Victorian Water Accounts

2018–2019

A statement of Victorian water resources

VICTORIA State Government | Environment, Land, Water and Planning

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Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

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Victorian Water Accounts 2018–2019

A statement of Victorian water resources

Foreword

The *2018–19 Victorian Water Accounts* provide an overview of the use and management of Victoria's water resources.

In a time of more extreme weather events and extended periods of water scarcity, regular and comprehensive public water reporting has never been more important. Victoria continues to lead the way in such reporting.

Victoria has developed online platforms to make monthly and annual reporting more easily accessible to the public.

In 2018–19, conditions were again drier than in the previous year, with below-average rainfall across most of Victoria. Northern parts of the state experienced particularly dry conditions and large parts of East Gippsland continued to suffer from a severe multi-year drought, which affected large parts of eastern Australia.

The decreased rainfall and hot conditions meant that there was less surface water available in 2018–19, compared to previous years. Consequently, there was an increase in the number of Victorian towns on water restrictions and an increase in restrictions on the volume that licensed landholders were allowed to divert from streams.

The release of the *Victorian Water Accounts 2018–19* marks the sixteenth in the series of annual reports. These accounts show the total volume of surface water, groundwater and recycled water available in 2018–19 was 12,073 GL, compared to 15,375 GL in the previous year.

Victoria is in a good position to face the challenges of population growth, climate change and extended periods of drought and dry conditions, but we cannot be complacent. The Victorian Government, together with our partners, is leading the way in managing our water resources sustainably through *Water for Victoria*, our plan for responding to the pressures of climate change and population growth and for doing more with less water. This includes building the Victorian Water Grid with major pipeline extensions, irrigation modernisation, use of the desalination plant and investing in recycling, stormwater use and water efficiency.

Together with the Victorian Water Accounts Highlights, released last year and available at https://howmuch.water.vic.gov.au/, we will soon be releasing an online version of the surface water accounts. These combined products will provide a new way to engage with water data and learn more about how water is managed. We are always looking to improve how we report, and if you have any suggestions about this please let the team know what you think by emailing us at water.reporting@delwp.vic.gov.au.

THE HON LISA NEVILLE

Minister for Water

Contents

Executive summary

Victorian Water Accounts 2018–19 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.
- Conditions in 2018–19 were even drier than in the previous year, with below-average rainfall across most of Victoria throughout the year. It was Victoria's driest July since 2002 and the second-driest September and ninth-driest spring on record. It was also Victoria's warmest summer and eighth-warmest autumn on record.
- At the end of June 2019, a severe, multi-year drought was affecting large parts of eastern Australia.
- The total available volume of surface water, groundwater and recycled water was lower than in the previous year.
- The drier, warmer conditions in 2018–19 (following on from a dry 2017–18) meant there were more restrictions in 2018–19 than in the previous year. Water use was restricted for the urban users, with six towns affected. More streams were restricted in 2018–19, with a peak of 162 streams restricted in March 2019 compared to 130 in March 2018.
- In July 2018, opening allocations were low for all entitlements in regulated systems. By February, almost all high-reliability entitlements received 100% allocation in regulated systems except the Loddon, Goulburn and Broken systems in the north and the Werribee and Bacchus Marsh district in the south: three less than the previous year.
- Storages once again ended the year lower than they began, and only 15 of Victoria's regional storages reached at least 90% of capacity by September 2018 (compared to 28 the previous year). Four of those reached full capacity and were spilling.
- Groundwater levels trends in 2018–19 were declining at a greater rate than in 2017–18.
- Surface water use decreased slightly, compared to 2017–18.
- Groundwater use decreased, compared to 2017–18.
- Recycled water use increased in 2018–19, compared to 2017–18.
- This year was the VEWH's eighth year managing water for the environment in Victoria. In 2018–19, 92% of identified required watering actions were fully or partially achieved through a combination of managed environmental flows, natural flows, unregulated passing flows and delivery of consumptive water en route.

About the *Victorian Water Accounts 2018–19*

The *Victorian Water Accounts 2018–19* is the sixteenth 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 2018 and 30 June 2019. 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 2018–19* demonstrates 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, the accounts are a valuable resource for people working in the water 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 (DELWP); 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 2018–19* 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 that track each system's inflows, outflows and storage volume changes during the year.

