	1,253
Total	**2,943**	**4,473**

Notes:

(1) Bungaree domestic and stock use is calculated using a factor of 1.5 ML per bore.

(2) Estimated domestic and stock use calculated using a factor of 2 ML per bore.

In the Hopkins–Corangamite groundwater catchment, groundwater provides urban water supply to Beaufort, Caramut, Darlington, Dean, Mortlake, Port Campbell, Timboon, Peterborough, Streatham, areas around Carlisle, Ballarat and Geelong. Licensed entitlements and metered use for urban supply are presented in Table 7-44. Total metered use almost doubled compared to the previous year, due to the increased use by Geelong.

Barwon Water also holds a bulk entitlement for the Anglesea groundwater borefield (located in the Otway-Torquay groundwater catchment) to provide urban water supply in greater Geelong, including Anglesea, Torquay and Lorne. This use is reported for that catchment in Table 7-41.

Table 7-44 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Ballarat – Bungaree bore	120	0	1
Ballarat West (1)	3,000	637	562
Beaufort	200	47	26
Caramut	50	31	27
Darlington	10	4	4
Dean	30	17	16
Greater Geelong (Barwon Downs borefield) (2)	20,000	1,846	0
Mortlake (part)	335	32	24
Otway System (Carlisle)	1,800	35	712
Port Campbell, Timboon and Peterborough	3,159	367	340
Streatham	60	21	31
Total	**28,764**	**3,037**	**1,743**

Notes:

(1) The volume of the licence for Ballarat is 1,700 ML, but up to 3,000 ML may be taken in any one year during a water shortage.

(2) Barwon Water holds a groundwater licence issued by Southern Rural Water which allows Barwon Water to extract 20,000 ML in one year, 80,000 ML over 10 years and 400,000 ML over 100 years from the Barwon Downs borefield to supply greater Geelong.

7.5.3 Portland groundwater catchment

The Portland groundwater catchment (Figure 7-16) is located in the Otway–Torquay groundwater basin in south-western Victoria. Neighbouring groundwater catchments are Glenelg to the west and Hopkins–Corangamite to the east.

Figure 7-16 Map of the Portland groundwater catchment

7.5.3.1 Groundwater resources overview

Groundwater resources in the Portland groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing licenses for groundwater use and bore construction.

The Portland groundwater catchment contains the Condah WSPA, Portland GMA, part of the Glenelg WSPA and an unincorporated area. In May 2015, the newly defined South West Limestone GMA was established and is partly contained within the Portland groundwater catchment area. This new GMA replaced the Nullaware and Yangery WSPAs and the Hawkesdale and Heywood GMAs, which were revoked during 2014–15. Of these four revoked GMUs, Yangery, Hawkesdale and Heywood occurred in this groundwater catchment.

Groundwater resources supply licence entitlements, domestic and stock use and 12 towns in the area. Most groundwater use in the Portland groundwater catchment is for irrigation and urban use and to a lesser extent for dairy wash and industrial supply.

In 2015–16, the groundwater level trend in the Condah WSPA was categorised as declining and as stable-to-declining in the Glenelg WSPA. Insufficient observation bores were available to determine trends for the South West Limestone and Portland GMAs.

7.5.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-45. Groundwater use within the catchment in 2015–16 was almost triple that of 2014–15.

Table 7-45 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Portland GMA	> 200	7,794	2,693	2,514
South West Limestone GMA, Portland section	See note 1	37,006	13,148	-
Condah WSPA	70–200	7,470	3,123	3,208
Unincorporated area	-	3,987	1,067	1,385
Total		**56,257**	**20,031**	**7,107**

Note:

(1) From the top of the upper mid-tertiary limestone to 50 m below the upper mid-tertiary (or the base) of the limestone.

An estimate of domestic and stock groundwater use is provided in Table 7-46. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-45.

Table 7-46 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Portland GMA	1	2
South West Limestone GMA	4,153	6,230
Condah WSPA	323	485
Glenelg WSPA	11	17
Unincorporated area	219	329
Total	**4,707**	**7,063**

Groundwater is used as an urban water supply for some towns in the Portland groundwater catchment. The licensed entitlements and metered use for these supplies are presented in Table 7-47.

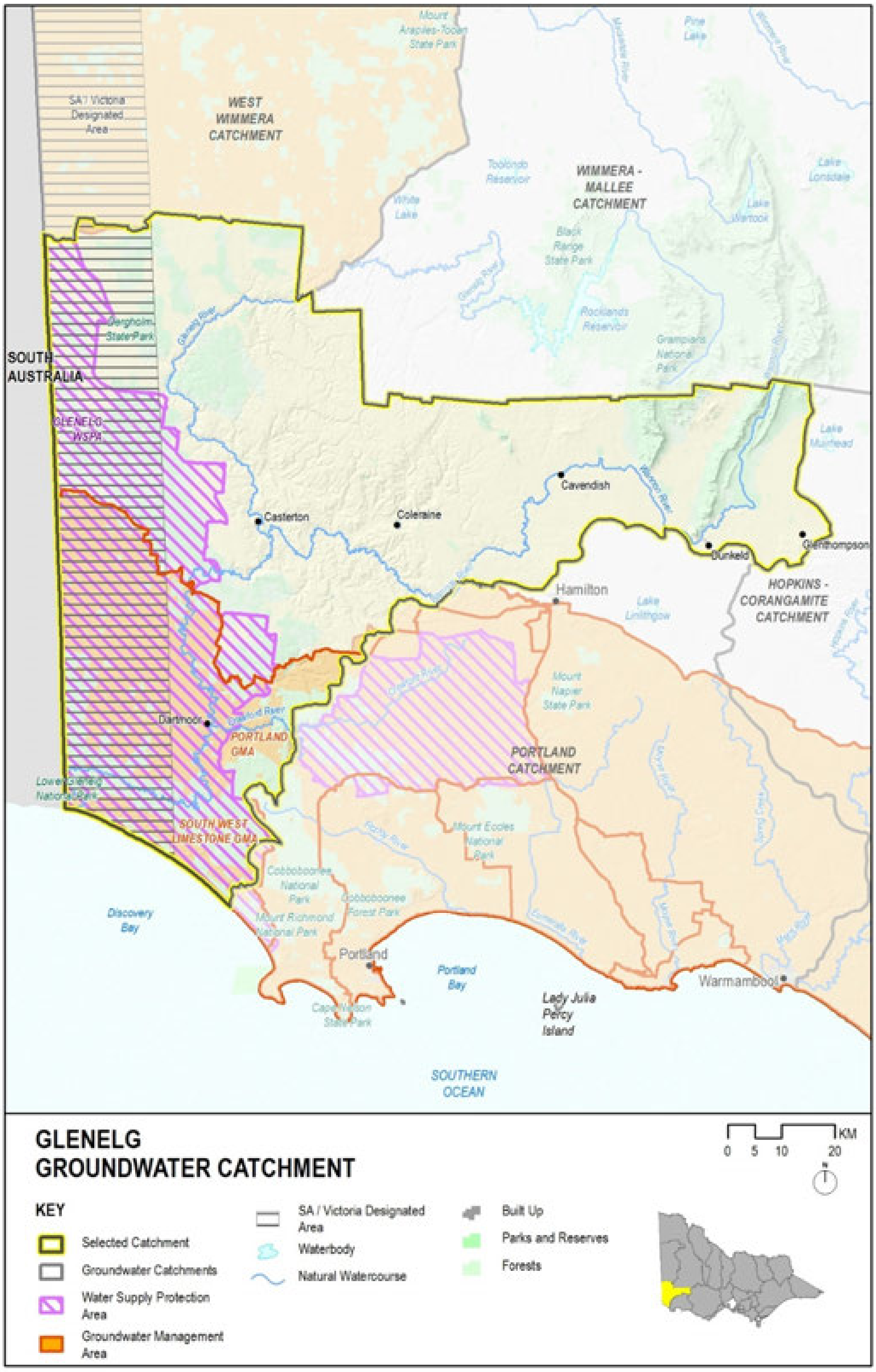
Table 7-47 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15(ML)
Hamilton, Tarrington, Dunkeld	1,102	2	.2
Heywood	333	162	135
Koroit	524	4	3
Macarthur	130	0	0
Penshurst	250	93	65
Port Fairy	1,026	633	590
Portland	6,222	1,898	1,789
Warrnambool, Allansford and Koroit (part)	750	333	387
Total	**10,337**	**3,124**	**2,969**

7.5.4 Glenelg groundwater catchment

The Glenelg groundwater catchment (Figure 7-17) is located in the Otway–Torquay basin in western Victoria, and contains the Glenelg basin and part of the Millicent Coast basin. The Victorian–South Australian border forms the western boundary of the Glenelg groundwater catchment, and the area that extends 20 km east from the border forms part of the Designated Area for the purposes of the 1985 Border Groundwaters Agreement between Victoria and South Australia. Neighbouring groundwater catchments are the Portland groundwater catchment to the south-east, the Hopkins–Corangamite groundwater catchment to the east and the West Wimmera and Wimmera–Mallee groundwater catchments to the north.

Figure 7-17 Map of the Glenelg groundwater catchment



7.5.4.1 Groundwater resources overview

Groundwater resources in the Glenelg groundwater catchment are managed by Southern Rural Water, which is responsible for developing and implementing groundwater management plans. Southern Rural Water is also responsible for issuing licenses for groundwater use and bore construction. Management responsibilities within the Designated Area are shared between Southern Rural Water and the Government of South Australia.

The Glenelg groundwater catchment contains the Glenelg WSPA and an unincorporated area, along with a very small part of the Portland GMA (which is mostly within the Portland groundwater catchment). In May 2015, the newly defined South West Limestone GMA was established and is also partly contained within the Glenelg groundwater catchment area. This new GMA replaced the Nullaware and Yangery WSPAs and the Hawkesdale and Heywood GMAs, which were revoked during 2014–15. None of these revoked GMUs were contained within this groundwater catchment.

Groundwater resources supply licence entitlements, domestic and stock use and Casterton, Dartmoor and Merino.

The groundwater level trend in the Glenelg WSPA was categorised as stable-to-declining in 2015–16.

7.5.4.2 Groundwater entitlements and use

Licensed entitlements and use for GMUs are presented in Table 7-48. Groundwater use within the groundwater catchment decreased by about 35% in 2015–16, compared to 2014–15.

Table 7-48 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Glenelg WSPA	All depths	15,756	5,018	7,787
Unincorporated area	-	2,095	215	210
South West Limestone GMA (1) Glenelg section	See note 1	17,505	4,522	-
Total		**35,356**	**9,755**	**7,997**

Note:

(1) From the top of the Upper mid-tertiary Limestone to 50 m below the top of the Upper Mid-Tertiary aquitard (or the base of the limestone).

An estimate of domestic and stock groundwater use is provided in Table 7-49. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-48.

Table 7-49 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 1.5 ML per bore) (ML)
Glenelg WSPA	1,058	1,587
South West Limestone GMA	62	93
UA	214	321
Total	1,334	2,001

Groundwater is available for urban water supply to Casterton, Dartmoor and Merino. The licensed entitlements and metered use for these supplies are presented in Table 7-50.

Table 7-50 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Casterton	1,000	445	409
Dartmoor	150	25	14
Merino	100	0	0
Total	**1,250**	**470**	**423**

7.6 Wimmera–Mallee groundwater basin

The Wimmera–Mallee groundwater basin is located in north-western Victoria. It borders the Otway–Torquay groundwater basin to the south and the Goulburn–Murray groundwater basin to the east. The Wimmera–Mallee groundwater basin also forms part of the Murray–Darling basin in Victoria.

The Victorian–South Australian border forms the western boundary of the Wimmera–Mallee groundwater basin, and the area that extends 20 km east from the border forms part of the Designated Area for the purposes of the 2005 Border Groundwaters Agreement between Victoria and South Australia.

The northern plains of the basin are dominated by sedimentary aquifers, and the southern area features fractured rock highlands extending along the Great Dividing Range.

As depth increases, the major aquifers in the region are:

- Upper Tertiary Aquifer including the Parilla Sands Aquifer, also known as the Pliocene Sands Aquifer
- Mid-Tertiary Aquifer including the Murray Group Limestone Aquifer
- Lower Tertiary Aquifer, primarily consisting of the Tertiary Confined Sands Aquifer, also known as the Renmark Group Aquifer.

In most areas, all the aquifers are considered to be connected, with thin aquitards between the aquifers in part or all of the catchment. The Renmark Group Aquifer in the West Wimmera GMA is the exception: it is considered to be disconnected from the water above it.

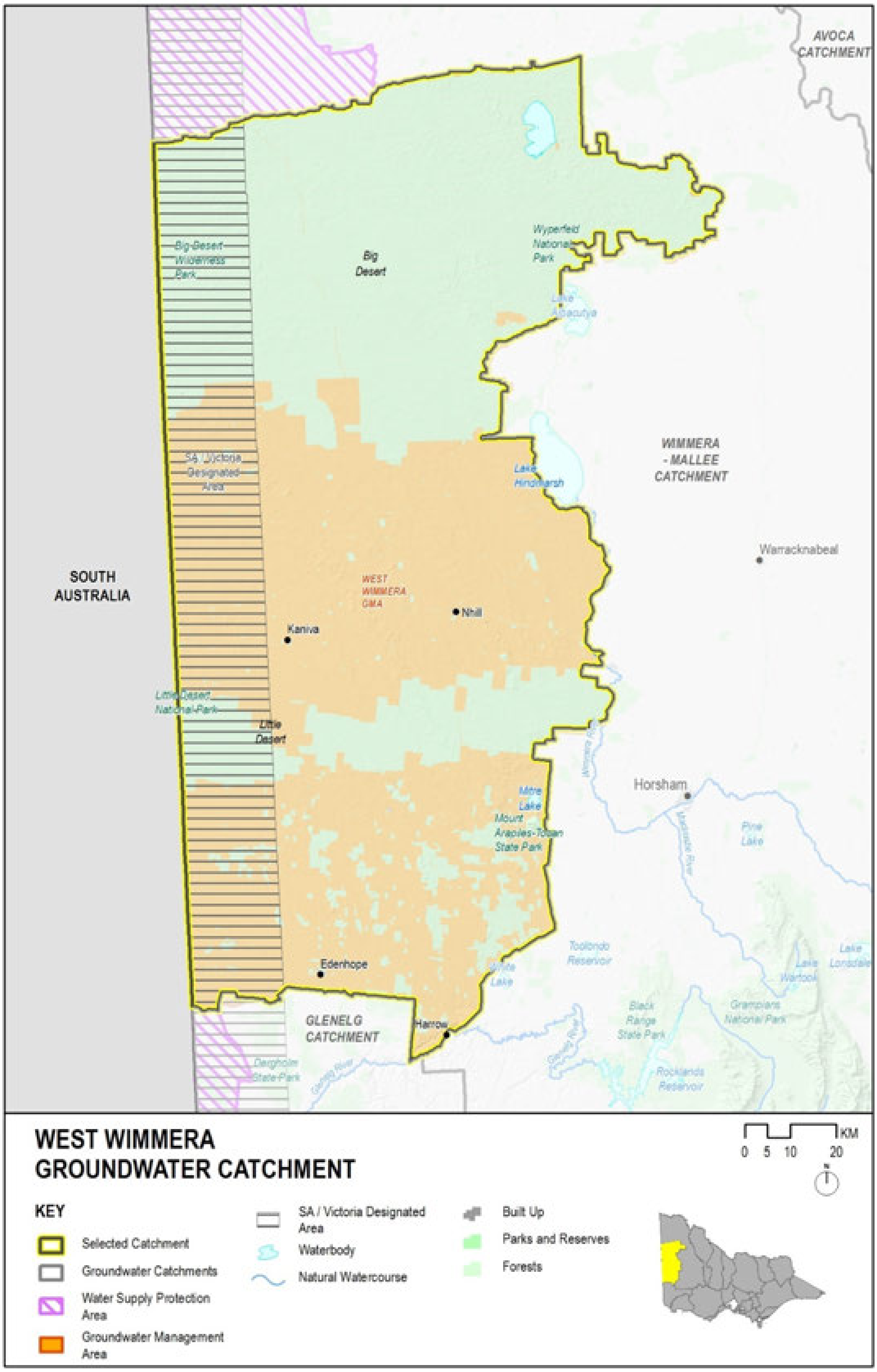
Most groundwater is extracted from the Murray Group Aquifer along the border with South Australia. The water in the Murray Group is thought to originate from recharge received during a much wetter period about 20,000 years ago. The contribution of modern recharge is considered to be modest across much of the area and less than the rate of use.

7.6 Wimmera –Mallee groundwater basin

7.6.1 West Wimmera groundwater catchment

The West Wimmera groundwater catchment (Figure 7-18) is located in western Victoria and contains portions of the Mallee, Wimmera and Millicent Coast river basins. The Victorian–South Australian border forms the western boundary of the West Wimmera groundwater catchment, and the area that extends 20 km east from the border forms part of the South Australia–Victoria Designated Area. Neighbouring groundwater catchments are the Wimmera–Mallee groundwater catchment to the east and north and the Glenelg groundwater catchment to the south.

Figure 7-18 Map of the West Wimmera groundwater catchment



7.6.1.1 Groundwater resources overview

Groundwater resources in the West Wimmera groundwater catchment are managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licenses for groundwater use and bore construction, and for surface water licensed diversions. Management responsibilities within the Designated Area are shared between Grampians Wimmera Mallee Water and the Government of South Australia.

The West Wimmera groundwater catchment contains the West Wimmera GMA and an unincorporated area. Groundwater resources supply license entitlements, domestic and stock use and Apsley, Harrow, Miram, Serviceton, Edenhope, Kiata, Goroke, Lillimur, Kaniva and Nhill.

In 2015–16, groundwater level trends in the West Wimmera GMA were categorised as stable throughout the year, but levels in the western part of the catchment have historically been declining. In response to this, a strategy was proposed to restrict some licensed entitlements to groundwater by 4% a year until levels stabilise. In line with this strategy, licence holders in Neuarpur subzone 1 were restricted to 80% of their licensed volume in 2015–16.

7.6.1.2 Groundwater entitlements and use

Licensed entitlements and use from GMUs within the West Wimmera groundwater catchment are shown in Table 7-51. Groundwater use within the catchment increased slightly in 2015–16, compared to 2014–15.

Table 7-51 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
West Wimmera GMA	All depths	53,362	22,658	21,851
Total		**53,362**	**22,658**	**21,851**

An estimate of domestic and stock groundwater use is provided in Table 7-52. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-51.

Table 7-52 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
West Wimmera GMA	627	1,250
Unincorporated area	1	2
Total	628	1,252

Groundwater is available for urban water supply to Apsley, Edenhope, Goroke, Harrow, Kaniva, Kiata, Lillimur, Miram, Nhill and Serviceton. The licensed entitlements and metered use for these supplies are presented in Table 7-53.

Table 7-53 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Apsley	40	29	24
Edenhope	250	227	260
Goroke	86	61	55
Harrow (1)	29	41	37
Kaniva	600	234	230
Kiata	40	6	5
Lillimur	32	9	9
Miram	7	1	1
Nhill	1,000	221	220
Serviceton	25	8	8
Total	**2,109**	**838**	**849**

Note:

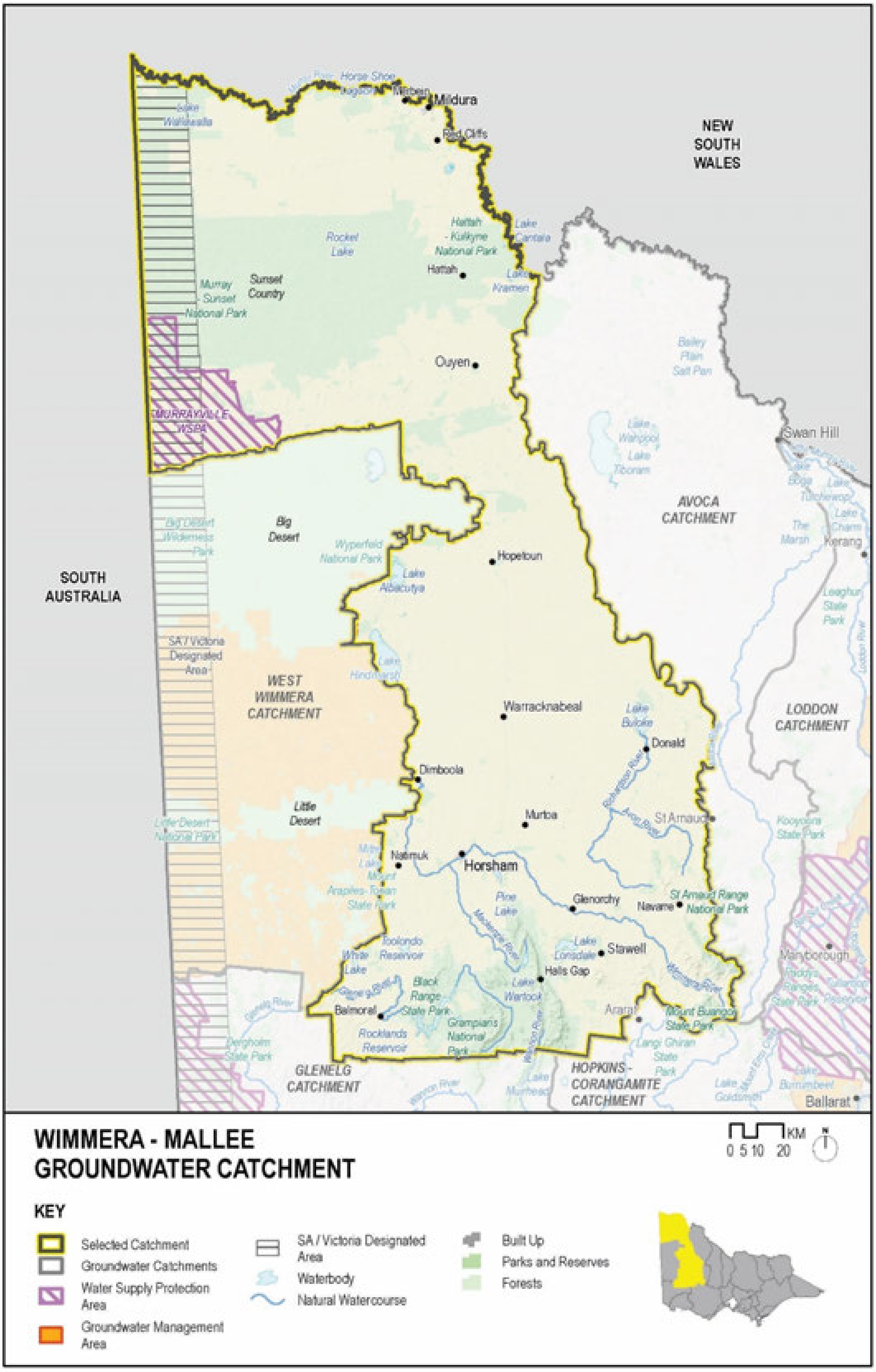
(1) Usage exceeded licensed volume in Harrow. A temporary trade of 12 ML enabled this use.

7.6 Wimmera –Mallee groundwater basin

7.6.2 Wimmera–Mallee groundwater catchment

The Wimmera–Mallee groundwater catchment (Figure 7-19) is located in north-western Victoria and overlaps the Mallee river basin in the north and the Wimmera river basin in its south. Neighbouring groundwater catchments are the West Wimmera groundwater catchment to the west, the Avoca groundwater catchment to the east and the Glenelg and Hopkins–Corangamite groundwater catchments to the south.

Figure 7-19 Map of the Wimmera–Mallee groundwater catchment



7.6.2.1 Groundwater resources overview

Groundwater resources in the Wimmera–Mallee groundwater catchment are managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licences for groundwater use and bore construction, as well as for surface water diversions. The Wimmera–Mallee groundwater catchment forms part of the Murray–Darling basin and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan. Management responsibilities within the Designated Area are shared between Grampians Wimmera Mallee Water and the Government of South Australia. The Wimmera–Mallee groundwater catchment contains the Murrayville WSPA and an unincorporated area.

Groundwater resources supply licence entitlements, domestic and stock use and Cowangie, Horsham, Landsborough and Murrayville. Groundwater resources from the Wimmera–Mallee groundwater catchment also supply Willaura, though the town itself is located outside the groundwater catchment.

In 2015–16, the groundwater level trend in the Murrayville WSPA was categorised as stable.

7.6.2.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from GMUs are presented in Table 7-54. Groundwater use within the catchment almost halved in 2015–16, compared to 2014–15. This was due to a significant drop in use in the unincorporated area.

Table 7-54 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Murrayville WSPA	70–200	9,634	6,131	5,511
Unincorporated area	–	10,533	341	5,922
Total		**20,167**	**6,472**	**11,433**

An estimate of domestic and stock groundwater use is provided in Table 7-55. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-54.

Table 7-55 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2.0 ML per bore) (ML)
Murrayville WSPA	191	382
Unincorporated area	270	540
Total	461	922

Groundwater is used for urban water supply to Cowangie, Horsham, Landsborough, Murrayville and Willaura. The licensed entitlements and metered use for these supplies are presented in Table 7-56.

Table 7-56 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Cowangie	40	13	9
Horsham	1,200	48	41
Landsborough	150	44	35
Murrayville	475	133	124
Willaura system (1)	220	162	80
Total	**2,085**	**401**	**289**

Note:

(1) While Willaura is located in the Hopkins–Corangamite groundwater catchment, the bores that supply the town are in the Wimmera–Mallee groundwater catchment in Mafeking.

7.6.3 Avoca groundwater catchment

The Avoca groundwater catchment is in north-western Victoria (Figure 7-20) and contains the Avoca river basin and a portion of the Wimmera-Avon basin. Neighbouring groundwater catchments are the Wimmera–Mallee to the west and Loddon to the east.

Figure 7-20 Map of the Avoca groundwater catchment

7.6.3.1 Groundwater resources overview

Groundwater resources in the Avoca groundwater catchment are mainly managed by Grampians Wimmera Mallee Water, which is responsible for developing and implementing groundwater management plans. Grampians Wimmera Mallee Water also issues licenses for groundwater use and bore construction, and for surface water licensed diversions. Central Highlands Water supplies groundwater to Amphitheatre, Avoca and Redbank.

The Avoca groundwater catchment forms part of the Murray–Darling basin, and groundwater management arrangements are subject to the requirements of the Murray–Darling Basin Plan.

The Avoca groundwater catchment is entirely an unincorporated area, with no GMAs or WSPAs.

7.6.3.2 Groundwater entitlements and use

Licensed groundwater entitlements and use from across the unincorporated area are presented in Table 7-57. Groundwater use within the catchment decreased in 2015–16 by about half, compared to 2014–15.

Table 7-57 Licensed groundwater volumes and use

WSPA/GMA	GMA/WSPA aquifer depth limits (m)	Licensed entitlement (ML/year)	Total licensed groundwater use (ML) 2015–16	Total licensed groundwater use (ML) 2014–15
Unincorporated area	-	2,572	499	1,033
Total		**2,572**	**499**	**1,033**

An estimate of domestic and stock groundwater use is provided in Table 7-58. A number of groundwater licences also incorporate domestic and stock use, and in these cases the use from these bores is reported in the licensed volume in Table 7-57.

Table 7-58 Number of domestic and stock bores and estimated use

WSPA/GMA	No. of domestic and stock bores	Estimated domestic and stock use (assuming 2 ML per bore) (ML)
Unincorporated area	63	126
Total	63	126

Groundwater is used to provide urban water supply to three towns in the Avoca groundwater catchment. The licensed entitlements and metered use for these supplies are presented in Table 7-59. Groundwater use for Avoca increased in 2015–16, compared to 2014–15. No groundwater was used for urban supply to Amphitheatre and Redbank during the year.

Table 7-59 Urban groundwater volumes and metered use

Town supplied	Licensed volume (ML)	Metered use 2015–16 (ML)	Metered use 2014–15 (ML)
Amphitheatre	20	0	0
Avoca	250	198	172
Redbank	50	6	6
Total	**320**	**204**	**178**

8 Distribution system water accounts 2015–16

8.1 Overview of methodology

This chapter provides the water accounts for each of Victoria's 19 distribution systems. It describes the movement of water through the constructed distribution systems that deliver water to users. These accounts track the water from the time it moves from a waterway, an aquifer or other source to the time it is delivered to a customer or another destination.

Distribution systems typically supply within irrigation districts or towns and urban areas. Some infrastructure services both of these end uses. On occasion, environmental entitlements are supplied using the distribution systems. Providing water accounts for distribution systems enable water corporations and the community to understand where delivery efficiency improvements to reduce losses can most readily be made.

A distribution system is the infrastructure constructed, maintained and owned by a water corporation that is used to distribute water from its source to a user. Distribution systems begin where water is taken from a source waterway or aquifer and end where the water is delivered to a customer.

These distribution system accounts include two components – bulk and reticulation. The bulk or feed infrastructure is used for large transfers of water and includes off-stream storages, bulk supply channels and treatment plants. The reticulation networks comprise the smaller infrastructure (such as pipes) to deliver water to each individual customer.

On-stream storages (for example, Lake Eildon) are not considered to be part of distribution systems as they are already covered in chapter 6 'Basin Water Accounts'.

An off-stream storage often has a certain amount of catchment inflows (that is, it has some on-stream characteristics). The bulk water entitlements that authorise water being taken from waterways serve as a guide to whether a storage is off-stream.

As far as possible, the accounts have been prepared on a consistent basis, while recognising the substantial differences between systems.

8.1.1 Groupings of distribution systems

Distribution system reporting is grouped by water corporation ownership. This reflects the fact that as water is moved from its source to a user, it may pass through more than one distribution system. For example, Melbourne Water uses its distribution system to divert water from its source and supply it to Melbourne retail water corporations. Then, the Melbourne retail water corporations take that water into their own distribution systems and supply it to their customers.

Distribution systems (except for the Goldfields Superpipe) are all operated by a single water corporation and are generally located in one of the four regions — Northern, Gippsland, Central and Western. Southern Rural Water operates three irrigation systems: one in the Gippsland region and two in the Central region. Southern Rural Water systems therefore appear in two regions: Central and Gippsland.

Most water corporation websites have diagrams or maps of their distribution systems.

Distribution system boundaries do not necessarily align with river basin boundaries. For example, Goulburn–Murray Water's Goulburn system straddles the Goulburn, Campaspe and Loddon river basins, and it also supplies water further west into the Avoca basin.

8.1.2 Types of distribution systems

For consistency, the following definitions are used:

- **Common distribution system**: a bulk or feeder system that mainly supplies two or more other distribution systems. It may have few or no retail customers. Examples include Melbourne Water's system, the Goldfields Superpipe (operated jointly by Coliban Water and Central Highlands Water) and the Waranga Western Channel (which supplies several irrigation and other systems including the Goldfields Superpipe).
- **Rural distribution system**:
  - an irrigation system which primarily supplies irrigation water, although it may also supply other commercial customers, urban systems and domestic and stock water; or
  - a domestic and stock system which primarily supplies non-irrigation rural customers and may also supply urban systems. It may previously have been (wholly or partly) a natural stream (for example, the upper and lower Broken Creek and several waterways in the Torrumbarry area), the flows of which are now controlled to the extent that it is more correctly described as all or part of a distribution system than as a river or stream.
- **Urban distribution system:** a system that primarily supplies urban customers. It may supply a single town or a group of towns and may also transfer water to other distribution systems. As explained above, an urban

distribution system may have feeder and reticulation components, with the water balance for the two components shown separately.

Wannon Water and Grampians Wimmera Mallee Water both operate rural distribution systems that supply several towns as well as rural customers. While deliveries to different customer groups can usually be separated (for example, deliveries to towns can be identified and shown separately to deliveries to rural customers), inflows and distribution losses often cannot be separated. For simplicity, reports on these systems consolidate urban and rural components as ‘combined distribution systems’.

8.1.3 Data sources and limitations

Almost all the data used for the accounts was provided by the water corporations that operate the systems. They obtained the data using various types of meters, various methods of infilling data when meters fail, hydrographic measurement, hydrologic techniques to estimate inflows they did not measure, and back-calculation. Details of these methods are available from the relevant corporation and are not necessarily included in notes to the accounts, which are as concise as possible.

The presentation of the accounts is consistent with the draft Australian Water Accounting Standards developed under the auspices of the Council of Australian Governments. For example, though some accounting approaches would report net evaporation from a storage as a loss, these accounts treat data on rainfall and evaporation as separate inflows and outflows. This may affect efficiency and loss measures, but the differences when compared to traditional figures are generally small.

8.1.4 Balancing items

In many cases, water balances are exact. This is because one of the items is back-calculated, thus forcing inflows to equal outflows. In the reports, the balancing item (usually distribution system losses, but sometimes inflows) is always identified as such.

In cases where all items in the accounts can be measured or estimated without resorting to back-calculations, the account will not balance exactly because of inevitable measurement inaccuracies. In such cases, a separate balancing item is shown as an unaccounted-for outflow or loss. If that figure is negative, it is an unaccounted-for inflow.

8.1.5 Efficiency calculations

System efficiency calculations for these accounts are based on the formula *Efficiency = 100 x (delivered to customers + passed to other systems) / total outflows*. DELWP recognises that the system efficiency formula is only one of many commonly used in the water industry.

‘Total outflows’ includes all the end uses of water received by the distribution system (the inflows). It includes deliveries to customers and water passed to other systems — these two together constitute useful deliveries — plus losses.

The reports classify outfalls at the end of channels as water passed to other systems if they are regulated to a river, wetland or downstream distribution system. Outfalls due to cancelled water orders already in delivery (also known as rain rejections) or inaccuracies in system regulation are classified as a distribution system loss, even though they may turn up in the downstream system as an unregulated inflow.

Some cases do not fit the above classifications and call for a commonsense approach. For example, at Loddon Weir in periods of regulated flows, inflows are received from the Loddon River into the Waranga Western Channel and regulated westward along the channel, leaving minimum flows to be passed downstream. In wet periods, almost all the Loddon Weir inflows simply pass downstream because there is no capacity to reregulate them. In both cases, it is common sense to record all Loddon Weir inflows as inflows to the channel and all water passed to the Loddon Weir as passed to other systems, to achieve a reasonable indication of distribution system efficiency.

In systems where there is a large balancing item (which implies poor measurement somewhere), the efficiency calculation may be relatively meaningless. In such cases, no calculated figure is shown in the tables and efficiency is simply recorded as ‘N/A’ (not applicable). In other cases, small measurement errors or unmeasured inflows result in a calculated efficiency higher than 100%, which is reported as such.

The efficiency figures that water corporations include in their annual reports and provide to the Essential Services Commission are often for the reticulation component of a distribution system, rather than for off-stream storages and treatment plants, as is essential in the present accounts. As explained above, sometimes it makes sense to show feeder and reticulation components separately. More corporations may choose to do this in future.

8.2 Interpreting and using distribution system accounts

The accounts in this chapter are summarised: the full account for a system has usually been condensed to a single line in a table. Nonetheless, the accounts are useful in drawing attention to possible management issues. For example, an unusually low distribution efficiency could occur for various reasons, such as:

- poor or difficult measurement
- the system configuration giving rise to intrinsically low efficiency (an example is the Millewa rural distribution system, which includes Lake Cullulleraine with its high evaporation; management options to improve the situation are limited, although they exist)
- inadequately maintained infrastructure or infrastructure that cannot be improved economically
- relatively high treatment system losses in small, urban systems
- unmeasured deliveries for purposes such as firefighting and transport by tanker as a drought-relief measure.

Conversely, unusually high efficiency can be the result of poor measurement, unmeasured inflows or other unknown factors.

The accounts can only indicate a possible issue: managers would need to investigate and analyse an issue before determining a response. Any management response would, of course, need to be cost-effective.

Any low efficiencies in systems with treated or desalinated water are particularly noteworthy because of the energy cost of, and the value added by, the treatment.

8.3 Northern region

8.3.1 North East Water

North East Water provides water (and sewerage) services to 41 localities in north-eastern Victoria. It operates largely as a retailer that onsells water from the wholesaler (Goulburn–Murray Water) which manages water storage, delivery and drainage systems.

North East Water serves an estimated 107,000 people in an area of about 20,000 km^2. The area extends from Corryong in the east along the Murray River to Yarrawonga, then south to Benalla and to Bright, Mount Beauty and Dartmouth in the Victorian Alps. Table 8-1 summarises North East Water's urban distribution systems.

Table 8-1 North East Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Alpine	Bright system – Bright, Wandiligong and Porepunkah	Unregulated Ovens River	Bright
	Harrietville	Simmons Creek and unregulated Ovens River	Harrietville
	Mount Beauty system – Tawonga, Tawonga South and Mount Beauty	West Kiewa River	Tawonga South
	Myrtleford	Buffalo Creek	Myrtleford
Broken River	Benalla	Ryan and Whiskey creeks	Benalla
Central	Goorambat	Groundwater	Goorambat
King and Ovens rivers	Glenrowan	Fifteen Mile Creek	Glenrowan
	Moyhu	Regulated King River	Moyhu
	Oxley	Regulated King River	Oxley
	Wangaratta (1)	Regulated Ovens River, groundwater	Wangaratta
	Whitfield	Musk Gully Creek	Whitfield
Mitta Mitta River	Dartmouth	Mt Tabor Creek	Dartmouth
	Eskdale	Regulated Mitta Mitta River	Eskdale
Murray River	Bellbridge	Lake Hume	Bellbridge
	Tallangatta	Lake Hume	Tallangatta
	Wahgunyah system – Wahgunyah and Rutherglen	Regulated Murray River	Wahgunyah
	Wodonga system – Wodonga, Baranduda, Kiewa, Springhurst, Tangambalanga, Bonegilla, Ebden, Barnawartha and Chiltern	Regulated Murray River	Wodonga
	Yarrawonga system – Yarrawonga, Tungamah, St James and Devenish	Regulated Murray River	Yarrawonga
Subalpine	Beechworth	Nine Mile Creek Frenchmans Creek Lake Kerferd catchment	Beechworth
	Yackandandah	Nine Mile Creek	Yackandandah
Upper Murray	Corryong system – Corryong and Cudgewa	Nariel Creek	Corryong
	Walwa	Unregulated Murray River	Walwa

Notes:
(1) Also supplies Glenrowan

8.3 Northern region

Table 8-2 summarises shows North East Water's urban distribution systems' water balances.

Table 8-2 North East Water urban distribution systems' water balances

Area / town / system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Total outflows		
			To urban residential	To urban non-residential	From water treatment plants	From distribution systems (1)			
Alpine area									
Bright system (2)	302	878	304	180	0	638	1,122	58	43%
Harrietville	0.4	67.2	30.0	17.0	3.0	17.2	67.2	0.4	70%
Mount Beauty System	5	362	172	66	10	114	362	5	66%
Myrtleford (3)	368	596	292	225	17	107	641	323	81%
Broken River									
Benalla	18	1,538	999	360	98	90	1,547	9	88%
Kings and Ovens Rivers									
Moyhu	0.1	37.5	23.0	3.0	3.0	8.5	37.5	0.1	69%
Oxley	0.2	65.0	34.0	1.0	8.0	22.0	65.0	0.2	54%
Wangaratta group	25	3,466	1,796	1,255	105	310	3,466	25	88%
Whitfield	0.5	17.8	12.0	4.0	1.0	0.9	17.9	0.5	90%
Mitta Mitta River									
Dartmouth	0.3	24.8	13.0	8.0	2.0	1.8	24.8	0.3	85%
Eskdale	0.1	14.9	10.0	3.0	1.0	0.9	14.9	0.2	87%
Murray River									
Bellbridge	0.5	60.8	43.0	3.0	3.0	11.7	60.7	0.6	76%
Rutherglen/Wahgunyah system	7	804	399	166	79	160	804	7	70%
Tallangatta	2	156	85	43	12	16	156	2	82%
Wodonga system	66	6,916	3,794	2,327	189	598	6,908	74	89%
Yarrawonga system	11	1,562	1,025	216	75	245	1,561	12	79%
Sub-alpine area									
Beechworth (3)	762	812	295	149	25	288	757	817	59%
Yackandandah	25	166	77	38	7	41	163	27	70%
Upper Murray River									
Corryong system	57	247	132	54	14	13	213	90	87%
Walwa	0.6	19.8	9.0	9.0	2.0	(0.3)	19.7	0.7	91%
Supplied from Groundwater									
Goorambat	0.8	13.3	11.0	1.0	0.0	2.0	14.0	0.1	86%

Notes:

(1) Where an account does not balance exactly, any unaccounted-for flows have been added to distribution system losses.

(2) The Bright system distribution loss has been adjusted for a large volume of unaccounted for loss. This appears to be due to the decrease in storage level over the water year.

(3) For the Myrtleford and Beechworth systems, the distribution system efficiency includes allowance for evaporation.

8.3.2 Goulburn Valley Water

Goulburn Valley Water provides urban water and wastewater services to over 125,000 people. It services about 57,500 properties in 54 towns, from the outskirts of Melbourne in the south to the Murray River in the north. Bulk water supply is principally from the Goulburn, Broken, Murray, Steavenson, Rubicon and Delatite rivers, and from some smaller local streams such as Sunday Creek and Seven Creeks. Table 8-3 summarises Goulburn Valley Water's urban distribution systems.