Drier, warmer conditions across Victoria

Conditions in 2018–19 were drier again than in the previous year, with below-average rainfall across most of Victoria throughout the year. Parts of the north and large parts of the east of Victoria received very-much-below-average rainfall in 2018–19. As at the end of June 2019, a severe multi-year drought was affecting large parts of eastern Australia and a warmer-than-average June across south-eastern Australia continued to add to soil moisture stress. In 2018–19, Victoria was hotter than the long-term average, particularly in December and January. Power blackouts affected about 200,000 homes across Victoria as temperatures soared on 25 January.

Rainfall in winter was below average across the north and east of the state, while in the south-west and south it was generally close to average. It was Victoria's ninth-driest spring on record, with areas of very much below average rainfall totals covering large parts of the state. Summer 2018–19 was Victoria's warmest on record and, averaged across the state, rainfall was just below the long-term average. In autumn 2019, rainfall was below average, and temperatures were above average (this being the eighth-warmest autumn on record).

Across most of the state, evapotranspiration represented a greater-than-average proportion of rainfall, with less rainfall flowing into streams and recharging groundwater aquifers than would be the case in an average year. As a result of low rainfall and high evapotranspiration, less rainfall remained for streamflows, with Victoria's total streamflows for the year reaching 46% of the long-term average.

There were more restrictions in 2018–19 than in 2017–18. Six towns — five more than 2017–18 — and 162 streams — compared to 130 streams in 2017–18 — were affected. High-reliability entitlements received 100% allocation in all but two regulated systems, one less than in 2017–18.

In groundwater catchments, water level trends were declining more than in 2017–18.

Decreased water availability

A total of 12,073 GL of surface water, groundwater and recycled water was available in 2018–19. This is less than the 15,375 GL available in 2017–18.

Victoria's total storage levels started the year at 7,378 GL (60% of capacity) and ended at 5,208 GL (42% of capacity). Storages once again ended the year lower than they began, and only 15 of Victoria's regional storages had reached at least 90% of capacity by September 2018 (compared to 28 the previous year), and four of those had reached full capacity and were spilling.

In 2018–19, all high-reliability entitlements reached 100% allocation except for the Broken system (which reached 37% allocation) and the Werribee and Bacchus Marsh district (which reached 45% allocation). Only two systems had low-reliability entitlement allocations. In northern Victoria, the Bullarook System reached 100% allocation for low-reliability entitlement, and in southern Victoria the Thomson–Macalister district received a 35% allocation against low-reliability entitlement. Allocations for the Wimmera Mallee Pipeline Product began with initial allocations of 9% which then reached 45% in February 2019 and ended with a final allocation of 55% of entitlement. In the Coliban Rural system, entitlement holders had access to 100% of their entitlement for the entire year.

Decreased water use

In Victoria, 3,976 GL of surface water, groundwater and recycled water was taken for consumptive use in 2018–19, less than the 4,087 GL taken the previous year. This volume represents about 33% of the total water available during the year, higher than the 27% in 2017–18.

Surface water use was 3,377 GL in 2018–19, 173 GL less than 2017–18. Less water was used for irrigation (182 GL less than the 2017–18 volume) while urban and commercial purposes use was 25 GL higher than in 2017–18.

Groundwater use increased in 2018–19, with Victorian water users extracting 498 GL of groundwater, compared to 440 GL in 2017–18.

Recycled water use increased slightly from the previous year, with 100 GL recycled in 2018–19, compared to 97 GL in 2017–18.

In 2018–19, the Victorian Environmental Water Holder (VEWH) oversaw the delivery of 546 GL of water to 90 priority river reaches and 78 wetlands, and 92% of identified, required watering actions were fully or partially achieved. The number of potential watering actions has increased each year since the VEWH's inception. Since 2013–14, the number of sites watered each year has fluctuated due to climatic conditions, water availability and infrastructure improvements. The number of sites watered in 2018–19 was similar to 2017–18.

Bushfires

There was an early start to the bushfire season, when fires began in eastern Victoria in August due to unusually warm, dry conditions. In early January, extreme temperatures and sudden changes in wind direction and strength produced conditions conducive to bushfires across eastern Victoria. There were 200 fires across Victoria, including a large fire near Rosedale in Gippsland that burnt more than 550 hectares and a complex fire in the Thomson catchment, just north of Mount Baw Baw, that had burnt through about 4770 hectares by 1 February.