Table 8-3 Goulburn Valley Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Broken Creek	Nathalia	Broken Creek	Nathalia
	Numurkah system – Numurkah and Wunghnu	Broken Creek and the Murray 6/6 Channel	Numurkah
Goulburn channels	Towns supplied from Shepparton Irrigation Area – Dookie and Katandra West	Shepparton Irrigation Area	At each town
	Towns supplied from Central Goulburn Irrigation Area – Tatura, Kyabram, Tongala, Girgarre, Stanhope, Merrigum and Rushworth	Central Goulburn Irrigation Area	At each town except Merrigum, which is supplied from Kyabram
	Colbinabbin	Rochester Irrigation Area	Colbinabbin
	Corop	Rochester Irrigation Area	Disinfection only
Goulburn River	Alexandra	Regulated Goulburn River	Alexandra
	Murchison	Regulated Goulburn River	Murchison
	Nagambie	Regulated Goulburn River	Nagambie
	Seymour system – Seymour, Avenel, Mangalore and Tallarook	Regulated Goulburn River	Seymour
	Shepparton system – Shepparton, Mooroopna, Congupna, Toolamba and Tallygaroopna	Regulated Goulburn River	Shepparton
	Kirwans Bridge	Regulated Goulburn River	Disinfection only
	Molesworth	Regulated Goulburn River	Disinfection only
	Baxters Road	Regulated Goulburn River	Disinfection only
	Woods Point	Unregulated Goulburn River	Disinfection only
Goulburn River tributaries	Broadford system – Broadford and Waterford Park (Clonbinane)	Sunday Creek Reservoir and regulated Goulburn River at Tallarook	Broadford
	Euroa system – Euroa and Violet Town	Mountain Hut Creek and Seven Creeks	Euroa
	Kilmore system – Kilmore, Wandong and Heathcote Junction	Sunday Creek Reservoir, Hazels Creek	Kilmore
	Longwood	Nine Mile Creek	Longwood
	Mansfield	Delatite River	Mansfield
	Marysville and Buxton	Steavenson River	Marysville
	Pyalong	Mollisons Creek	Pyalong
	Strathbogie	Seven Creeks	Disinfection only
	Upper Delatite system – Sawmill Settlement and Merrijig	Delatite River	Sawmill Settlement
	Yea	Yea River	Yea
Lake Eildon	Bonnie Doon and Eildon	Brankeet Creek / Lake Eildon	Bonnie Doon
Murray channels	Katamatite and Picola	Murray Valley Irrigation Area	At each town
Murray River	Barmah	Murray River	Barmah
	Cobram system – Cobram, Strathmerton and Yarroweyah	Murray River	Cobram
Supplied from groundwater	Katunga		Disinfection only (1)

8.3 Northern region

Table 8-4 shows Goulburn Valley Water's urban distribution systems' water balances.

Table 8-4 Goulburn Valley Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)						End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses					
			To urban residential	To urban non-residential	From water treatment plants [1]	From distribution systems	Passed to other systems [3]	Total outflows		
Broken Creek										
Nathalia	-	484	223	89	10	94	68	484	-	79%
Numurkah system	-	1,077	607	236	169	35	30	1,077	-	81%
Goulburn Channels										
Towns supplied from Central Goulburn IA [1]	638	5,777	1,981	2,901	92	729	75	5,777	638	86%
Towns supplied from Rochester IA	0	44	26	8	1	3	5	44	0	90%
Towns supplied from Shepparton IA	0	168	101	23	30	9	5	168	0	77%
Goulburn River										
Alexandra	0	603	261	83	10	49	200	603	0	90%
Murchison	0	205	115	42	4	17	27	205	0	90%
Nagambie system	0	691	233	361	24	66	7	691	0	87%
Seymour system	0	1,845	943	363	47	219	273	1,845	0	86%
Shepparton system	0	13,222	6,571	4,686	281	832	853	13,222	0	92%
Woods Point	-	7.5	3.6	2.3	.1	1.5	0.0	7.5	-	79%
Goulburn River Tributaries										
Broadford system	62	623	422	106	(14)	113	0	625	60	84%
Euroa system	0	860	556	185	(2)	122	0	860	0	86%
Kilmore system	59	1,408	748	164	135	250	106	1,403	64	73%
Longwood	27	61	35	12	0	13	1	61	27	79%
Mansfield	428	950	396	159	137	230	60	983	395	63%
Marysville & Buxton [1]	92	297	90	39	7	152	9	297	92	47%
Pyalong [1]	14	42	31	4	(8)	13	0	40	16	88%
Thornton	-	41	25	17	0	0	0	41	-	100%
Upper Delatite system	-	96	46	9	14	10	18	96	-	76%
Yea system	-	244	156	60	7	22	0	244	-	88%
Lake Eildon										
Eildon and Bonnie Doon	45	187	100	57	6	22	3	187	45	86%
Murray Channels										
Katamatite and Picola	16	1,148	48	7	14	2	1,078	1,148	16	99%
Murray River										
Barmah	-	62	45	6	1	9	1	62	-	83%
Cobram system [1]	-	3,067	810	2,008	60	119	70	3,067	-	94%
Supplied from Groundwater										
Katunga	-	55	33	7	0	8	7	55	-	86%

Notes:

(1) *'Treatment plant losses'* are used as the balancing item. Where the treatment plant loss reported is negative, metering issues have been identified that explain the apparent unaccounted-for inflows.

(2) *'Passed to other systems'* includes estimated water treatment supernatant / backwash water returned to wastewater management facilities, rivers and channel systems (based on Goulburn Valley Water's 2012 water plan demand strategy forecast).

8.3.3 Goulburn–Murray Water

Goulburn–Murray Water manages water-related services for an area of 68,000 km^2 bordered by the Great Dividing Range in the south and the Murray River in the north and stretching from Corryong in the east downriver to Nyah. It supplies irrigators and other rural water users and provides bulk water supply to many towns within irrigation areas and along regulated rivers.

It operates two common distribution systems:

- the Waranga Western Channel
- the Victorian Mid-Murray Storages and associated bulk carriers.

It also operates nine irrigation and six other rural distribution systems, as shown in Table 8-8.

8.3.3.1 Waranga Western Channel

The Waranga Western Channel (WWC) sources most of its water from the Goulburn River at Goulburn Weir and is supplemented by extractions from the Campaspe and Loddon rivers. The major supply channels of Stuart Murray Canal and Cattenach Canal are included in the WWC. It supplies water to three irrigation areas, three domestic and stock areas and to Bendigo and Ballarat via the Goldfields Superpipe. The Waranga basin, a substantial off-stream storage, is also included in the WWC. It has been divided into three segments because it crosses three river basins: the division facilitates cap reporting to the Murray–Darling Basin Authority.

The water balance, divided into its three segments, is shown in Table 8-5.

Table 8-5 Waranga Western Channel water balance

Waranga Western Channel	Goulburn segment (ML)	Campaspe segment (ML) (1)	Loddon segment (ML) (2)	Eliminations (ML) (3)	Total (ML)
Volumes in store					
Start volume in store (1 July 2015)					
Waranga basin	151,694				151,694
Greens Lake		22,370			22,370
End volume in store (30 June 2016)					
Waranga basin	226,768				226,768
Greens Lake		17,862			17,862
Change in storage	**378,462**	**40,232**			**418,694**
Inflows					
From Goulburn River	844,568				844,568
Rainfall on Waranga basin	19,237				19,237
From WWC Goulburn segment		377,347		(377,347)	0
From Cornella Creek					
Rainfall on Greens Lake		2,047			2,047
From WWC Campaspe segment			201,263	(201,263)	0
From Loddon River			23,230		23,230
Unattributed inflows		3,189			3,189
Total inflows	**863,805**	**382,583**	**224,493**	**(578,610)**	**892,271**
Outflows					
Passed to other systems					
To Central Goulburn Irrigation area	350,585				350,585
To Goldfields superpipe					
To WWC Campaspe segment	377,347			(377,347)	0
To Rochester Irrigation Area		175,634			175,634
To WWC Loddon segment		201,263		(201,263)	0
To Loddon Valley Irrigation Area			203,100		203,100
To Campaspe River		450			450
To Loddon River			21,293		21,293
Total passed to other systems	**727,932**	**377,347**	**224,393**	**(578,610)**	**751,062**
Losses					
Evaporation from Waranga basin	49,100				49,100
Evaporation from Greens Lake		5,236			5,236
Unattributed Outflows	11,699		100		11,799
Total losses	**60,799**	**5,236**	**100**		**66,135**
Total outflows	**788,731**	**382,583**	**224,493**	**(578,610)**	**817,197**

Notes:

(1) The balancing item for the Campaspe segment is outflows to Rochester Irrigation Area.

(2) The balancing item for the Loddon segment is outflows to Pyramid–Boort Irrigation Area.

(3) The eliminations column removes the internal transfers between components of the Waranga Western Channel to enable a total balance for the channel to be presented in the 'Total' column in the table.

8.3.3.2 Victorian Mid-Murray Storages

The Victorian Mid-Murray Storages (VMMS) concept was introduced as a means of capturing a portion of the increased unregulated Victorian tributary flows into the Murray River resulting from the decommissioning of Lake Mokoan in the Broken River basin. These unregulated flows occur mainly from May to November.

The VMMS consists of Kow Swamp, Lake Boga, Lake Charm and Kangaroo Lake, which have a combined active capacity of nearly 58,000 ML. They are connected by a number of bulk carriers, for which losses are apportioned.

Each year, an average of 22,100 ML a year is harvested into Lake Boga, Lake Charm and Kangaroo Lake, and released. The capture of water offsets the reduction of the required annual release from the Snowy River to the Upper

Murray by retaining some unregulated flows in Victoria. The water is available to supplement Victoria's Murray resource.

Table 8-6 shows the water balance for the VMMS.

Table 8-6 Victorian Mid-Murray Storages water balance

VMMS	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	115,908
End volume in store (30 June 2016)	
Total Kow Swamp, Lake Charm, Kangaroo Lake, Lake Boga	108,566
Change in storage	**(7,342)**
Inflows	
Rain on all storages	14,734
Inflows from Torrumbarry Irrigation Area	46,985
Total inflows	**61,719**
Outflows	
Passed to other systems	
Lake Charm to Murray River	0
Lake Boga to Murray River	0
6/7 channel to Murray River	1,428
Total passed to other systems	**1,428**
Losses	
Evaporation on storages	56,191
Distribution losses (1)	11,442
Total losses	**67,633**
Total outflows	**69,061**

Note:
(1) Fixed allowance for distribution system losses.

8.3.3.3 Other distribution systems

Goulburn–Murray Water's other distribution systems are rural and are summarised in Table 8-7.

Table 8-7 Goulburn–Murray Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
Central Goulburn Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to seven towns in its area	Waranga Western Channel system – from Stuart Murray Canal, Waranga basin and Waranga Western Channel
Loddon Valley Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to four towns in its area and small volumes to the Torrumbarry Irrigation Area	Waranga Western Channel, Loddon River supplement and Torrumbarry Irrigation Area
Murray Valley Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to two towns in its area	Murray River via Yarrawonga Main Channel and pumps. Shepparton Irrigation Area via Lower Broken Creek
Nyah Irrigation District	Irrigation and domestic and stock to irrigators	Pumped from Murray River
Rochester Irrigation Area	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to four towns in its area	Waranga Western Channel
Shepparton Irrigation Area	Primarily irrigation and domestic and stock; also provides bulk supply to two towns in its area and to the Murray Valley system via the lower Broken Creek	Goulburn River at Goulburn Weir
Torrumbarry Irrigation Area and Gunbower Creek (excluding Woorinen, Tresco and VMMS)	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to VMMS, Tresco Irrigation Area, two towns in its area and significant supplies to environmental sites	National Channel and other minor sources from the Murray River; unregulated Loddon flows; small volumes from Pyramid–Boort Irrigation Area
Tresco Irrigation Area	Irrigation and domestic and stock to irrigators	Torrumbarry Irrigation Area
Woorinen Irrigation Area	Irrigation and domestic and stock to irrigators	Pumped from Murray
Other rural distribution systems		
East Loddon domestic and stock	Rural domestic and stock	Waranga Western Channel
Lower Broken Creek	Primarily irrigation and domestic and stock to irrigators; also provides bulk supply to two towns in its area	Shepparton Irrigation Area; minor unregulated inflows from upper Broken Creek
Normanville domestic and stock	Rural domestic and stock; also provides bulk supply to Quambatook urban	Waranga Western Channel
Tungamah domestic and stock	Rural domestic and stock	Shepparton Irrigation Area
Upper Broken Creek	Irrigation diversions	Broken River at Caseys Weir

West Loddon domestic and stock	Rural domestic and stock	Waranga Western Channel

Table 8-8 shows Goulburn–Murray Water's rural distribution systems' water balances.

Table 8-8 Goulburn–Murray Water rural distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses (1)	Passed to other systems	Total outflows		
			To rural customers	To other					
Irrigation districts									
Central Goulburn Irrigation area	-	350,585	278,444	0	66,865	5,276	350,585	-	81%
Murray Valley Irrigation area	-	316,747	193,557	0	48,598	74,592	316,747	-	85%
Nyah Irrigation area	-	6,224	5,094	0	1,130	-	6,224	-	82%
Loddon Valley Irrigation Area	-	226,330	154,543	2,000	46,324	23,463	226,330	-	80%
Rochester Irrigation area	-	178,823	151,075	0	25,875	1,873	178,823	-	86%
Shepparton Irrigation area	-	190,781	107,942	0	21,885	60,954	190,781	-	89%
Torrumbarry Irrigation area	12,326	671,326	246,926	50,364	121,125	252,143	670,558	13,094	82%
Tresco Irrigation area	-	6,106	5,711	0	395	-	6,106	-	94%
Woorinen Irrigation area	0	12,180	10,787	0	1,393	0	12,180	0	89%
Other rural distribution systems									
East Loddon domestic and stock	-	864	0	814	49	-	863	-	94%
Lower Broken Creek (1)	-	98,572	0	15,245	7,008	76,319	98,572	-	93%
Normanville domestic and stock	48	359	0	204	8	133	345	62	98%
Tungamah domestic and stock (1)	-	515	0	423	92	-	515	-	n/a
Upper Broken Creek	0	5,213	0	830	3,344	1,039	5,213	0	36%
West Loddon domestic and stock	0	301	0	301	0	-	301	0	100%

Note:

(1) The balancing item in Lower Broken Creek and Tungamah is unattributed inflows.

The Shepparton Irrigation Area had early take-up of modernisation — lined channels, some closure of spur channels, remotely operated weirs and gates and accurate metering. This is reflected in the system's 89% efficiency.

On the other hand, the Torrumbarry system's efficiency is 82%. This lower efficiency can be explained by it being only in the early stages of modernisation, as well as by the use of natural carriers like Gunbower Creek as part of the system.

8.3.4 Coliban Water

Coliban Water provides water and wastewater services to about 146,000 people in 49 towns across central and northern Victoria. The largest places it services are Bendigo, Castlemaine, Echuca and Kyneton. Coliban Water also supplies about 1,500 rural licence holders from 500 km of open channels in the Coliban rural water supply system extending from Malmsbury to Bendigo, and to Raywood and surrounding areas.

Coliban Water's service area is within parts of the Campaspe, Loddon, Murray, Goulburn and Avoca river basins. It operates two common distribution systems:

- the Goldfields Superpipe incorporating the Eppalock Pipeline which it jointly operates with Central Highlands Water
- the Coliban Main Channel.

Coliban Water operates nine urban water supply systems including two separate groundwater systems (Elmore and Trentham) and 11 rural subsystems.

8.3.4.1 Goldfields Superpipe

This pipeline transfers water from the Waranga Western Channel and from Lake Eppalock (Campaspe system) for use in the Coliban Water supply system and to supply water to Central Highlands Water's Ballarat system. Table 8-9 shows the superpipe's water balance.

8.3 Northern region

Table 8-9 Goldfields Superpipe water balance

Goldfields Superpipe	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	0
End volume in store (30 June 2016)	0
Change in storage	**-**
Inflows	
From Lake Eppalock - Coliban Water	18,988
From Lake Eppalock - Central Highlands Water	7,200
From Waranga Western Channel at Colbinabbin - Coliban Water	0
From Waranga Western Channel at Colbinabbin - Central Highlands Water	0
From Sandhurst Reservoir (1)	0
Total inflows	**26,188**
Outflows	
Deliveries to rural customers	
Direct deliveries to rural customers	334
Total deliveries to rural customers	**334**
Passed to other systems	
To Emu Valley rural channel sub-system	239
To Axe Creek rural channel sub-system	472
To Specimen Hill rural channel sub-system	2,195
Transfer to Central Highlands Water (to White Swan Reservoir)	0
To Heathcote urban system (Caledonia Reservoir)	0
To Sandhurst Reservoir-Coliban Water	20,448
To Spring Gully Reservoir	2,317
Total passed to other systems	**25,671**
Total outflows	**26,005**
System efficiency (%)	**99%**

Note:

(1) Flows from Sandhurst Reservoir – Coliban Water is the balancing item in this water balance.

8.3.4.2 Coliban Main Channel

This channel conveys water from the Coliban storages (Upper Coliban, Lauriston and Malmsbury reservoirs) to supply rural subsystems and the Coliban North and Coliban South urban water supply systems. Table 8-10 shows the water balance for the Coliban Main Channel.

Table 8-10 Coliban Main Channel water balance

Coliban Main Channel	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	0
End volume in store (30 June 2016)	0
Change in storage	**–**
Inflows	
From Malmsbury reservoir	10,212
Total inflows	**10,212**
Outflows	
Deliveries to rural customers	
Direct deliveries to rural customers	478
Total deliveries to rural customers	**478**
Passed to other systems	
To Coliban North system at Sandhurst Reservoir	472
To Poverty Gully rural sub-system	2,726
To Harcourt rural sub-system	3,373
To Emu Valley rural Sub-system	1,335
To Spring Gully rural sub-system	1,083
To Specimen Hill rural sub-system	7
Total passed to other systems	**8,996**
Losses	
System losses (1)	737
Total losses	**737**
Total outflows	**10,211**
System efficiency (%)	**93%**

Note:

(1) System losses are unknown and are represented as the balancing item for this account.

8.3.4.3 Rural distribution systems

Coliban Water's rural distribution system supplies licenced rural customers (including domestic and stock, and irrigation customers) with entitlements of about 15,800 ML in rural areas extending from Castlemaine to Bendigo, and further north to Raywood. Table 8-11 shows Coliban Water's rural distribution systems' water balances.

Table 8-11 Coliban Water rural distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Deliveries to rural customers	Losses (1)	Passed to other systems	Total outflows		
Ascot	0	1,129	929	200	0	1,129	0	82%
Axe Creek (2)	0	362	149	213	0	362	0	41%
Cockatoo Hill	0	669	313	356	0	669	0	47%
Emu Valley	0	1,213	603	610	0	1,213	0	50%
Harcourt	1,160	4,259	1,110	3,249	0	4,359	1,060	25%
Jackass Flat	0	31	8	23	0	31	0	26%
Lockwood	0	1,016	560	456	0	1,016	0	55%
Poverty Gully (3)	0	2,830	14	509	2,307	2,830	0	82%
Specimen Hill (4)	0	1,860.0	281.0	532.0	1,047.0	1,860.0	0	71%
Spring Gully Reservoir (5)	702	2,882	289	655	1,798	2,742	842	76%
Spring Gully (6)	0	281	92	141	48	281	0	50%

Notes:

(1) Losses are the balancing item for all systems.
(2) Deliveries include 26 ML delivered to Longlea Reservoir.
(3) 'Passed to other systems' represents a transfer to the urban Castlemaine system.
(4) '*Passed to other systems*' represents a transfer to Jackass Flat and Lockwood.
(5) '*Passed to other systems*' represents a transfer to Ascot and Cockatoo Hill.
(6) '*Passed to other systems*' represents a transfer to Spring Gully Reservoir.

In some rural distribution systems, customers have relinquished their licences due to urban encroachment. This is particularly true for Jackass Flat, and has led to low efficiencies in channels in this area during 2015–16.

8.3.4.4 Urban distribution systems

Table 8-12 summarises Coliban Water's nine urban distribution systems.

Table 8-12 Coliban Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Campaspe	Goornong	Campaspe River	Goornong
Coliban Northern	Bendigo system - Bendigo, Axedale, Raywood and Sebastian	Coliban storages (via Main Channel), Lake Eppalock and the Goulburn system (Lake Eildon and Waranga basin via Goldfields Superpipe)	Bendigo and Raywood
	Heathcote and Tooborac	Lake Eppalock and the Goulburn system (via Goldfields Superpipe)	Heathcote
Coliban Southern	Castlemaine system – Castlemaine, Maldon, Campbells Creek, Chewton, Newstead, Elphinstone, Taradale and Harcourt	Coliban storages (via Coliban Main Channel)	Castlemaine
	Kyneton system – Kyneton, Malmsbury and Tylden	Lauriston Reservoir	Kyneton
Elmore groundwater	Elmore	Lower Campaspe Valley Water Supply Protection Area	Elmore
Goulburn	Towns supplied from Pyramid–Boort Irrigation Area – Boort, Dingee, Macorna, Mitiamo, Mysia and Pyramid Hill	Goulburn system (Lake Eildon and Waranga basin)	Boort and Pyramid Hill; No treatment at Dingee, Macorna, Mitiamo and Mysia
	Towns supplied from Rochester Irrigation Area – Lockington and part of Rochester	Goulburn system (Lake Eildon and Waranga basin)	Lockington and Rochester
Loddon	Bridgewater system – Bridgewater and Inglewood	Loddon River	Bridgewater
	Jarklin	Loddon River – Serpentine Creek and tankered	No treatment (not a drinking water supply)
	Laanecoorie system – Laanecoorie, Tarnagulla, Bealiba and Dunolly	Loddon River	Laanecoorie
	Serpentine	Loddon River – Serpentine Creek and tankered	Serpentine
Murray	Cohuna rural system – Cohuna, Mead, Gunbower	Murray River – Gunbower Creek	Cohuna
	Echuca	Murray River	Echuca
	Gunbower	Murray River – Taylors Creek	Gunbower
	Leitchville	Murray River – Gunbower Creek and Cohuna irrigation channel	Leitchville
Trentham Groundwater	Trentham	Spring water and groundwater from Campaspe basin	Trentham
Wimmera	Borung	Wimmera–Mallee Pipeline	No treatment (not a drinking water supply)
	Korong Vale and Wedderburn	Wimmera–Mallee Pipeline	Korong Vale
	Wychitella	Wimmera–Mallee Pipeline	No treatment (not a drinking water supply)

Table 8-13 shows Coliban Water's urban distribution systems' water balances.

Table 8-13 Coliban Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries						
			To urban residential	To urban non-residential	Distribution system losses (1)	Passed to other systems	Total outflows		
Campaspe									
Goornong	-	73	35	19	19	-	73	-	74%
Coliban Northern									
Bendigo system	2,072	14,015	8,749	3,066	1,677	0	13,492	2,595	88%
Heathcote system	162	464	166	115	151	-	432	194	65%
Coliban Southern									
Castlemaine system - McKay Reservoir	1,168	2,418	1,059	856	645	-	2,560	1,026	75%
Kyneton system	-	958	491	398	69	-	958	-	93%
Goulburn system									
Supplied from PH-Boort Irrigation Area (2)	0	434	180	79	175	-	434	0	60%
Supplied from Rochester Irrigation Area (3)	0	1,530	460	669	401	-	1,530	0	74%
Loddon system									
Bridgewater system	0	230	90	59	81	-	230	0	65%
Jarklin	-	1	1	0	0	-	1	0	100%
Laanecoorie system	-	146	79	37	30	-	146	-	79%
Serpentine	-	33	16	4	13	-	33	-	61%
Murray system									
Cohuna	-	808	350	296	162	-	808	-	80%
Echuca	-	3,552	1,844	1,368	340	-	3,552	-	90%
Gunbower	-	63	38	14	11	-	63	-	83%
Leitchville	-	224	49	121	54	0	224	-	76%
Wimmera system									
Borung	-	4	4	0	0	-	4	-	100%
Koorong Vale - Wedderburn	-	220	86	46	88	-	220	-	60%
Wychitella	-	2	1	1	0	-	2	-	100%
Supplied by groundwater									
Elmore	-	148	74	57	17	-	148	-	89%
Trentham (4)	69	108	75	20	21	-	116	61	82%

Notes:

(1) Distribution system losses are the balancing item for all systems.

(2) Trentham water passed to other systems is spilled down Trent Creek.

8.3.5 Lower Murray Water

Lower Murray Water's area of operation extends along the Murray River from Kerang to the South Australian border, taking in the municipalities of Mildura, Swan Hill and Gannawarra. It provides the region with urban water (and wastewater) services, and it supplies river-quality water to domestic and stock users as well as irrigation customers. It also operates subsurface irrigation drainage water collection systems.

Lower Murray Water operates four irrigation distribution systems, three other rural distribution systems and 10 urban distribution systems.

8.3 Northern region

Table 8-14 summarises Lower Murray Water's rural distribution systems.

Table 8-14 Lower Murray Water rural distribution systems

System	Customers supplied	Source of supply
Irrigation distribution systems		
First Mildura Irrigation District	Primarily irrigators both in and adjacent to the district, which supplies irrigation and domestic and stock	Murray River at Mildura pumps
Merbein Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock; also passes water to the Wargan–Yelta part of the Cardross–Yelta waterworks district	Murray River at Merbein pumps
Red Cliffs Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock; also supplies environmental water to Cardross basin and passes water to the Cardross part of the Cardross–Yelta waterworks district	Murray River at Red Cliffs pumps
Robinvale Irrigation District	Primarily irrigators, both in and adjacent to the district, which supplies irrigation and domestic and stock customers	Murray River at Robinvale pumps
Other rural distribution systems		
Cardross–Yelta waterworks district – Cardross part only	Domestic and stock customers	Red Cliffs Irrigation District
Millewa waterworks district	Primarily piped supply to domestic and stock customers; also supplies three small towns and irrigation water diverted from Lake Cullulleraine	Murray River at Lake Cullulleraine pumps
Cardross–Yelta waterworks district – Wargan–Yelta part only	Domestic and stock customers	Merbein Irrigation District

Table 8-15 shows Lower Murray Water's rural distribution systems' water balances.

Table 8-15 Lower Murray Water rural distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries						
			To rural customers	To other	Losses	Passed to other systems	Total outflows		
Irrigation distribution systems									
First Mildura Irrigation District	-	39,275	34,903	433	3,939	0	39,275	-	90%
Merbein Irrigation District	-	21,417	19,067	0	2,242	0	21,309	-	89%
Red Cliffs Irrigation District	-	31,591	27,513	1,032	3,046	0	31,591	-	90%
Robinvale Irrigation District	-	21,865	21,865	0	0	0	21,865	-	100%
Other rural distribution systems									
Millewa water works district (1)	120	1,091	842	0	188	61	1,091	120	83%
Yelta water works district	-	2,675	2,675	0	0	0	2,675	-	100%

Note:
(1) For the Millewa waterworks district, the distribution system efficiency includes allowance for evaporation losses from Lake Cullulleraine (off-stream storage).

Table 8-16 summarises Lower Murray Water's urban distribution systems.

Table 8-16 Lower Murray Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location / comment
Kerang	Murray River, Loddon River, Torrumbarry Irrigation Area	Kerang
Koondrook	Murray River	Koondrook
Mildura system – Mildura (including Cardross, Koorlong and Nicholls Point), Merbein and Irymple	Murray River	Mildura
Millewa system – Werrimull, Meringur and Cullulleraine	Millewa waterworks district	Millewa
Murrabit	Murray River	Murrabit
Mystic Park	Victorian Mid-Murray Storage (Lake Kangaroo)	Raw water supply only (no treatment plant)
Piangil	Murray River	Piangil
Red Cliffs	Murray River	Red Cliffs
Robinvale	Murray River	Robinvale
Swan Hill system – Swan Hill, Lake Boga, Nyah, Nyah West, Woorinen South and Wakool Shire (NSW)	Murray River	Swan Hill

Table 8-17 shows Lower Murray Water's urban distribution systems' water balances.

Table 8-17 Lower Murray Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses (1)	Total outflows		
			To urban residential	To urban others				
Kerang	6	1,133	814	189	130	1,133	6	88%
Koondrook	3	255	186	21	48	255	3	81%
Mildura system	48	12,973	9,774	2,673	526	12,973	48	96%
Millewa system	0	61	61	0	0	61	0	100%
Murrabit	2	42	20	8	14	42	2	66%
Mystic Park	-	13	6	1	6	13	-	54%
Piangil	1	129	52	55	22	129	1	83%
Red Cliffs	7	1,345	704	520	121	1,345	7	91%
Robinvale	5	654	406	194	54	654	5	92%
Swan Hill system	14	4,321	2,886	989	446	4,321	14	90%

Note:

(1) Distribution system losses are used as the balancing item for all systems.

8.4 Gippsland region

8.4.1 East Gippsland Water

East Gippsland Water's service area spans 21,000 km^2. It extends east from Lindenow through to the region's capital Bairnsdale, the holiday centres of Paynesville and Lakes Entrance, and on to the Wilderness Coast and Mallacoota near the New South Wales border. The corporation also serves as far north as Dinner Plain in the High Country of the Victorian Alps. Water services are provided to more than 35,000 customers via nine separate water supply systems.

Table 8-18 summarises East Gippsland Water's urban distribution systems.

Table 8-18 East Gippsland Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Bemm River	Bemm River	Bemm River
Buchan	Buchan River	Buchan
Cann River	Cann River	Cann River
Dinner Plain	Groundwater	Dinner Plain
Mallacoota	Betka River and groundwater	Mallacoota
Mitchell system – Bairnsdale, Paynesville, Lindenow, Lindenow South, Eagle Point, Newlands Arm, Raymond Island, Banksia Peninsula, Granite Rock, Wy Yung, Bruthen, Sarsfield, Nicholson, Johnsonville, Swan Reach, Metung, Lakes Entrance, Lake Bunga, Lake Tyers, Lake Tyers Beach and Nowa Nowa	Mitchell River at Glenaladale	Woodglen
Omeo	Butchers Creek	Omeo
Orbost system – Orbost, Newmerella and Marlo	Rocky and Brodribb rivers	Orbost
Swifts Creek	Tambo River	Swifts Creek

Table 8-19 shows East Gippsland Water's urban distribution systems' water balances.

Table 8-19 East Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Distribution system losses	Total outflows		
			To urban residential	To urban non-residential				
Bemm River	3	27	10	6	8	24	5	66%
Buchan	0	23	11	8	4	23	0	83%
Cann River	2	36	14	15	6	35	3	82%
Dinner Plain	0	47	20	10	17	47	0	64%
Mallacoota	61	157	98	47	22	167	51	87%
Mitchell system	1,446	4,280	2,532	1,208	900	4,640	1,086	81%
Omeo	5	60	26	19	15	60	6	75%
Orbost system	37	697	237	378	100	715	19	86%
Swifts Creek	3	25	13	11	1	25	4	96%

8.4.2 Gippsland Water

Gippsland Water services an area of just over 5,000 km^2 in the Latrobe Valley. The area has a population of more than 65,000 people. Major industries include dairy, energy and pulp and paper.

Table 8-20 summarises Gippsland Water's urban distribution systems.

Table 8-20 Gippsland Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Macalister–Thomson	Maffra system – Boisdale, Maffra and Stratford	Macalister River	Maffra
	Coongulla system – Coongulla and Glenmaggie	Lake Glenmaggie	Coongulla
	Heyfield	Thomson River	Heyfield
	Briagalong	Groundwater	Briagalong
Moe	Moe system – Moe, Newborough, Yallourn North, Trafalgar, Darnum and Yarragon	Narracan Creek and Tanjil River	Moe
Moondarra Reservoir	Moondarra system – Boolarra, Churchill, Cowwarr, Glengarry, Hazelwood North, Jumbuck, Morwell, Rosedale, Toongabbie, Traralgon,	Moondarra Reservoir	Morwell, Traralgon and Tyers

	Tyers and Yinnar		
Sale	Sale and Wurruk	Groundwater	Sale
Warragul–Drouin	Warragul system – Buln Buln, Drouin, Nilma, Warragul and Warragul South	Tarago River	Warragul
Small towns in Latrobe and South Gippsland basins	Boolarra	Walkleys / O'Gradys Creek	Boolarra
	Erica and Rawson	Trigger Creek	Rawson
	Mirboo North	Little Morwell River	Mirboo North
	Neerim South and Noojee	Tarago Reservoir	Neerim South
	Seaspray	Merrimans Creek	Seaspray
	Thorpdale	Easterbrook Creek	Thorpdale
	Willow Grove	Blue Rock Reservoir	Willow Grove

Table 8-21 Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Total outflows		
			To urban residential	To urban non-residential (1)	From treatment plants	From distribution systems			
Erica and Rawson	33	63	35	17	3	8	63	33	83%
Macalister – Thomson area	41	1,548	798	517	43	188	1,546	42	85%
Mirboo North	2	196	118	32	10	36	196	2	77%
Moe system	51	3,696	1,681	1,736	75	205	3,697	50	92%
Moondarra system	716	48,483	4,571	41,489	547	1,867	48,474	725	95%
Neerim South and Noojee	4	218	152	26	2	39	219	3	81%
Sale and Wurruk	19	1,850	1,151	459	61	178	1,849	20	87%
Seaspray	3	36	21	5	5	4	35	3	73%
Thorpdale	2	12	9	3	0	2	14	0	86%
Warragul system	90	3,323	1,992	585	237	533	3,347	66	77%
Willow Grove	0	42	32	1	3	6	42	0	79%

Notes:

(1) 'Urban non-residential' includes non-residential use and includes major industry users in some systems.

8.4.3 Southern Rural Water (Macalister system)

Southern Rural Water is responsible for rural water supplies across the whole of southern Victoria (except for water supplied by Wannon Water to its rural customers) from the Great Dividing Range to the coast, and from the South Australian border to the New South Wales border. The majority of Southern Rural Water's customers are direct diverters from unregulated streams or groundwater, but it also operates three irrigation districts.

The largest of these is the Macalister Irrigation District, which is supplied principally from Lake Glenmaggie on the Macalister River and from Cowwarr Weir on the Thomson River. Werribee and Bacchus Marsh irrigation districts are reported in the Central Region section.

Table 8-22 shows the water balance for the Macalister Irrigation District.

Table 8-22 Southern Rural Water Macalister Irrigation District water balance

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Irrigation deliveries (1)	Passed to other systems (2)	Losses	Total outflows		
Macalister Irrigation District	-	167,574	122,456	16,629	28,489	167,574	-	83%

Notes:

(1) '*Irrigation deliveries'* include supply to domestic and stock customers.

(2) *'Passed to other systems'* includes water returned to the Thomson and Macalister rivers (outfalls) as well as deliveries to Gippsland Water urban systems

8.4.4 South Gippsland Water

South Gippsland Water supplies 21 rural centres in South Gippsland from Wonthaggi in the west to Yarram and Alberton in the east. It operates 10 separate urban distribution systems and covers a total area of about 4,000 km^2.

Table 8-23 summarises South Gippsland Water's urban distribution systems.

Table 8-23 South Gippsland Water urban distribution systems

System / towns supplied	Source of supply	Treatment plant location
Dumbalk	Tarwin River (east branch)	Dumbalk
Fish Creek	Battery Creek	Fish Creek
Foster	Deep Creek / Foster Dam	Foster
Korumburra	Coalition Creek storage network	Korumburra
Leongatha and Koonwarra	Ruby Creek storage network	Leongatha
Loch system – Loch, Nyora and Poowong	Little Bass River	Poowong
Meeniyan	Tarwin River (west branch)	Meeniyan
Toora system – Toora, Port Franklin, Welshpool and Port Welshpool	Agnes River	Toora
Wonthaggi system – Wonthaggi, Inverloch and Cape Patterson	Lance Creek and Lance Creek Reservoir	Lance Creek
Yarram system – Devon North, Alberton, Yarram and Port Albert	Tarra River	Devon North

Table 8-24 shows South Gippsland Water's urban distribution systems' water balances.

Table 8-24 South Gippsland Water urban distribution systems' water balances

Area/system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Total outflows		
			To urban residential	To urban non-residential	Reticulation losses	Other system losses (1)			
Dumbalk	-	16	11	5	0	0	16	-	100%
Fish Creek	-	111	12	54	40	5	111	-	59%
Foster	-	180	83	70	9	18	180	-	85%
Korumburra	-	673	246	293	116	18	673	-	80%
Leongatha	-	1,732	389	1,164	85	94	1,732	-	90%
Loch system	-	231	77	90	54	10	231	-	72%
Meeniyan	-	64	36	17	4	7	64	-	83%
Toora system	-	525	72	252	154	47	525	-	62%
Wonthaggi system	-	1,719	998	482	193	46	1,719	-	86%
Yarram system	-	478	152	226	61	39	478	-	79%

Note:

(1) '*Other system losses*' is the balancing item in these accounts.

8.5 Central region

8.5.1 Westernport Water

Westernport Water supplies towns and adjacent properties on Phillip Island, and on the eastern shore of Western Port from The Gurdies to Dalyston. Water is sourced from:

- Candowie Reservoir, a storage on Tennant Creek in the South Gippsland river basin
- direct diversion from the Bass River
- Corinella Aquifer via three groundwater bores.

Water is treated at Candowie Reservoir and passed to the San Remo storage basin, from which it is delivered via a single, integrated distribution system. A permanent population of about 19,000 people is supplied: the population swells to over 100,000 people in peak holiday periods.

Table 8-25 summarises Westernport Water's distribution system's water balances.

Table 8-25 Westernport Water distribution system's water balance

Westernport Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	-
End volume in store (30 June 2016)	-
Change in storage	**-**
Inflows	
From Candowie Reservoir	2,139
From Bass River	0
Recycled water	70
Total inflows	**2,209**
Outflows	
Deliveries	
To residential customers	1,161
To non-residential customers	728
Total deliveries	**1,819**
Losses	
System losses	320
Total losses	**320**
Total outflows	**2,209**
System efficiency (%)	**86%**

8.5.2 Melbourne Water

Melbourne Water operates a 'common' or wholesale distribution system for the greater Melbourne metropolitan area as well as for connected regional water authorities. It spans four river basins (Bunyip, Yarra, Maribyrnong and Werribee). Water is harvested from the Bunyip, Yarra, Thomson and Goulburn river basins. The distribution system draws from several on-stream storages and includes four significant off-stream storages (Silvan, Cardinia, Sugarloaf and Greenvale reservoirs).

Melbourne Water supplies the three Melbourne retail water corporations (South East Water, Yarra Valley Water and City West Water). It also supplies the bulk entitlement holders in the Greater Yarra system – Thomson River Pool — City West Water, South East Water, Yarra Valley Water, Barwon Water, South Gippsland Water, Western Water and Westernport Water.

Most of the inflows come from protected catchments in the Yarra, Bunyip and Thomson basins, and minimal treatment (chlorination) is required. However, about 20% come from unprotected catchments and are fully treated by treatment plants at Sugarloaf, Tarago and Yan Yean storages.

Table 8-26 summarises Melbourne Water's distribution system's water balance.

8.5 Central region

Table 8-26 Melbourne Water distribution system's water balance

Melbourne Water	Volume (ML)
Volumes in store (1)	
Start volume in store (1 July 2015)	
Silvan Reservoir	34,021
Cardinia Reservoir	166,957
Sugarloaf Reservoir	65,804
Greenvale Reservoir	22,342
Total start volume	**289,124**
End volume in store (30 June 2016)	
Silvan Reservoir	35,962
Cardinia Reservoir	181,593
Sugarloaf Reservoir	65,804
Greenvale Reservoir	21,492
Total end volume	**304,851**
Change in storage	**15,727**
Inflows	
From Yarra basin to Silvan	348,551
From Yarra basin to Sugarloaf	88,038
From Goulburn River to Sugarloaf	0
From Tarago Reservoir	12,255
Rainfall on four main storages	14,911
Unaccounted for inflow	5,361
Total inflows	**469,116**
Outflows	
Passed to other systems	
To South East Water	154,460
To Yarra Valley Water	159,762
To City West Water	111,775
To Western Water	5,601
To Gippsland Water	931
To Cardinia Creek from Cardinia	1,830
To Stonyford Creek from Silvan	732
Total passed to other systems	**435,091**
Losses	
Evaporation from four main storages	16,962
System losses (2)	1,336
Total losses	**18,298**
Total outflows	**453,389**
System efficiency	96%

Notes:
(1) Storage figures do not include service reservoirs and tanks.
(2) System losses include treatment plant losses, but exclude aqueduct leaks as that is outside of the common distribution system.

Factors contributing to the unaccounted-for inflows include ungauged run-off from the catchments of reservoirs, as well as outflows passed to other systems being more accurately metered than inflows to the distribution system.

8.5.3 South East Water

South East Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering south-east Melbourne, the Mornington Peninsula and part of South Gippsland.

Table 8-27 shows South East Water's urban distribution system's water balance.

Table 8-27 South East Water urban distribution system's water balance

South East Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	523
End volume in store (30 June 2016)	523
Change in storage	**0**
Inflows	
From Melbourne Water	154,510
Recycled water - imported from bulk supplier	2,030
Recycled water - imported from local treatment plant	3,968
Unaccounted for inflow	4,795
Total inflows	**165,303**
Outflows	
Deliveries	
To residential customers	103,377
To non-residential customers	36,535
Non-revenue consumptive delivery	5,625
Recycled water used	5,386
Total deliveries	**150,923**
Losses	
System losses (1)	14,380
Total losses	**14,380**
Total outflows	**165,303**
System efficiency (%)	**91%**

Note:
(1) The balancing item in this account is system losses (back-calculated from total inflows).

8.5.4 Yarra Valley Water

Yarra Valley Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering the part of greater Melbourne that is in the Yarra basin, extending to Warburton in the east and Wallan in the north. Table 8-28 shows Yarra Valley Water's urban distribution system's water balance.

Table 8-28 Yarra Valley Water urban distribution system's water balance

Yarra Valley Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	-
End volume in store (30 June 2016)	-
Change in storage	**-**
Inflows	
From Melbourne Water	159,762
Total inflows	**159,762**
Outflows	
Deliveries	
To residential customers	110,847
To non-residential customers	29,798
Non-revenue consumptive delivery	3,452
Total deliveries	**144,097**
Losses	
System losses (1)	15,429
Unaccounted for outflow	236
Total losses	**15,665**
Total outflows	**159,762**
System efficiency	**90%**

Note:
(1) The balancing item in this account is system losses (back-calculated from total inflows).

8.5.5 City West Water

City West Water is one of Melbourne's three retail water corporations. It obtains treated bulk water from Melbourne Water and operates a single, integrated distribution system covering Melbourne's central business district and its inner and western suburbs. Table 8-29 shows City West Water's urban distribution system's water balance.

Table 8-29 City West Water urban distribution system's water balance

City West Water	Volume (ML)
Volumes in store	
Start volume in store (1 July 2015)	-
End volume in store (30 June 2016)	-
Change in storages [(1)]	-
Inflows	
From Melbourne Water	111,621
Recycled water - imported from bulk supplier [(1)]	282
Unaccounted for inflow	2,279
Total inflows	**114,182**
Outflows	
Deliveries	
To residential customers	58,362
To non-residential customers	42,720
Recycled water used	2,560
Non-revenue consumptive delivery	2,692
Total deliveries	**106,334**
Losses	
System losses [(2)]	7,848
Total losses	**7,848**
Total outflows	**114,182**
System efficiency	**93%**

Notes:
(1) The recycled / imported inflows amount represents a bulk purchase from Melbourne Water.
(2) The balancing item in this account is system losses (back-calculated from total inflows).

8.5.6 Western Water

Western Water is services a rapidly growing area to the west of and adjacent to Melbourne.

It operates a main integrated distribution system, with a separate supply to Myrniong. Romsey utilises local water for most of the time, but can be supplemented from the main integrated system in times of drought.

Table 8-30 summarises Western Water's urban distribution systems.

Table 8-30 Western Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Main integrated system	Sunbury, Gisborne, Bacchus Marsh, Diggers Rest, Riddles Creek, Macedon, Melton, Mount Macedon, Romsey, Woodend and Lancefield	Bulk supply from Melbourne Water, Rosslynne Reservoir system, Merrimu Reservoir, Djerriwarrh Reservoir and Kerrie Reservoir, Garden Hut Reservoir and groundwater, Campaspe Reservoir and Campaspe River tributaries, Mount Macedon storages and tributaries *(indirectly supplemented from integrated system in times of drought)*	Melton, Gisborne, Romsey, Lancefield, Woodend
Myrniong	Myrniong	Pykes Creek Reservoir	Myrniong

Table 8-31 shows Western Water's urban distribution systems' water balances.

Table 8-31 Western Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)						End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Passed to other systems	Total outflows		
			To urban residential	To urban other	Reticulation [(1)]	Other system losses [(2)]				
Main integrated system	1,289	15,345	10,986	2,025	1,296	993	-	15,300	1,334	85%
Myrniong	-	51	36	7	0	9	-	51	-	83%

Notes:
(1) Reticulation losses represent the losses in the reticulation system.
(2) Other system losses represent the loss of water from the point of extraction from the source and the reticulation system (and is a balancing item).

8.5.7 Barwon Water

Barwon Water supplies the greater Geelong area (including the Bellarine Peninsula and towns as far west as Birregurra and Forrest) and the Colac, Aireys Inlet, Lorne and Apollo Bay areas.

Table 8-32 summarises Barwon Water's urban distribution systems.

Table 8-32 Barwon Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Aireys Inlet	Aireys Inlet and Fairhaven	Painkalac Reservoir on the Painkalac Creek	Aireys Inlet
Apollo Bay	Apollo Bay, Marengo and Skenes Creek	Diversion weir on the West Barham River in the Otway Ranges	Near Marengo
Colac system	Colac urban, and rural areas and towns including Gellibrand, Pirron Yallock, Irrewarra, Coragulac, Alvie, Beeac and Cressy	Olangolah and West Gellibrand reservoirs, which are fed by streams in the Otway Ranges	Colac
Greater Geelong and Bellarine Peninsula system	Greater Geelong – Geelong, Anakie, Avalon, Balliang, Bamganie, Bannockburn, Batesford, Birregurra, Fyansford, Gheringhap, Inverleigh, Leopold, Lethbridge, Little River, Marshall, Maude, Meredith, Modewarre, Moorabool, Moriac, Mount Moriac, Murgheboluc, She Oaks, Shelford, Staughton Vale, Sutherlands Creek, Teesdale, Thompson, Winchelsea and Wurdiboluc) Bellarine Peninsula – Barwon Heads, Bellarine, Breamlea, Clifton Springs, Curlewis, Drysdale, Indented Head, Mannerim, Marcus Hill, Ocean Grove, Point Lonsdale, Portarlington, Queenscliff, St Leonards, Swan Bay and Wallington)	Barwon River system – West Barwon Reservoir on the West Barwon River	Wurdee Boluc
		Moorabool River system – various streams in the Moorabool basin	She Oaks
		Barwon Downs borefield – Barwon Downs Aquifer	At bores
		Anglesea borefield – Lower Eastern View formation	At bores
Lorne	Lorne	Allen Reservoir on the St George River, west of Lorne	Lorne

Table 8-33 shows Barwon Water's urban distribution systems' water balances.

Table 8-33 Barwon Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Total outflows		
			To urban residential	To urban other	Reticulation [1]	Other system losses [2]			
Aireys Inlet	0	209	164	14	25	6	209	0	85%
Apollo Bay	356	429	204	119	32	61	416	369	78%
Colac system	577	3,840	1,522	1,295	99	1,008	3,924	493	72%
Greater Geelong and Bellarine Peninsula system	25,713	30,169	21,531	8,453	1,674	5,689	37,347	18,535	80%
Lorne	0	432	246	93	39	54	432	0	78%

Notes:
(1) '*Reticulation losses'* represent the losses in the reticulation system.
(2) *'Other system losses'* represent the loss of water from the point of extraction from the source and the reticulation system (and is a balancing item).

8.5.8 Central Highlands Water

Central Highlands Water supplies water to the greater Ballarat region and to numerous other towns and districts ranging from Ballan in the east to Landsborough and Navarre in the north-west and Rokewood in the south. Supply and distribution systems spread across seven river basins, both north and south of the Great Dividing Range.

Table 8-34 summarises Central Highlands Water's urban distribution systems.

8.5 Central region

Table 8-34 Central Highlands Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Greater Ballarat (multiple basins)	Greater Ballarat system – Alfredton, Ballan, Ballarat, Black Hill, Brown Hill, Bungaree, Buninyong, Corindhap, Creswick, Golden Point, Gordon, Linton, Mt Clear, Scarsdale, Smythesdale, Snake Valley, Skipton and Wallace	White Swan Reservoir in the Barwon basin, Lal Lal Reservoir in the Moorabool basin, Ballarat West groundwater bores and the Goldfields Superpipe which extracts water from the Goulburn basin	
Maryborough and district (Loddon basin)	Maryborough system –Adelaide Lead, Alma/Moonlight, Betley, Carisbrook, Craigie, Daisy Hill, Havelock, Majorca, Maryborough, Rodborough, Simson/Bet Bet, Talbot and Timor/Bowenvale	Evansford and Talbot reservoirs (which source water from McCallums Creek) and Tullaroop Reservoir on the Loddon River	Single treatment plant at the central holding basin (Centenary Reservoir)
Individual or small groups of towns	Amphitheatre (Avoca basin)	Reservoir on Forest Creek	None (non-potable supply)
	Avoca (Avoca basin)	Sugarloaf Reservoir in the Avoca basin	Avoca
	Beaufort and Raglan (Hopkins basin)	Musical Gully Reservoir, which captures water via diversion weirs from streams in the Hopkins basin	Supply to Raglan is untreated; supply to Beaufort is chlorinated at Musical Gully
	Blackwood and Barrys Reef (Werribee basin)	Blackwood Basin, which is supplied by diversion from Kyneton Gully Creek and Long Gully Creek; supplemented by emergency groundwater bore	UV disinfection at Blackwood basin
	Clunes (Loddon basin)	Groundwater bore	Hardness removed and disinfected; treatment plant is adjacent to the bore
	Daylesford system –Daylesford, Hepburn and Hepburn Springs (Loddon basin)	Three small storages supplied from various streams	Single treatment plant for the three towns
	Dean (Loddon basin)	Groundwater bore	Chlorine disinfection
	Forest Hill system (Loddon basin) – Allendale, Newlyn, Smeaton, Kingston, Springmount, Broomfield and homes in rural areas	Three groundwater bores at Forest Hill	Hardness removed and disinfected; treatment plant is adjacent to the bores
	Landsborough and Navarre (Wimmera basin)	Landsborough Reservoir, which is supplied by diversions from several streams; supplemented by a drought-relief bore	None (non-potable supply)
	Learmonth (Loddon basin)	Groundwater bore	High-quality supply, little treatment is required
	Lexton (Loddon basin)	Lexton Reservoir, which captures water from springs in its catchment	Lexton Reservoir
	Redbank (Avoca basin)	Redbank Reservoir on the upper Avoca River, with a supplementary groundwater bore	None (non-potable supply)
	Waubra (Loddon basin)	Two groundwater bores	Chlorination at storage tanks

Table 8-35 shows Central Highlands Water's urban distribution systems' water balances. All Central Highlands Water reservoirs are on-stream and hence not included in water balance calculations. Also, White Swan Reservoir is treated in the basin chapters of the accounts as an on-stream storage and thus is not covered here. The headworks system — the channels connecting Moorabool Reservoir to White Swan — is also not covered in this account.

Table 8-35 Central Highlands Water urban distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML) [1]	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries		Losses		Total outflows		
			To urban residential	To urban other	Reticulation [2]	Other system losses [3]			
Amphitheatre	-	13.0	11.8	0.5	0	0.7	13.0	-	95%
Avoca	-	214	89	34	10	81	214	-	57%
Beaufort & Raglan	-	253	110	35	36	74	253	-	57%
Blackwood & Barrys Reef	-	55	29	8	6	13	55	-	66%
Clunes	-	228	146	43	36	3	228	-	83%
Daylesford system	-	726	399	179	142	6	726	-	80%
Dean	-	17	3	2	0	12	17	-	27%
Forest Hill system	-	160	111	22	27	0	160	-	83%
Greater Ballarat	-	14,047	8,146	4,016	916	970	14,047	-	87%
Landsborough & Navarre	-	44	17	7	13	6	44	-	55%
Learmonth	-	58	27	24	0	8	58	-	87%
Lexton	-	24	15	2	4	3	24	-	71%
Maryborough and District	-	1,526	901	328	158	140	1,526	-	81%
Redbank	-	6.2	3.8	0.2	0	2.2	6.2	-	65%
Waubra	-	31	21	2	0	8	31	-	73%

Notes:

(1) Total inflows represent the flows measured into the distribution system: generally, this represents the volume leaving the treatment plant.

(2) Reticulation losses represent the losses in the reticulation system.

(3) '*Other system losses'* represent the loss of water from the point of extraction from the source and the reticulation system (and is a balancing item).

8.5.9 Southern Rural Water (Werribee and Bacchus Marsh systems)

Southern Rural Water operates the Werribee and Bacchus Marsh irrigation districts. Both are in the Werribee basin and are supplied from the Werribee River and its tributaries. The Werribee irrigation district is also supplied with recycled water from Melbourne Water's Western Treatment Plant, which is not shown in the table.

Table 8-36 shows Southern Rural Water's Werribee and Bacchus Marsh irrigation districts' water balances.

Table 8-36 Southern Rural Water Werribee and Bacchus Marsh irrigation districts' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)				End volume in store (ML)	Distribution system efficiency (%)
			Irrigation deliveries	Passed to other systems [1]	Losses	Total outflows		
Bacchus Marsh Irrigation district	10	2,362	1,255	0	1,107	2,362	10	53%
Werribee Irrigation district	150	13,083	7,007	245	5,881	13,133	100	55%

Note:

(1) *'Passed to other systems'* represent outfalls from the systems. Bacchus Marsh Irrigation District returns into the Lerderderg River. Werribee Irrigation District returns into Port Phillip Bay or a lower estuary of the Werribee River.

8.6 Western region

8.6.1 Wannon Water

Wannon Water's region extends over 24,500 km^2 from the South Australian border in the west, to Balmoral in the north, to Lismore in the east and to the lower Gellibrand River catchment on the south coast. The City of Warrnambool, Corangamite Shire, Glenelg Shire, Moyne Shire and Southern Grampians Shire local government areas are all within its service area.

Most of Wannon Water's distribution systems supply both towns and rural customers and are shown as consolidated systems. Table 8-37 summarises Wannon Water's combined distribution systems.

Table 8-37 Wannon Water combined distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location
Balmoral	Balmoral	Rocklands Reservoir	Balmoral
Dilwyn Aquifer	Portland, Heywood, Dartmoor, Port Fairy, Port Campbell, Peterborough and Timboon	Groundwater flows – numerous bores in localities serviced	Portland, Heywood, Dartmoor, Port Fairy and Port Campbell
Glenthompson	Glenthompson	Local surface water catchments into Glenthompson and Railway reservoirs, bulk supply from Grampians Wimmera Mallee Water	Glenthompson
Grampians system	Hamilton, Cavendish, Dunkeld and Tarrington	Victoria Ranges catchment (small streams and groundwater flows extracted from bores) and Rocklands Reservoir	Hamilton, Cavendish and Dunkeld
Konongwootong	Rural customers only	Local surface water catchment into Konongwootong Reservoir	None (non-potable supply)
Newer Volcanic Aquifer	Darlington, Caramut, Penshurst, Macarthur and Mortlake	Groundwater flows extracted at bores in localities serviced	Darlington, Caramut, Penshurst and Macarthur
Otway system	Warrnambool, Simpson, Cobden, Camperdown, Glenormiston, Lismore, Derrinallum, Terang, Mortlake, Purnim, Allansford and Koroit	Arkins Creek catchment, Gellibrand River catchment, groundwater flows extracted from bores near Carlisle River and at Albert Park, Warrnambool	Warrnambool, Simpson, Cobden, Camperdown, Terang and Purnim
Port Campbell Limestone Aquifer	Casterton, Coleraine, Sandford, Merino and Warrnambool	Groundwater flows extracted at Tullich borefield and at Albert Park, Warrnambool	Casterton

Table 8-38 shows Wannon Water's combined distribution systems' water balances. The volume of water in storage and total inflows volumes are calculated at the system level, hence data for these items is not available for individual towns. Similarly, reticulation system loss volumes are not available for individual towns for the Otway system and are presented at the system level.

Table 8-38 Wannon Water combined distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)							End volume in store (ML)	Distribution system efficiency (%)
			Deliveries			Losses					
			To urban residential	To urban other	To rural customers	Reticulation (1)	Other system (2)	Passed to other systems	Total outflows		
Balmoral	0	49	17	5	22	0	6	0	49	0	89%
Dilwyn Aquifer	-	3,085	1,261	1,143	98	0	583	0	3,085	-	81%
Glenthompson	56	56	9	1	28	0	34	0	73	39	53%
Grampians System (excl. Balmoral)	1,998	1,528	827	244	86	0	540	49	1,746	1,780	69%
Konongwootong	0	230	0	0	48	0	182	0	230	0	21%
Newer Volcanic Aquifer	-	142	68	26	10	0	24	14	142	-	83%
Otway System	2,029	9,351	3,123	2,379	2,237	0	1,622	0	9,362	2,018	83%
Port Campbell Limestone Aquifer	0	783	209	86	50	0	100	338	783	0	87%

Notes:

(1) '*Reticulation losses*' represent the losses in the reticulation system.

(2) '*Other system losses'* represent the loss of water from the point of extraction from the source and the reticulation system (and is a balancing item).

8.6.2 Grampians Wimmera Mallee Water

Grampians Wimmera Mallee Water supplies water to urban and rural customers via the extensive Wimmera–Mallee pipeline system. It supplies the larger urban areas in the south (Ararat, Stawell and Horsham) via separate distribution systems. It supplies many towns from groundwater.

Grampians Wimmera Mallee Water services a large area – about 25% of Victoria – in the north-west of the state. It sources most of its water from a complex system of storages in the Grampians, but the northern part of the rural pipeline system is supplied from the Murray.

The rural pipeline system has been divided for reporting purposes into seven distribution systems, each of which supplies several towns. These are presented for simplicity as consolidated reports for the urban and rural systems.

Table 8-39 summarises Grampians Wimmera Mallee Water's combined distribution systems.

Table 8-39 Grampians Wimmera Mallee Water combined rural and urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Northern Mallee Pipeline	Supplies rural customers around Ouyen and urban customers in Chillingollah, Chinkapook, Ouyen, Manangatang, Nandaly, Nullawil, Patchewollock, Speed, Tempy, Underbool, Waitchie and Walpeup	Murray River at Wemen, Piangil, Nyah and Swan Hill	Treatment plants at Ouyen and Underbool; Chlorinators at Manangatang, Nullawil and Walpeup; untreated at Chillingollah, Chinkapook, Nandaly, Patchewollock, Speed, Tempy and Waitchie
Wimmera–Mallee Pipeline supply systems 1 and 7	Supplies rural customers in the south-west Wimmera and urban customers in Pimpinio, Dimboola, Antwerp, Yaapeet, Jeparit, Rainbow and Tarranyurk	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Dimboola and Rainbow; Untreated at Pimpinio, Antwerp, Yaapeet, Jeparit and Tarranyurk
Wimmera–Mallee Pipeline Supply System 2	Supplies rural customers as far north as Lascelles and urban customers in Jung, Murtoa, Warracknabeal, Brim, Beulah, Hopetoun, Woomelang and Lascelles	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Warracknabeal, Murtoa and Hopetoun; Chlorinators at Jung, Brim, Beulah and Woomelang; Untreated at Lascelles
Wimmera–Mallee Pipeline Supply System 3	Supplies rural customers to the north-east of Horsham and urban customers in Birchip, Glenorchy, Marnoo, Minyip, Rupanyup and Watchem	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Birchip and Rupanyup; Chlorinator at Minyip; Untreated at Glenorchy, Marnoo and Watchem
Wimmera–Mallee Pipeline Supply System 4	Supplies rural customers to the north-east of Horsham and urban customers in Charlton, Donald, St Arnaud and Wycheproof	Wimmera headworks at Lake Bellfield and/or Taylors Lake	Treatment plants at Charlton and St Arnaud; Chlorinator at Donald and Wycheproof
Wimmera–Mallee Pipeline Supply System 5	Supplies rural customers to the south and west of Swan Hill and urban customers in Berriwillock, Sea Lake, Culgoa, Lalbert and Ultima	Murray River at Swan Hill	Chlorinators at Sea Lake, Lalbert and Ultima; Untreated at Berriwillock and Culgoa
Wimmera–Mallee Pipeline Supply System 6	Supplies rural customers to the west and south of Horsham	Wimmera headworks on Moora Channel supplied from either Lake Wartook or Moora Moora Reservoir into the Brimpaen storages	Raw water supply only; Untreated at Clear Lake and Noradjuha

Grampians Wimmera Mallee Water also operates 18 urban-only distribution systems, summarised in Table 8-40.

8.6 Western region

Table 8-40 Grampians Wimmera Mallee Water urban distribution systems

Area	System / towns supplied	Source of supply	Treatment plant location / comment
Ararat system	Ararat and surrounds	Mount Cole Reservoir and Lake Fyans	Ararat
Halls Gap system	Halls Gap and Pomonal	Lake Bellfield	Halls Gap
Horsham system	City of Horsham and surrounds including Haven and Natimuk	Lake Wartook and Laharum groundwater bores	Mount Zero
Quambatook	Quambatook	Normanville domestic and stock system (Loddon basin)	Chlorinator at Quambatook
Stawell system	Stawell, Great Western	Fyans Creek and Lake Fyans	Stawell and Great Western
Willaura system	Willaura, Lake Bolac, Moyston and Wickliffe	Mt William, Stony and Masons creeks; groundwater bores (unincorporated area)	Willaura serves Willaura and Lake Bolac; untreated at Moyston and Wickliffe
Towns supplied from groundwater	Apsley	West Wimmera	Untreated
	Cowangie	Murrayville	Untreated
	Goroke	West Wimmera	Untreated
	Edenhope	West Wimmera	Edenhope
	Harrow	West Wimmera	Untreated
	Kaniva	West Wimmera	Untreated
	Kiata	West Wimmera	Untreated
	Lillimur	West Wimmera	Untreated
	Miram	Murrayville	Untreated
	Murrayville	West Wimmera	Untreated
	Nhill	West Wimmera	Untreated
	Serviceton	Glenelg Catchment Unit	Untreated
	Streatham and Westmere	West Wimmera	Untreated

Table 8-41 shows Grampians Wimmera Mallee Water's combined distribution systems' water balances.

Table 8-41 Grampians Wimmera Mallee Water combined distribution systems' water balances

Distribution system	Start volume in store (ML)	Total inflows (ML)	Outflows (ML)					End volume in store (ML)	Distribution system efficiency (%)
			Deliveries			Distribution system losses (1)	Total outflows		
			To urban residential	To urban other	To rural customers				
Northern Mallee Pipeline	180	3,421	497	228	1,589	1,107	3,421	180	61%
Wimmera Mallee Pipeline Supply Systems 1	-	1,559	558	184	486	332	1,559	-	67%
Wimmera Mallee Pipeline Supply System 2	-	3,187	637	164	1,708	678	3,187	-	74%
Wimmera Mallee Pipeline Supply System 3	-	1,990	120	25	1,421	423	1,990	-	77%
Wimmera Mallee Pipeline Supply System 4	-	4,219	656	316	2,350	897	4,219	-	71%
Wimmera Mallee Pipeline Supply System 5	-	326	41	17	242	26	326	-	87%
Wimmera Mallee Pipeline Supply System 6	107	561	1	0	471	81	553	99	85%
Wimmera Mallee Pipeline Supply Systems 7	-	223	72	95	8	47	223	-	36%

Note:
(1) Distribution system losses are used as the balancing item in these accounts.

Table 8-42 shows Grampians Wimmera Mallee Water's urban distribution systems' water balances.

Table 8-42 Grampians Wimmera Mallee Water urban distribution systems' water balances

Distribution system	Start volume in store (ML) 1 July 2015	Total inflows (ML)	Outflows (ML)						End volume in store (ML) 30 June 2016	Distribution system efficiency (%)
			Deliveries		Losses		Passed to other systems	Total outflows		
			To urban residential	To urban other	Reticulation (1)	Other system losses (2)				
Surface water systems										
Ararat system (3)	262	1,599	442	920	122	115	-	1,599	262	85%
Buangor	26	16	13	3	0	3	-	19	29	84%
East Grampians system (Willuara)	95	338	116	91	0	91	41	339	94	61%
Elmhurst	29	30	17	2	0	11	-	30	11	63%
Horsham system	225	3,219	2,038	393	254	535	-	3,219	225	76%
Quambatook	100	133	35	26	0	72	-	133	100	46%
Stawell system (3)	323	2,142	657	1,018	84	316	-	2,074	390	81%
Groundwater systems										
Apsley	0.00	29.44	22.40	7.30	0.00	(.25)	-	29.45	0.00	101%
Cowangie	0	13	1	3	0	9	-	13	0	28%
Edenhope	0	227	174	31	0	23	-	227	0	90%
Goroke	0	61	6	34	0	21	-	61	0	66%
Harrow	0	41	24	3	0	14	-	41	0	65%
Kaniva	0	234	73	149	0	13	-	234	0	95%
Kiata	0	6	5		0	0	-	6	0	100%
Lillimur	0	9	7	0	0	2	-	9	0	76%
Miram	0	1	1	0	0	0	-	1	0	71%
Murrayville	0	133	71	41	0	21	-	133	0	84%
Serviceton	0	8	7	1	0	0	-	8	0	100%
Streatham & Westmere	8	21	7	8	0	12	-	27	3	56%

Notes:

(1) Reticulation losses can include treatment plant losses where they are known. Where this is zero, losses cannot be attributed to the reticulation system itself.

(2) 'Other system losses' represents all other losses. Where reticulation losses equal zero, it represents the entire loss in the system (it is the balancing item in these accounts).

(3) Unattributed inflows or metering errors explain the negative losses in the Ararat and Stawell systems.

Abbreviations

AWRC	Australian Water Resources Council
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment management authority
DELWP	Department of Environment, Land, Water and Planning (Victorian Government)
ESC	Essential Services Commission
GMA	Groundwater management area
GMU	Groundwater management unit
MDBA	Murray–Darling Basin Authority
ML	Megalitre
PCV	Permissible consumptive volume
PWSR	Permanent water saving rules
REALM	Resource allocation model
UA	Unincorporated area
VEWH	Victorian Environmental Water Holder
WSPA	Water supply protection area

Glossary

Allocation: The assignment of water within a given water year against a water entitlement held by a person or authority. See also 'Seasonal allocation'.

Aquifer: A layer of underground sediments which holds groundwater and allows water to flow through it.

Aquitard: An underground layer of clay, silt or rock with low permeability which restricts the movement of groundwater between aquifers.

Basin (river basin): The area of land into which a river and its tributaries drain. In the Victorian water accounts, river basins are consistent with those defined by the AWRC. The exception is the Murray basin which, for the purposes of this report, includes the Upper Murray basin as defined by AWRC and areas in Victoria supplied from the Murray River downstream of Lake Hume. See also 'river basin'.

Bulk entitlement: The right to water held by water and other authorities defined in the *Water Act 1989*. A bulk entitlement defines the amount of water from a river or storage to which an authority is entitled, and may include the rate at which it may be taken and the reliability of the entitlement.

Bulk entitlement conversion order: The statutory instrument used to issue a bulk entitlement under the provisions in the *Water Act 1989*.

Consumptive entitlement: A water entitlement that permits the holder to use the water taken under the entitlement for the purposes of consumption.

Cap: A limit placed on the amount of water that can be taken from a system within a given timeframe.

Carryover: Provides the right to take unused allocations at the end of one season into the subsequent season. Carryover is available under rules to the holders of permanent entitlements, including water shares, supplies by agreement and specified bulk and environmental entitlements, in the regulated water systems of northern Victoria.

Catchment: An area of land where run-off from rainfall goes into one river system.

Catchment management authorities (CMAs): Statutory bodies established under the *Catchment and Land Protection Act 1994*. CMAs have responsibilities under both the Catchment and Land Protection Act and the *Water Act 1989* for river health; regional and catchment planning and coordination; and waterway, floodplain, salinity and water quality management.

Declared systems: A water system that has been declared in accordance with section 6A of the *Water Act 1989*. Water rights and take and use licences in declared water systems have been converted into unbundled entitlements.

Distribution system: The infrastructure constructed, maintained and owned by a water corporation that is used to distribute water from its source to a user.

Entitlement: See 'Water entitlement'.

Environment: Surroundings in which an organisation operates including air, water, land, natural resources, flora, fauna, humans and their interdependence.

Environmental (bulk) entitlement: A water entitlement held by the Minister for Water that permits the use of water in a river or storage for a purpose that benefits the environment.

Environmental flow: The streamflow required to maintain appropriate environmental conditions in a waterway.

Evaporation: The process by which water changes from a liquid to a gas or vapour.

Evapotranspiration: The sum of transpiration by plants, evaporation from soil and open water surfaces, and evaporation from the wet surfaces of plants soon after rainfall.

Floodplain: Land adjacent to rivers which is subject to overflow during flood events. Floodplains are often valuable for their ecological assets.

Groundwater: The reserve of water that is located beneath the earth's surface in pores and crevices of rocks and soil. These areas vary in size and volume throughout Victoria and are known as aquifers.

Groundwater management unit (GMU): Groundwater in Victoria is managed through groundwater management units (GMUs). A GMU may be classified as either a groundwater management area (GMA) or a water supply protection area (WSPA).

Groundwater management area (GMA): A discrete area where groundwater resources of a suitable quality for irrigation, commercial or domestic and stock use are available or expected to be available. The area may have a management plan approved by the relevant rural water corporation.

Heritage river: A river protected in Victoria for its special features under the *Heritage Rivers Act 1992*.

Irrigation district: An area declared under the *Water Act 1989* that is supplied with water by channels and pipelines used mainly for irrigation purposes.

Long-term average annual rainfall (expressed as a percentage): The amount of rainfall across the geographical spread of an area, which is averaged over a grid of about 25 by 25 km.

Living Murray: A program to improve the health of the Murray River, established by the Murray–Darling Basin Ministerial Council in 2002 and funded by the New South Wales, Victorian, South Australian, Australian Capital Territory and Australian governments.

Megalitre: One million litres.

Millennium Drought: The most severe drought in Victoria's recorded history, spanning from 1997 to 2009.

Murray–Darling basin cap: The climatically adjusted limit on surface water diversions in the Murray–Darling Basin, agreed by a ministerial council under the Murray–Darling Basin Agreement.

Non-potable: Water not suitable for drinking

Order (ordering of water): The advance notification given by an entitlement holder to a storage operator to enable the storage operator to regulate water flows so that all entitlement holders' needs can be met at a particular time.

Passing flow requirements: The flows that a water authority must pass at its weirs or reservoirs before it can take water for other uses. Passing flow requirements are specified as obligations in bulk entitlements, and entitlement holders must report on their compliance with these requirements.

Percent full: The volume of water in storage as a percentage of the accessible storage capacity. Note that the percentage full may exceed 100% (for example, due to floods).

Permissible consumptive volume (PCV): The total amount of water that can be taken in a GMU under a ministerial declaration.

Qualification of rights: The Minister for Water has the power (under section 33AAA of the *Water Act 1989*) to qualify rights to water to maintain essential supplies to towns and rural communities. The Minister may declare a temporary qualification of rights where a water shortage exists in an area or water system. Where the water shortage is due to a long-term change to water availability, a permanent qualification of rights may be declared but only following a long-term water resources assessment which finds the long-term water availability will have a disproportionate effect on water allocated for consumptive purposes or the environmental water reserve.

Ramsar Convention: An international treaty that aims to conserve wetlands which have been listed for their international significance, to ensure they are managed wisely. It was agreed in Ramsar, Iran, in 1971.

REALM model: A computer-based water supply system model used by the Victorian Department of Environment, Land, Water and Planning to aid the allocation of Victoria's water resources. It is an abbreviation of REsource ALlocation Model.

Recycled water: Water (derived from sewerage systems or industry processes) that is treated to a standard appropriate for its intended end use.

Regulated river: A river containing structures (such as dams or major diversion weirs) which control the flow of water in the river for licensed diverters or users in an irrigation district.

Reticulation system: The network of pipelines used to deliver water to end users.

Riparian: Situated alongside a river or stream.

River: Large stream of water flowing to the sea, a lake, a marsh or another river.

River basin: The land into which a river and its tributaries drain. See also 'Basin'.

Seasonal allocation: An entitlement holder's share of the water available for a season, determined by a water corporation and expressed as a percentage of the entitlement holder's water share. It is sometimes shortened to 'Allocation'.

Sewage: The waterborne wastes of a community.

Small catchment dam: A dam that is filled from its own catchment and is not located on a waterway. This includes small catchment dams used for domestic and stock purposes which are not required to be licensed. It also includes dams used for commercial purposes and irrigation which are now required to be registered (under the *Water Act 1989*). Not all small catchment dams are registered as yet.

Snowy Water Inquiry: The Snowy Water Inquiry was established under *Snowy Hydro Corporatisation Act 1997* (NSW). This inquiry identified and analysed options to mitigate the impact of the Snowy Scheme on environmental flows.

South Australia–Victoria Designated Area: The area extending 20 km either side of the border between South Australia and Victoria, as set out under the *Groundwater (Border Agreement) Act 1985*, established for the cooperative management and equitable sharing of groundwater resources between the states.

Spill: An uncontrolled flow of water past a reservoir or a weir.

Stream: A body of water flowing in a bed, river or brook.

Streamflow management plan: A statutory management plan prepared for a WSPA to manage the surface water resources of the area.

Take and use licence: A fixed-term entitlement to take and use water from a waterway, catchment dam, spring, soak or aquifer. Each licence is subject to conditions set by the Minister for Water and specified on the licence.

Terminal lakes: Lakes which form the end point of all surface water flow within a basin.

Transpiration: The process by which water that is absorbed by plants, usually through the roots, is evaporated from the plant surface into the atmosphere.

Unincorporated area: An area of Victoria which contains substantial and often unquantified groundwater of varying yield and quality that has not been designated as either a GMA or a WSPA.

Unregulated river: A river that does not contain any dams or major diversion weirs which control the flow of water in the river.

Use (water use): The water use data presented in this edition of the Victorian water accounts is reported as the volume of water diverted from a stream or groundwater bore. It is not the same as 'use' by the end consumer of the water.

***Victorian Water Register*:** Provides water users with essential information about water entitlements, seasonal allocations, trade and transfers. The water register is the authoritative record of water entitlements, and it facilitates the transactions that underpin Victoria's water markets.

Wastewater: The volume of sewage that enters a dedicated treatment plant.

Water corporations: Government organisations charged with supplying water to urban and rural water users. They administer the diversion of water from waterways and the extraction of groundwater. They were formerly known as water authorities.

Water balance: A statement of the water flows in a given area and time period, in which the sum of the outflows from the area equals the sum of the inflows less the water accumulated in the area.

Water entitlement: The volume of water authorised to be taken and used by the holder. Water entitlements include bulk entitlements, environmental entitlements, water rights, surface water and groundwater licences.

Water for the environment: The share of water set aside in Victoria's water allocation framework to preserve the environmental values and health of water ecosystems.

Water leaving the basin: The volume of water that is calculated to flow out of the basin. This amount is typically derived from both gauged streamflow information and calculated information.

Water right: A water entitlement held by an irrigator in an irrigation district.

Water share: A legally recognised, secure share of the water available to be taken from a declared water system. Water shares were created as part of the unbundling reforms. Water shares may be high-reliability or low-reliability, and they are specified as a maximum volume of seasonal allocation that may be made against that share.

Water supply protection area (WSPA): An area declared under section 27 of the *Water Act 1989* to protect the area's groundwater or surface water resources for equitable management and long-term sustainability. A WSPA is subject to a statutory management plan approved by the Minister for Water.

Waterway: The *Water Act 1989* defines a waterway as a river, creek, stream, watercourse and a natural channel where water regularly flows, whether or not the flow is continuous.

Wetlands: Inland, standing, shallow bodies of water that may be permanent or temporary, and fresh or saline.

Yield: The quantity of water that a storage or aquifer produces.

Appendix A: Evapotranspiration estimates

Evapotranspiration is the term used to describe the part of the water cycle which removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation.

Evapotranspiration is not the same as evaporation. Evaporation occurs when liquid water is converted to water vapour and hence removed from a surface (such as a lake, soil or wet vegetation) into the air. Transpiration occurs when water in plant tissues is lost to the atmosphere, predominantly through the small openings in the leaves of plants and grasses called stomata.

Evapotranspiration is modelled as transpiration by plants, plus evaporation from soil and open water surfaces, plus evaporation from the wet surfaces of plants soon after rainfall. This appendix presents modelled basin estimates of evapotranspiration for each basin.

Evapotranspiration amounts vary considerably across Victoria depending on a range of factors including water availability. Averaged across Victoria as a whole, evapotranspiration in 2015–16 was estimated to be 498 mm, which is about 9% less than the long-term average from 1961 to 1990.

Modelled estimates of basin evapotranspiration are presented in Figure A-1, which shows evapotranspiration estimates for 2015–16 lower than the long-term average in most basins across Victoria. In Figure A-1, evapotranspiration is expressed as millimetres per unit area to allow easy comparison between catchments of different sizes.

The difference between the modelled evapotranspiration volumes for 2015–16 and the long-term averages varied across the state. The difference was greatest in the west of the state, where evapotranspiration was up to 24% below the long-term average. In the east of the state, the evapotranspiration estimates were closer to the long-term average and slightly greater in some basins (Figure A-1). These differences broadly reflect rainfall over the year, with most areas of Victoria receiving below-average rainfall.

Figure A-1 Modelled evapotranspiration per unit area (mm), 2015–16, and long-term average (1961-1990)

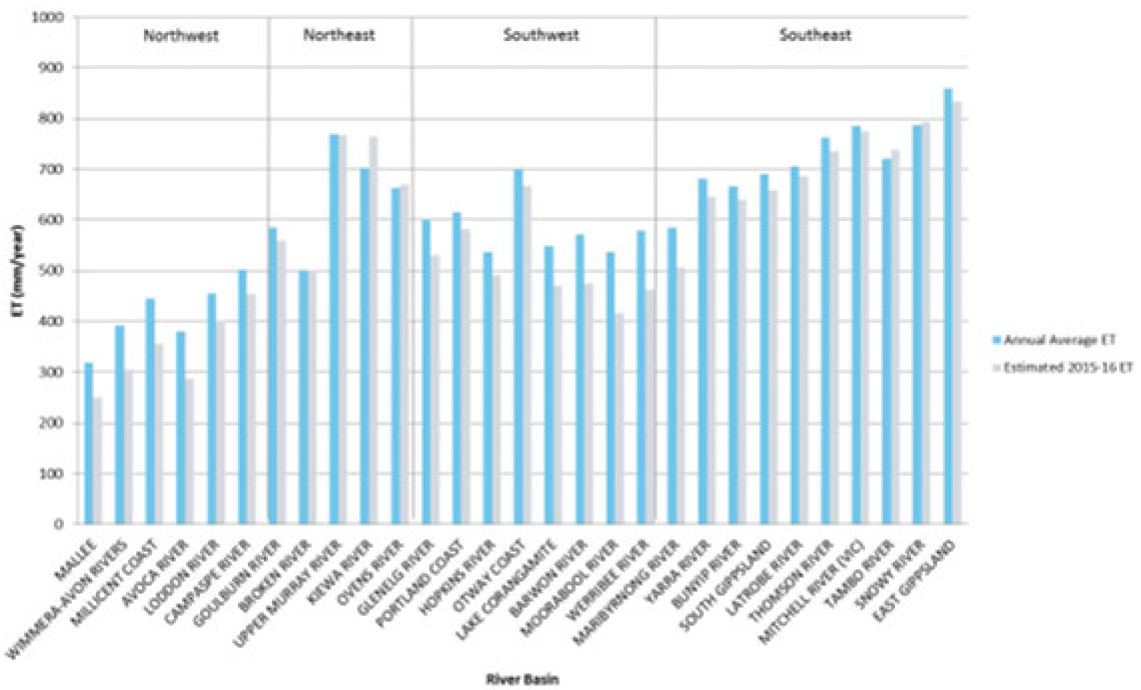
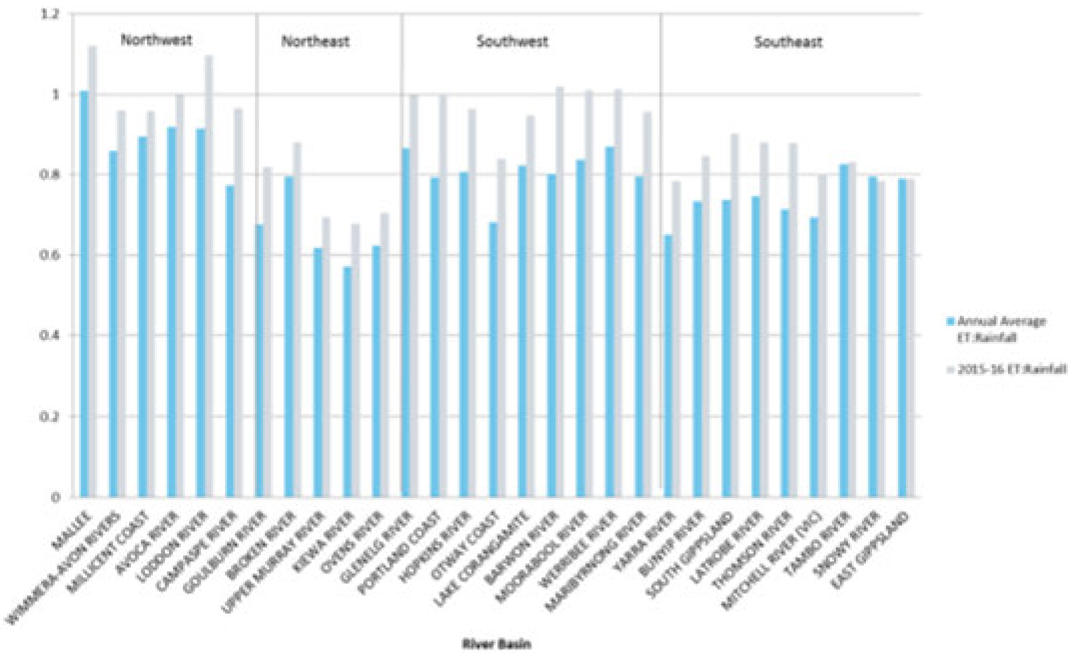


Figure A-2 illustrates evapotranspiration as a proportion of rainfall in Victoria's basins. In 2015–16, the proportion of evapotranspiration to rainfall was generally higher than the long-term average in most basins except in some areas in the south-east. This is consistent with below-average rainfall across most parts of the state during 2015–16, because the proportion of evapotranspiration to rainfall generally increases as rainfall decreases. As a result, significantly less rainfall remained for streamflow and groundwater recharge in 2015–16 than would be the case in an average year.

Figure A-2 Modelled evapotranspiration as a percentage of rainfall, 2015–16, and long-term average (1961-1990)



North-east Victoria (Goulburn to Upper Murray river basins)

The estimated evapotranspiration ranged from 500 mm in the Broken basin to 767 mm in the Upper Murray basin, and comparisons with the long-term average ranged from 4% below average in the Goulburn basin to 9% above average in the Kiewa basin (Figure A-1).

In 2015–16, evapotranspiration as a proportion of rainfall in the north-eastern basins was higher than the long-term average. The Broken basin was estimated to have the north-east area's highest evapotranspiration as a proportion of the year's rainfall (80%, compared to the long-term average of 79%), and the lowest was in the Kiewa basin (68%, compared to the long-term average of 57%) (Figure A-2).

South-east Victoria (East Gippsland to Yarra river basins)

In 2015–16, the estimated evapotranspiration ranged from 639 mm in the Bunyip basin to 834 mm in the East Gippsland basin, and comparisons with the long-term average ranged from 5% below average in the Yarra and South Gippsland basins to 3% above average in the Tambo basin (Figure A-1).

In 2015–16, evapotranspiration as a proportion of rainfall in the south-eastern basins varied between 1% below average to 17% above average. The South Gippsland basin was estimated to have the south-east region's highest evapotranspiration as a proportion of the year's rainfall (90%, compared to the long-term average of 74%), and the lowest were in the Yarra (78%, compared to the long-term average of 65%) and Snowy basins (78%, compared to the long-term average of 79%) (Figure A-2).

South-west Victoria (Maribyrnong to Glenelg river basins)

Below-average rainfall over south-west Victoria resulted in estimates of evapotranspiration that were below average for the south-western basins. In 2015–16, the estimated evapotranspiration ranged from 415 mm in the Moorabool basin to 668 mm in the Otway basin, and comparisons with the long-term average ranged from 23% below average in the Maribyrnong basin to 5% below average in the Otway basin (Figure A-1).

In 2015–16, evapotranspiration as a proportion of rainfall in the south-western basins was greater than the long-term average. The Barwon basin was estimated to have the south-west region's highest evapotranspiration as a proportion of rainfall in 2015–16, (102%, compared to the long-term average of 80%) and the Otway basin the lowest (84%, compared to the long-term average of 68%) (Figure A-2).

North-west Victoria (Mallee to Campaspe river basins)

Below-average rainfall in north-west Victoria resulted in estimates of evapotranspiration that were below average for the north-west basins. In 2015–16, the estimated evapotranspiration ranged from 250 mm in the Mallee basin to 453 mm in the Campaspe basin, and comparisons with the long-term average ranged from 24% below average in the Avoca basin to 10% below average in the Campaspe basin (Figure A-1).

In 2015–16, evapotranspiration was either similar or greater than the rainfall. This indicates that some land uses (for example, deep-rooted vegetation) may have been accessing groundwater. The Mallee basin was estimated to have the north-west's highest evapotranspiration as a proportion of rainfall (112%, compared to the long-term average of 101%) and the lowest was in the Wimmera and Millicent Coast basins (96%, compared to the average of 86% and 90% respectively) (Figure A-2).

Key assumptions and data limitations

The estimates of evapotranspiration presented in this appendix are based on results from the SoilFlux model, which is a one-dimensional water balance model. Modelling evapotranspiration requires many approximations and assumptions, which limit the accuracy of the estimates. Major assumptions and limitations of the method used to derive the estimates of evapotranspiration include:

- not accounting for water applied by irrigation
- not allowing for changes in water storage (that is, rises and falls in the water table and soil moisture) or lateral flow
- using land use information from 2014, which has been condensed from the Victorian Land Use Information System into 10 representative land use types to facilitate water balance modelling. Note that the land use information has been improved in the 2015–16 accounts as estimates of evapotranspiration reported in previous Victorian water accounts were based on land use information from 2009
- using one-kilometre gridded data for land use, geology, depth to groundwater and rainfall.

The basin areas used to report evapotranspiration estimates are slightly different to those used for reporting in the basin water accounts in chapter 6. In the basin water accounts, the Murray basin captures information about Murray River irrigation districts in the Mallee, Avoca, Loddon, Campaspe, Goulburn and Broken basins. For evapotranspiration reporting, these irrigation districts are included within their host river basin (for example, the Mildura Irrigation District is in the Mallee basin). However, as noted above, the impact of this is likely to be small as the evapotranspiration estimates do not account for water applied by irrigation.

Appendix B: Storage levels

Basin	Reservoir	Storage type	Storage capacity (ML)	Percentage full at 1 July 2015	Percentage full at 30 June 2016
Murray	Lake Cullulleraine	On-stream	5,270	82%	84%
	Lake Dartmouth (Victoria's share)	On-stream	1,928,116	98%	54%
	Lake Hume (Victoria's share)	On-stream	1,502,579	32%	39%
	Lake Victoria (Victoria's share)	On-stream	338,500	74%	65%
	Menindee Lakes (VIC share)	On-stream	1,025,000	0%	0%
Kiewa	Clover Pondage	Off-stream	255	82%	23%
	Lake Guy	On-stream	1,416	31%	25%
	Pretty Valley basin	Off-stream	355	100%	100%
	Rocky Valley	On-stream	28,294	53%	64%
Ovens	Lake Buffalo	On-stream	23,340	63%	63%
	Lake William Hovell	On-stream	13,690	98%	101%
Broken	Lake Nillahcootie	On-stream	40,400	53%	29%
	Loombah–McCall Say	On-stream	1,747	93%	100%
Goulburn	Goulburn Weir	On-stream	25,500	99%	79%
	Greens Lake	Off-stream	32,500	69%	55%
	Lake Eildon	On-stream	3,334,158	56%	36%
	Sunday Creek Reservoir	On-stream	1,650	64%	39%
	Waranga basin	Off-stream	432,360	35%	52%
Campaspe	Campaspe Weir	On-stream	2,624	90%	101%
	Lake Eppalock	On-stream	304,651	45%	22%
	Lauriston Reservoir	On-stream	19,790	88%	66%
	Malmsbury Reservoir	On-stream	12,034	37%	23%
	Upper Coliban Reservoir	On-stream	37,770	54%	39%
Loddon	Cairn Curran Reservoir	On-stream	147,130	35%	12%
	Evansford Reservoir	Off-stream	1,346	84%	68%
	Hepburn Lagoon	On-stream	2,457	48%	18%
	Laanecoorie Reservoir	On-stream	8,000	32%	21%
	Newlyn Reservoir	On-stream	3,012	45%	17%
	Sandhurst Reservoir	Off-stream	2,590	80%	100%
	Spring Gully Reservoir	Off-stream	1,680	50%	16%
	Tullaroop Reservoir	On-stream	72,950	38%	21%
East Gippsland	None	-	-	-	-
Snowy	None	-	-	-	-
Tambo	None	-	-	-	-
Mitchell	None	-	-	-	-
Thomson	Lake Glenmaggie	On-stream	177,640	66%	46%
	Thomson Reservoir	On-stream	1,068,000	72%	56%
Latrobe	Blue Rock	On-stream	198,280	105%	86%
	Lake Narracan	On-stream	7,230	85%	61%
	Moondarra Reservoir	On-stream	30,458	100%	85%
South Gippsland	Candowie Reservoir	On-stream	4,463	61%	50%

	Hyland Reservoir	On-stream	671	42%	59%
	Lance Creek Reservoir	On-stream	4,200	98%	79%
	Western Reservoir	On-stream	1,137	72%	42%
Bunyip	Tarago Reservoir	On-stream	37,580	100%	91%
Yarra	Cardinia Reservoir	Off-stream	286,911	58%	63%
	Greenvale Reservoir	Off-stream	26,839	83%	80%
	Maroondah Reservoir	On-stream	22,179	61%	49%
	O'Shannassy Reservoir	On-stream	3,123	60%	74%
	Silvan Reservoir	Off-stream	40,445	84%	89%
	Sugarloaf Reservoir	Off-stream	96,253	68%	68%
	Upper Yarra Reservoir	On-stream	200,579	50%	51%
	Yan Yean Reservoir	On-stream	30,266	85%	80%
Maribyrnong	Rosslynne Reservoir	On-stream	25,368	44%	15%
Werribee	Djerriwarrh Reservoir	On-stream	1,014	55%	39%
	Melton Reservoir	On-stream	14,364	9%	7%
	Merrimu Reservoir (total)	On-stream	32,516	29%	10%
	Pykes Creek Reservoir	On-stream	22,119	58%	27%
Moorabool	Bostock Reservoir	On-stream	7,455	2%	1%
	Korweinguboora Reservoir	On-stream	2,091	21%	18%
	Lal Lal Reservoir	On-stream	59,549	68%	36%
	Moorabool Reservoir	On-stream	6,192	27%	12%
	Upper Stony Creek Reservoir	Off-stream	9,494	57%	41%
	Wilsons Reservoir	On-stream	1,010	1%	2%
Barwon	Gong Gong Reservoir	On-stream	1902	26%	13%
	West Barwon Reservoir	On-stream	21,504	77%	21%
	White Swan Reservoir	On-stream	14,107	49%	59%
	Wurdee Boluc Reservoir	Off-stream	40,431	48%	34%
Corangamite	None	-	-	-	-
Otway Coast	West Gellibrand Reservoir	On-stream	1,856	74%	64%
Hopkins	None	-	-	-	-
Portland Coast	None	-	-	-	-
Glenelg	Hamilton system reservoirs	On-stream	2,654	75%	67%
	Konongwootong Reservoir	On-stream	1920	86%	74%
	Moora Moora Reservoir	On-stream	6,300	19%	14%
	Rocklands Reservoir	On-stream	296,000	20%	15%
Millicent Coast	None	-	-	-	-
Wimmera	Dock Lake	On-stream	4,420	0%	0%
	Fyans Lake	On-stream	18,460	67%	53%
	Green Lake	On-stream	5,350	38%	9%
	Lake Bellfield	On-stream	78,560	65%	56%
	Lake Lonsdale	On-stream	53,300	1%	0%
	Pine Lake	On-stream	62,000	0%	0%
	Taylors Lake	On-stream	27,060	34%	46%
	Toolondo Reservoir	On-stream	50,530	19%	7%
	Wartook Reservoir	On-stream	29,300	62%	53%
Mallee	None	-	-	-	-
Avoca	None	-	-	-	-

Appendix C: Groundwater entitlement and use

Groundwater Management Unit	Permissible Consumptive Volume (ML)	Allocation limit at 30 June 2016 (ML)	Licenses				Domestic and stock		Total use (licensed + domestic and stock)
			Licensed entitlements (ML)	No. of licences	No. of metered bores	Metered use (ML)	No. of domestic and stock bores (1)	Estimated use (ML) (2)	
Goulburn–Murray Water									
Water supply protection areas									
Katunga (3)	60,577	42,460	60,405	249	308	34,566	752	1,504	36,070
Loddon Highlands (4)	20,697	19,924	20,667	180	283	10,149	518	1,036	11,185
Lower Campaspe Valley	55,875	55,860	55,860	135	190	44,994	535	1,070	46,064
Upper Ovens	4,010	4,010	3,764	105	123	973	264	528	1,501
Groundwater management areas									
Barnawartha	2,100	2,100	375	4	7	9	23	46	55
Central Victorian Mineral Springs	6,024	6,024	4,976	137	152	1,069	1,444	2,888	3,957
Kiewa	3,852	3,852	3,101	106	125	391	292	584	975
Lower Ovens	25,200	25,200	19,905	265	347	5,494	1,534	3,068	8,562
Mid-Goulburn	14,900	14,900	12,470	64	81	4,214	121	242	4,456
Mid-Loddon	34,037	34,037	33,927	108	125	25,249	326	652	25,901
Shepparton Irrigation (5) (6)	n/a	n/a	191,702	1,086	40	79,448	1,367	2,734	82,182
Strathbogie	1,660	1,660	1,463	59	68	556	275	550	1,106
Upper Goulburn	8,568	8,568	6,057	112	157	1,087	532	1,064	2,151
Upper Murray	7,674	7,674	3,403	72	94	511	205	410	921
Unincorporated areas									
Goulburn–Murray	n/a	n/a	17,690	222	279	4,643	1,430	2,860	7,503
Grampians Wimmera Mallee Water									
Water supply protection areas									
Murrayville	10,883	10,883	9,634	32	0	6,131	191	382	6,513
Groundwater management areas									
West Wimmera (7) (8)	55,659	55,659	53,362	172	0	22,658	627	1,250	23,908
Unincorporated areas									
Grampians Wimmera Mallee Water	n/a	n/a	13,003	50	54	839	334	668	1,507
Southern Rural Water									
Water supply protection areas									
Condah	7,475	7,475	7,470	34	44	3,123	323	485	3,608

Deutgam (9)	5,100	2,550	5,082	150	175	1,278	37	56	1,334
Glenelg	33,262	33,262	15,756	40	52	5,018	1,058	1,587	6,605
Koo Wee Rup	12,915	12,915	12,580	352	243	4,348	996	1,494	5,842
Sale	21,238	21,238	21,218	113	119	10,172	435	653	10,825
Warrion	14,086	14,086	14,081	136	142	5,348	261	392	5,740
Yarram	25,690	25,690	25,689	87	89	14,941	272	408	15,349
Groundwater management areas									
Bungaree (10)	5,334	5,334	5,293	101	146	3,053	177	266	3,319
Colongulac	4,695	4,695	4,406	68	37	1,735	103	155	1,890
Cardigan	3,967	3,967	3,878	22	23	934	83	125	1,059
Corinella	2,550	2,550	662	14	9	72	56	84	156
Cut Paw Paw	3,650	3,650	514	4	4	12	4	6	18
Denison (11)	18,502	18,502	18,501	122	127	8,741	206	309	9,050
Frankston	3,200	3,200	2,229	29	21	302	93	140	442
Gellibrand	0	0	0	0	0	0	1	2	2
Gerangamete (12)	20,000	20,000	20,000	1	6	1,846	3	5	1,851
Giffard	5,689	5,689	5,689	18	18	2,312	95	143	2,455
Glenormiston	2,698	2,698	2,636	44	29	1,148	73	110	1,258
Jan Juc (13)	39,250	39,250	11,250	3	8	1,341	3	5	1,345
Lancefield	1,485	1,485	1,378	15	21	80	57	86	165
Leongatha	6,500	6,500	1,803	33	12	206	72	108	314
Merrimu	451	451	691	21	19	319	12	18	337
Moe	8,200	8,200	3,889	97	33	1,222	112	168	1,390
Moorabbin	2,700	2,700	2,581	54	71	1,293	197	296	1,589
Nepean (7)	6,110	6,110	6,110	76	79	2,961	1,843	1,843	4,804
Newlingrook	1,977	1,977	1,958	6	6	60	2	3	63
Orbost	1,217	1,217	1,217	4	5	154	2	3	157
Paaratte	4,606	4,606	3,212	6	1	367	2	3	370
Portland	7,795	7,795	7,794	8	7	2,693	1	2	2,695
Rosedale (7) (14)	22,372	22,372	22,073	70	51	11,401	80	120	11,521
South West Limestone (15)	85,000	85,000	81,783	848	646	35,360	5,537	8,306	43,666
Stratford (7) (14)	27,645	27,645	3,6635	10	6	21,823	0	0	21,823
Tarwin	1,300	1,300	38	3	1	7	541	812	819
Wa De Lock (7) (11)	30,795	30,795	29,286	251	194	7,201	426	639	7,840
Wandin Yallock (10)	3,008	3,008	2,995	193	204	743	53	80	823
Wy Yung (7)	7,463	7,463	7,462	60	74	414	34	51	465
Unincorporated areas									
Southern Rural Water	n/a	n/a	69,044	1,336	796	14,016	5,233	7,850	21,866
Total	**759,641**	**738,186**	**968,647**	**7,587**	**5,951**	**409,025**	**29,253**	**48,349**	**457,374**

Notes:

(1) The number of domestic and stock bores includes all bores from the groundwater management system that are less than 30 years old. Bore depths (where recorded) have been taken into account to ensure that domestic and stock bores are assigned to the appropriate GMU where management units overlap.

(2) Domestic and stock use is estimated as 2 ML per bore except for the Southern Rural Water GMUs, where 1.5 ML per bore has been used (unless otherwise noted) and the Nepean GMA, where 1 ML per bore is used as a more accurate estimate.

(3) Extractions from Katunga WSPA were restricted to 70% allocation.

(4) Extractions from Newlyn trading zone in the Loddon Highlands WSPA were restricted to 75% allocation.

(5) The Minister for Water abolished the Shepparton Irrigation WSPA and revoked the Groundwater Management Plan in February 2014. The Shepparton Irrigation GMA was introduced with a new groundwater management plan approved on 3 June 2015. There is no permissible consumptive volume for the Shepparton Irrigation GMA as there is no limit on the total volume of shallow groundwater entitlement available.

(6) Groundwater use in the SIR GMA is estimated at the end of each season using a method which considers: annual use by a subset of SIR GMA licensed groundwater users that are metered; the volume of metered groundwater use in the Katunga Water Supply Protection Area, and spring rainfall.
(7) The PCV that applies to West Wimmera GMA, Wy Yung GMA, Nepean GMA, Rosedale GMA, Stratford GMA and Wa De Lock GMA total the sum of the PCVs for all zones within each GMU.
(8) Extractions from Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% allocation.
(9) Extractions from Deutgam WSPA were restricted to 50% allocation.
(10) Wandin Yallock and Bungaree WSPA status was revoked in December 2016.
(11) The volume of use in Denison WSPA and Wa De Lock GMA includes metered extractions for salinity control (Denison WSPA 1701.39 ML and Wa De Lock GMA 712.2 ML).
(12) The PCV for the Gerangamete GMA is aligned with Barwon Water's groundwater licence which allows extraction from the Gerangamete GMA of a maximum of 20,000 ML in any one year, 80,000 ML over a consecutive 10-year period and 400,000 ML over a 100-year period.
(13) The PCV for Jan Juc GMA is Zone 1 all formations 250 ML, Zone 2 Upper Eastern View formation 4,000 ML and Zone 2 Lower Eastern View formation 35,000 ML in any five-year period. The Jan Juc bulk entitlement, which applies to Zone 2 Lower Eastern View formation, is based on a five-year total of 35,000 ML with a maximum annual extraction of 10,000 ML. The total of 39,250 ML includes 4,250 ML and the five-year bulk entitlement of 35,000 ML.
(14) The use volume reported in Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 5,203 ML and Stratford GMA 21,801.1 ML).
(15) The *South West Limestone Local Management Plan* for the South West Limestone GMA was approved in May 2016.

Appendix D: Bulk entitlement holders

Water source	Entitlements	Holder
Murray	*Bulk Entitlement (Corryong) Conversion Order 2000*	North East Water
	Bulk Entitlement (Cudgewa) Conversion Order 2000	North East Water
	Bulk Entitlement (Dartmouth) Conversion Order 2000	North East Water
	Bulk Entitlement (Omeo) Conversion Order 2008	East Gippsland Water
	Bulk Entitlement (River Murray – City West Water) Order 2012	City West Water
	Bulk Entitlement (River Murray – Coliban Water) Conversion Order 1999	Coliban Water
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – Goulburn Valley Water) Conversion Order 1999	Goulburn Valley Water
	Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999	Goulburn-Murray Water
	Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Conversion Order 1999	Grampians Wimmera Mallee Water
	Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	Lower Murray Water
	Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Urban) Conversion Order 1999	Lower Murray Water
	Bulk Entitlement (River Murray – North East Water) Conversion Order 1999	North East Water
	Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	Victorian Environmental Water Holder
	Bulk Entitlement (River Murray – South East Water) Order 2012	South East Water
	Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012	Yarra Valley Water
	Bulk Entitlement (Walwa) Conversion Order 2000	North East Water
Kiewa	*Bulk Entitlement (Kiewa – Hydro) Conversion Order 1997*	AGL Hydro Partnership
	Bulk Entitlement (Kiewa – Tangambalanga) Conversion Order 2000	North East Water
	Bulk Entitlement (Mount Beauty – Tawonga) Conversion Order 1997	North East Water
	Bulk Entitlement (Yackandandah) Conversion Order 2001	North East Water
Ovens	*Bulk Entitlement (Beechworth) Conversion Order 2001*	North East Water
	Bulk Entitlement (Bright) Conversion Order 2000	North East Water
	Bulk Entitlement (Chiltern) Conversion Order 2000	North East Water
	Bulk Entitlement (Glenrowan) Conversion Order 1999	North East Water
	Bulk Entitlement (Harrietville) Conversion Order 1999	North East Water
	Bulk Entitlement (Myrtleford) Conversion Order 2001	North East Water
	Bulk Entitlement (Ovens System - Goulburn-Murray Water) Conversion Order 2004	Goulburn-Murray Water
	Bulk Entitlement (Ovens System – Moyhu, Oxley and Wangaratta – North East Water) Conversion Order 2004	North East Water
	Bulk Entitlement (Springhurst) Conversion Order 1999	North East Water
	Bulk Entitlement (Whitfield) Conversion Order 1999	North East Water
Broken	*Bulk Entitlement (Broken System - Goulburn-Murray Water) Conversion Order 2004*	Goulburn-Murray Water
	Bulk Entitlement (Broken System - Tungamah, Devenish & St James - North East Water) Conversion Order 2004	North East Water
	Bulk Entitlement (Loombah McCall-Say) Conversion Order 2001	North East Water
Goulburn	*Bulk Entitlement (Broadford, Kilmore & Wallan) Conversion and Augmentation Order 2003*	Goulburn Valley Water

Water source	Entitlements	Holder
	Bulk Entitlement (Buxton) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	Goulburn-Murray Water
	Environmental Entitlement (Goulburn System – Living Murray) 2007	Victorian Environmental Water Holder
	Bulk Entitlement (Euroa System) Conversion Order 2001	Goulburn Valley Water
	Bulk Entitlement (Goulburn Channel System - Coliban Water) Order 2012	Coliban Water
	Bulk Entitlement (Goulburn Channel System - Goulburn Valley Water) Order 2012	Goulburn Valley Water
	Bulk Entitlement (Goulburn River & Eildon - Goulburn Valley Water) Order 2012	Goulburn Valley Water
	Goulburn River Environmental Entitlement 2010	Victorian Environmental Water Holder
	Bulk Entitlement (Goulburn System – City West Water) Order 2012	City West Water
	Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012	Victorian Environmental Water Holder
	Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	Victorian Environmental Water Holder
	Bulk Entitlement (Goulburn System – South East Water) Order 2012	South East Water
	Bulk Entitlement (Goulburn System – Yarra Valley Water) Order 2012	Yarra Valley Water
	Bulk Entitlement (Longwood) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Mansfield) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Marysville) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Pyalong) Conversion Order 1997	Goulburn Valley Water
	Bulk Entitlement (Quambatook - Grampians Wimmera-Mallee Water) Order 2006	Grampians Wimmera Mallee Water
	Bulk Entitlement (Rubicon - Hydro) Conversion Order 1997	AGL Hydro Partnership
	Silver & Wallaby Creeks Environmental Entitlement 2006	Victorian Environmental Water Holder
	Bulk Entitlement (Silver & Wallaby Creeks - Melbourne Water) Order 2014	Melbourne Water
	Bulk Entitlement (Strathbogie) Conversion Order 2012	Goulburn Valley Water
	Bulk Entitlement (Thornton) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Upper Delatite) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Violet Town) Conversion Order 1997	Goulburn Valley Water
	Bulk Entitlement (Woods Point) Conversion Order 1995	Goulburn Valley Water
	Bulk Entitlement (Yea) Conversion Order 1997	Goulburn Valley Water
Campaspe	*Bulk Entitlement (Axedale, Goornong and Part Rochester) Conversion Order 1999*	Coliban Water
	Campaspe River Environmental Entitlement 2013	Victorian Environmental Water Holder
	Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999	Coliban Water
	Bulk Entitlement (Campaspe System - Goulburn-Murray Water) Conversion Order 2000	Goulburn-Murray Water
	Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	Victorian Environmental Water Holder
	Bulk Entitlement (Trentham) Conversion Order 2012	Coliban Water
	Bulk Entitlement (Woodend) Conversion Order 2004	Western Water
Loddon	*Environmental Entitlement (Birch Creek – Bullarook System) 2009*	Victorian Environmental Water Holder
	Bulk Entitlement (Bullarook System - Central Highlands Water) Conversion Order 2009	Central Highlands Water
	Bulk Entitlement (Bullarook System - Goulburn-Murray Water) Conversion Order 2009	Goulburn-Murray Water
	Bulk Entitlement (Creswick) Conversion Order 2004	Central Highlands Water
	Bulk Entitlement (Daylesford-Hepburn Springs) Conversion Order 2004	Central Highlands Water
	Bulk Entitlement (Evansford-Talbot System – Part Maryborough – Central Highlands Water) Conversion Order 2006	Central Highlands Water
	Bulk Entitlement (Lexton) Conversion Order 2004	Central Highlands Water

Water source	Entitlements	Holder
	Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005	Victorian Environmental Water Holder
	Bulk Entitlement (Loddon System – Coliban Water) Conversion Order 2005	Coliban Water
	Bulk Entitlement (Loddon System - Goulburn-Murray Water) Conversion Order 2005	Goulburn-Murray Water
	Bulk Entitlement (Loddon System – Part Maryborough – Central Highlands Water) Conversion Order 2005	Central Highlands Water
East Gippsland	*Bulk Entitlement (Bemm River) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Cann River) Conversion Order 1997	East Gippsland Water
	Bulk Entitlement (Mallacoota) Conversion Order 1997	East Gippsland Water
Snowy	*Bulk Entitlement (Buchan) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Orbost System) Conversion Order 1997	East Gippsland Water
Tambo	*Bulk Entitlement (Nowa Nowa) Conversion Order 1997*	East Gippsland Water
	Bulk Entitlement (Swifts Creek) Conversion Order 1997	East Gippsland Water
Mitchell	*Bulk Entitlement (Bairnsdale) Conversion Order 2000*	East Gippsland Water
Thomson	*Macalister River Environmental Entitlement 2010*	Victorian Environmental Water Holder
	Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001	Southern Rural Water
	Bulk Entitlement (Thomson Macalister Towns – Gippsland Water) Conversion Order 2005	Gippsland Water
	Bulk Entitlement (Thomson River – Melbourne Water) Order 2014	Melbourne Water
	Bulk Entitlement (Thomson River – Environment) Order 2005	Victorian Environmental Water Holder
Latrobe	*Blue Rock Environmental Entitlement 2013*	Victorian Environmental Water Holder
	Bulk Entitlement (Boolarra) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Gippsland Water – Blue Rock) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Erica) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Latrobe – Southern Rural) Conversion Order 1996	Southern Rural Water
	Lower Latrobe Wetlands Environmental Entitlement 2010	Victorian Environmental Water Holder
	Bulk Entitlement (Mirboo North) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Moe – Narracan Creek) Conversion Order 1998	Gippsland Water
	Bulk Entitlement (Moondarra Reservoir) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Noojee) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Thorpdale) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Latrobe - Loy Yang B) Conversion Order 1996	Southern Rural Water
	Bulk Entitlement (Latrobe - Loy Yang A) Conversion Order 1996	AGL Loy Yang Partnership
	Bulk Entitlement (Latrobe - Loy Yang 3/4 Bench) Conversion Order 1996	Minister for Energy, Environment and Climate Change (on behalf of Victorian Government)
	Bulk Entitlement (Latrobe - Yallourn) Conversion Order 1996	Energy Australia
	Bulk Entitlement (Latrobe Reserve) Order 2013	Southern Rural Water
South Gippsland	*Bulk Entitlement (Devon North, Alberton, Yarram & Port Albert) Conversion Order 1997*	South Gippsland Water
	Bulk Entitlement (Dumbalk) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Fish Creek) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Foster) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Korumburra) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Leongatha) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Loch, Poowong & Nyora) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Meeniyan) Conversion Order 1997	South Gippsland Water

Water source	Entitlements	Holder
	Bulk Entitlement (Seaspray) Conversion Order 1997	Gippsland Water
	Bulk Entitlement (Toora, Port Franklin, Welshpool & Port Welshpool) Conversion Order 1997	South Gippsland Water
	Bulk Entitlement (Westernport) Conversion Order 1997	Westernport Water
	Bulk Entitlement (Westernport – Bass River) Order 2009	Westernport Water
	Bulk Entitlement (Wonthaggi – Inverloch) Conversion Order 1997	South Gippsland Water
Bunyip	*Tarago and Bunyip Rivers Environmental Entitlement 2009*	Victorian Environmental Water Holder
	Bulk Entitlement (Tarago River – Gippsland Water) Conversion Order 2009	Gippsland Water
	Bulk Entitlement (Tarago River – Southern Rural Water) Conversion Order 2009	Southern Rural Water
	Bulk Entitlement (Tarago and Bunyip Rivers - Melbourne Water) Order 2014	Melbourne Water
Yarra	*Bulk Entitlement (Yarra River - Melbourne Water) Order 2014*	Melbourne Water
	Bulk Entitlement (Yarra Environment Entitlement) 2006	Victorian Environmental Water Holder
Maribyrnong	*Bulk Entitlement (Gisborne – Barringo Creek) Conversion Order 2004*	Western Water
	Bulk Entitlement (Lancefield) Conversion Order 2001	Western Water
	Bulk Entitlement (Macedon and Mount Macedon) Conversion Order 2004	Western Water
	Bulk Entitlement (Maribyrnong – Melbourne Water) Conversion Order 2000	Melbourne Water
	Bulk Entitlement (Maribyrnong – Southern Rural Water) Conversion Order 2000	Southern Rural Water
	Bulk Entitlement (Maribyrnong – Western Water) Conversion Order 2000	Western Water
	Bulk Entitlement (Riddells Creek) Conversion Order 2001	Western Water
	Bulk Entitlement (Romsey) Conversion Order 2001	Western Water
Werribee	*Bulk Entitlement (Ballan) Conversion Order 1998*	Central Highlands Water
	Bulk Entitlement (Blackwood & Barry's Reef) Conversion Order 1998	Central Highlands Water
	Bulk Entitlement (Myrniong) Conversion Order 2004	Western Water
	Werribee River Environmental Entitlement 2011	Victorian Environmental Water Holder
	Bulk Entitlement (Werribee System – Irrigation) Conversion Order 1997	Southern Rural Water
	Bulk Entitlement (Werribee System – Western Water) Conversion Order 2004	Western Water
Moorabool	*Bulk Entitlement (Lal Lal – Barwon) Conversion Order 1995*	Barwon Water
	Bulk Entitlement (Lal Lal – Central Highlands) Conversion Order 1995	Central Highlands Water
	Bulk Entitlement (Meredith) Conversion Order 1995	Barwon Water
	Moorabool River Environmental Entitlement 2010	Victorian Environmental Water Holder
	Bulk Entitlement (She Oaks) Conversion Order 1995	Barwon Water
	Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	Barwon Water
	Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	Central Highlands Water
Barwon	*Barwon River Environmental Entitlement 2011*	Victorian Environmental Water Holder
	Bulk Entitlement (Upper Barwon System) Conversion Order 2002	Barwon Water
	Bulk Entitlement (Yarrowee - White Swan System) Conversion Order 2002	Central Highlands Water
Otway Coast	*Bulk Entitlement (Aireys Inlet) Conversion Order 1997*	Barwon Water
	Bulk Entitlement (Apollo Bay) Order 2010	Barwon Water
	Bulk Entitlement (Colac) Amendment Order 2003	Barwon Water
	Bulk Entitlement (Gellibrand) Conversion Order 1997	Barwon Water
	Bulk Entitlement (Lorne) Conversion Order 1997	Barwon Water
	Bulk Entitlement (Otway System) Conversion Order 1998	Wannon Water
Hopkins	*Bulk Entitlement (Beaufort) Conversion Order 2005*	Central Highlands Water
	Bulk Entitlement (Skipton) Conversion Order 2005	Central Highlands Water

Water source	Entitlements	Holder
Glenelg	*Bulk Entitlement (Coleraine, Casterton & Sandford) Conversion Order 1997*	Wannon Water
	Bulk Entitlement (Dunkeld System) Conversion Order 1997	Wannon Water
	Bulk Entitlement (Glenthompson) Conversion Order 1997	Wannon Water
	Bulk Entitlement (Hamilton) Conversion Order 1997	Wannon Water
Wimmera	*Bulk Entitlement (Landsborough-Navarre) Conversion Order 2003*	Central Highlands Water
	Bulk Entitlement (Willaura, Elmhurst and Buangor Systems – Grampians Wimmera Mallee Water) Conversion Order 2012	Grampians Wimmera Mallee Water
	Bulk Entitlement (Willaura System – Wannon Water) Conversion Order 2012	Wannon Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - Coliban Water) Order 2010	Coliban Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - Grampians Wimmera Mallee Water) Order 2010	Grampians Wimmera Mallee Water
	Bulk Entitlement (Wimmera and Glenelg Rivers - Wannon Water) Order 2010	Wannon Water
	Wimmera and Glenelg Rivers Environmental Entitlement 2010	Victorian Environmental Water Holder
Avoca	*Bulk Entitlement (Amphitheatre) Conversion Order 2003*	Central Highlands Water
	Bulk Entitlement (Avoca) Conversion Order 2003	Central Highlands Water
	Bulk Entitlement (Redbank) Conversion Order 2003	Central Highlands Water
Jan Juc GMA	*Bulk Entitlement (Anglesea Groundwater) Order 2009*	Barwon Water
Greater Yarra System	*Bulk Entitlement (Greater Yarra System-Thomson River Pool-City West Water Limited) Conversion Order 2014*	City West Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool-South East Water Limited) Conversion Order 2014	South East Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool-Yarra Valley Water Limited) Conversion Order 2014	Yarra Valley Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool- Barwon Water) Order 2014	Barwon Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool- South Gippsland Water) Order 2014	South Gippsland Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool- Western Water) Order 2014	Western Water
	Bulk Entitlement (Greater Yarra System-Thomson River Pool- Westernport Water) Order 2014	Westernport Water
Desalination Plant	*Bulk Entitlement (Desalinated Water - City West Water) Order 2014*	City West Water
	Bulk Entitlement (Desalinated Water - South East Water) Order 2014	South East Water
	Bulk Entitlement (Desalinated Water - Yarra Valley Water) Order 2014	Yarra Valley Water

Appendix E: Revised estimation of small catchment dam capacity

Small catchment dams are dams that are not located on a defined watercourse but harvest water from their local catchment. In other jurisdictions and contexts, these are sometimes referred to as “farm dams”, “hillside dams”, or “runoff dams”. The presence of small catchment dams changes the hydrology in a basin by reducing the rate of overland flows (surface run-off) and by altering evaporation and groundwater seepage. Small catchment dams reduce the volume of surface run-off that might otherwise become streamflows in a basin.

In prior Victorian water accounts, the total volume of water harvested by small catchment dams was determined based on estimates of the total volume of small catchment dams in a basin obtained from DELWP’s Sustainable Diversions Limits project in 2002 and Flow Stressed Ranking Procedure project in 2005, and from computer-based simulation modelling of the impact of small catchment dams on mean annual streamflows. These estimation methods are dependent on available GIS data.

In these *Victorian Water Accounts 2015–16*, after more than 10 years, the GIS data used to derive the capacity values for small catchment dams was updated to provide a more accurate measure. The new estimations for small catchment dam capacity based on the updated GIS data will continue to be used in future reporting in the annual Victorian water accounts.

Estimations of small catchment dam impacts are represented in the river basin water balances (Chapter 6) as three separate components:

- The estimated volume harvested by small catchment dams in each basin appears as catchment inflow in the water balance. This is calculating by multiplying the estimated total capacity by an impact factor. This makes an estimate of how much water is harvested by small catchments over the course of a year.
- The estimated volume that owners extract from dams to supply their needs is accounted for as a diversion in the surface water balance. The volume extracted (volume used in each basin) is calculated by multiplying the estimated total capacity by an extraction factor.
- The estimated volume of evaporation from small catchment dams is accounted for as a loss in the surface water balance. This volume is determined to be the difference between the amount harvested and the amount used.

Small catchment dam estimates of volumes harvested, volumes extracted, and volumes evaporated all have a high degree of uncertainty. Although estimates are provided in the Victorian water accounts, given the high degree of uncertainty associated with these estimates care is required when interpreting the estimates, and they will not be suitable for some applications.

All volumes presented for small catchment dams are annual average figures. In extremely dry years, these annual average figures are factored down to reflect the reduced water availability from lower rainfall. As 2015–16 was not an extremely dry year for any of Victoria’s 29 basins, the average annual volumes have been applied.

Water harvested for farm dams is considered an inflow to the catchment, therefore is included in the calculation of water availability (or catchment inflow) for the basin. Thus, a significant change to the small catchment dam capacity value will in turn affect the catchment inflow value. Where there are significant differences between catchment inflows reported for 2014-15 and 2015-16, this should not always be interpreted as a significant reduction in available water. Instead, these are usually due to either improved identification of very small catchment dams (less than 5ML), or improved ability to differentiate small catchments dams from other small waterbodies such as natural lakes or wetlands. Where the change has been significant, an explanatory note has been included in the water balance (see Chapter 6) for the particular basin.

Table E-1 below shows the estimated small catchment dam capacity volume for both types of use in every Victorian basin for:

- 2015-16, using the new GIS data to estimate small catchment dam capacity volumes that will used for future years also
- 2014-15, using the old GIS data to estimate small catchment dam capacity volumes.

Table E-1: Change in capacity of small catchment dams from 2014-15 to 2015-16

Basin	Dam category	Old capacity (ML)	New capacity (ML)
Murray	Domestic and stock (not licensed)	7,154	2,287
	Registered commercial and irrigation	3,414	14,379
Kiewa	Domestic and stock (not licensed)	3,972	7,157
	Registered commercial and irrigation	2,311	4,597
Ovens	Domestic and stock (not licensed)	14,739	29,375
	Registered commercial and irrigation	10,141	10,793
Broken	Domestic and stock (not licensed)	15,382	18,875
	Registered commercial and irrigation	9,580	8,724
Goulburn	Domestic and stock (not licensed)	35,876	57,724
	Registered commercial and irrigation	35,207	21,719
Campaspe	Domestic and stock (not licensed)	15,036	32,076
	Registered commercial and irrigation	25,307	7,136
Loddon	Domestic and stock (not licensed)	31,649	48,816
	Registered commercial and irrigation	40,729	17,801
East Gippsland	Domestic and stock (not licensed)	770	1,126
	Registered commercial and irrigation	851	176
Snowy	Domestic and stock (not licensed)	3,143	2,948
	Registered commercial and irrigation	2,124	1,592
Tambo	Domestic and stock (not licensed)	4,494	5,088
	Registered commercial and irrigation	2,052	1,330
Mitchell	Domestic and stock (not licensed)	4,218	4,031
	Registered commercial and irrigation	2,915	2,978
Thomson	Domestic and stock (not licensed)	5,635	5,508
	Registered commercial and irrigation	4,961	3,239
Latrobe	Domestic and stock (not licensed)	13,009	12,701
	Registered commercial and irrigation	16,717	19,585
South Gippsland	Domestic and stock (not licensed)	22,962	32,447
	Registered commercial and irrigation	15,208	14,480
Bunyip	Domestic and stock (not licensed)	8,026	23,867
	Registered commercial and irrigation	13,704	24,885
Yarra	Domestic and stock (not licensed)	10,524	18,375
	Registered commercial and irrigation	12,574	9,712
Maribyrnong	Domestic and stock (not licensed)	5,769	10,499
	Registered commercial and irrigation	5,831	1,936
Werribee	Domestic and stock (not licensed)	5,868	9,284
	Registered commercial and irrigation	7,634	1,002
Moorabool	Domestic and stock (not licensed)	6,079	13,187
	Registered commercial and irrigation	22,807	7,641
Barwon	Domestic and stock (not licensed)	10,374	24,327
	Registered commercial and irrigation	30,609	10,273
Corangamite	Domestic and stock (not licensed)	8,100	10,116
	Registered commercial and irrigation	9,900	3,937
Otway Coast	Domestic and stock (not licensed)	10,736	14,217
	Registered commercial and irrigation	8,762	10,057
Hopkins	Domestic and stock (not licensed)	30,913	28,278

	Registered commercial and irrigation	58,430	8,699
Portland Coast	Domestic and stock (not licensed)	4,524	6,634
	Registered commercial and irrigation	16,516	631
Glenelg	Domestic and stock (not licensed)	27,109	34,504
	Registered commercial and irrigation	49,915	1,961
Millicent Coast	Domestic and stock (not licensed)	0	1,789
	Registered commercial and irrigation	0	5,612
Wimmera	Domestic and stock (not licensed)	12,950	23,883
	Registered commercial and irrigation	9,360	7,582
Mallee	Domestic and stock (not licensed)	0	0
	Registered commercial and irrigation	0	10
Avoca	Domestic and stock (not licensed)	10,514	10,285
	Registered commercial and irrigation	8,852	5,503
Total		**755,937**	**717,374**

Table E-2 shows the calculated catchment inflow for each basin in 2015-16 using the new GIS data to estimate small catchment dam capacity volumes. This is compared to the calculated catchment inflow for each basin using the previous GIS data to estimate small catchment dam capacity volumes to illustrate the impact of the updated capacity numbers have on water availability in the basin.

Table E-2: Comparison of calculated catchment inflow volumes

Basin	Average annual streamflow (ML)	2015-16 (using OLD estimates of small catchment dam capacity)		2015–16 (using NEW estimates of small catchment dam capacity)		Catchment inflow change due to improved estimation of small catchment dam capacity volumes (1)
		Catchment inflow (ML) (2)	(% of average)	Catchment inflow (ML) (2)	(% of average)	(%)
Murray	7,618,000	2,835,799	37%	2,840,190	37%	0%
Kiewa	689,000	469,483	68%	473,860	69%	1%
Ovens	1,758,000	701,299	40%	713,835	41%	2%
Broken	308,000	75,031	24%	77,457	25%	3%
Goulburn (3)	3,363,000	1,034,796	31%	1,041,566	31%	1%
Campaspe	352,000	55,688	16%	54,467	15%	-2%
Loddon	373,000	85,446	23%	79,109	21%	-7%
East Gippsland	714,000	1,161,724	163%	1,161,494	163%	0%
Snowy (4)	1,022,000	1,927,883	189%	1,927,323	189%	0%
Tambo	297,800	435,773	146%	435,656	146%	0%
Mitchell	884,500	514,583	58%	514,486	58%	0%
Thomson	1,101,760	561,341	51%	559,677	51%	0%
Latrobe	847,400	550,275	65%	552,528	65%	0%
South Gippsland	911,500	572,565	63%	579,308	64%	1%
Bunyip	541,000	446,421	83%	466,417	86%	4%
Yarra	1,054,000	492,028	47%	495,720	47%	1%
Maribyrnong	113,000	18,896	17%	19,806	18%	5%
Werribee	102,000	24,739	24%	21,233	21%	-14%
Moorabool	97,000	31,676	33%	23,457	24%	-26%
Barwon	360,000	111,586	31%	104,820	29%	-6%
Corangamite	316,000	44,789	14%	40,645	13%	-9%
Otway Coast	884,000	415,420	47%	419,384	47%	1%

Hopkins	635,000	136,353	21%	80,845	13%	-41%
Portland Coast	361,000	117,822	33%	104,323	29%	-11%
Glenelg	964,000	158,976	16%	116,795	12%	-27%
Millicent Coast (5)	n/a	n/a	n/a	n/a	n/a	n/a
Wimmera	316,400	34,948	11%	44,378	14%	27%
Mallee (5)	n/a	n/a	n/a	n/a	n/a	n/a
Avoca	136,200	22,528	17%	18,377	13%	-18%
Total	**26,119,560**	**13,037,864**	**50%**	**12,967,152**	**50%**	**-1%**

Notes:

(1) The comparison between catchment inflow values calculated with pre-2015–16 small catchment dam capacity model numbers and 2015–16 values calculated with the new small catchment dam capacity model numbers.

(2) 'Streamflow' is equivalent to 'catchment inflow' in the water balances presented in chapter 6.

(3) This includes inflows from Broken River.

(4) Volumes shown for the Snowy basin exclude catchment inflows from New South Wales (upstream of Burnt Hut Crossing)

(5) Surface water balances are not prepared for the Millicent Coast and Mallee basins, therefore no comparison of farm dam volumes is required.