More fires started in February, and with little rain in March several fires became very large including those in the Bunyip State Park and Alpine National Park. Numerous other fires were also started by lightning in early March.

Floods and storms

In November, much of central southern Victoria and south-to-west Gippsland received more rain in just three hours than in the previous two months combined, with flash flooding affecting multiple towns. There was also flash flooding in north-eastern Victoria when strong winds, heavy rain and severe thunderstorms on 13 and 14 December brought about a month's worth of rain.

A dust storm moved through Mildura on 7 May, with the wind gusting to over 80 km/h and the storm reducing visibility to a few hundred metres. Dust storms are most often seen in summer, but north-west Victoria had been very dry for several months.

Continuous improvement of the accounts

Two main improvements have been made to the 2018–19 accounts:

- a review was conducted of the data and method used to calculate the volume of water leaving a basin (outflows)
- the estimates of long-term water availability were reviewed and updated.

Review of the method and surface water gauged sites used to calculate outflows

'Water passed at outlet of basin' (also known as outflows) represents the total volume of flows that leaves the end of a basin, shown in chapter 6. 'Water passed at outlet of basin' is estimated by using gauged streamflow data at a point as close to the basin outlet as possible and the gauged data is then extrapolated to the ungauged basin area. The calculation methods and streamflow data were reviewed by consultants in late 2019, to ensure the best-available data and methods were being used to calculate outflows.

Changes to the gauged streamflow data and calculation method were recommended and implemented in 14 basins, providing a higher level of certainty about the outflow calculation. Chapter 6.1.2 has more information.

Review of estimates of long-term water availability

As part of the *Long-Term Water Resource Assessment for Southern Victoria* and as further explained in chapter 2.2, the original estimates of long-term water availability — also known as long-term average inflows — were refined using improved data and methods and a period that better represents the current climate (based on data from 1975 to the present).

Further work has been completed for the 2018–19 accounts to update the long-term-average inflow estimates so they come from one consistent data source. Changes were made to all long-term-average inflow estimates except for the Mallee and Millicent Coast basins. Chapter 6.1.2 and Appendix E have more information about the review.

Want to know more?

The *Victorian Water Accounts 2018–19* have been creatively represented through the online 'Managing Victoria's water resources' at https://howmuch.water.vic.gov.au/.

A soon-to-be-released new online platform will cover the surface water and distribution systems chapters of the Victorian Water Accounts. People will be able to use the website to find out where water is sourced through to where it is used by customers.

More information about **water quality** can be found at DELWP's online Water Quality visualisation at http://quality.water.vic.gov.au/.

More information about **sustainable water management** across Victoria can be found at www.delwp.vic.gov.au/water.

More information about **water supply and use** is available from water corporations 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 http://www.vewh.vic.gov.au/.

More information about **rainfall and temperatures** can be found at www.bom.gov.au.

Part 1: Overview of Victoria's water resources 2018–19

Part 1 of the *Victorian Water Accounts 2018–19* 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, water storages, aquifers and desalinated water
- the quantity of water allocated for consumptive use from reservoirs, streams and aquifers under entitlements issued by government, as well as quantities used, recycled and desalinated
- water available to the environment
- Victoria's water trade activity.

1. Management of Victoria's water resources

The *Water Act 1989* is the primary legislation guiding the management of Victoria's water resources. Under the Act, the Crown retains the overall right to the use, flow and control of all surface water and groundwater on behalf of all Victorians.

The Act establishes a water entitlement framework, and the government has established a water resource planning framework, to provide for the efficient and equitable sharing of Victoria's water resources. The entitlement framework clearly specifies the legal rights and obligations of entitlement holders and the state in overseeing management of Victoria's water resources. A feature of the framework is that it gives entitlement holders flexibility and certainty about how they manage their water, enabling them to make decisions and manage their own risks. This flexibility and certainty underpins investment decisions by irrigators, urban water authorities and industry. The water entitlement and water resource planning frameworks are explained in chapter 1.3. Good-quality, timely water resource management information is essential for the frameworks to operate effectively.

This chapter:

- provides an overview of the types of water resources governed under Victoria's water entitlement and water resource planning frameworks
- describes the water sector's institutional arrangements for managing Victoria's water resources
- explains the key features of the water entitlement and water resource planning frameworks and how they provide flexibility to respond to seasonal variability in water availability
- describes how we monitor and report on water resources.

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:

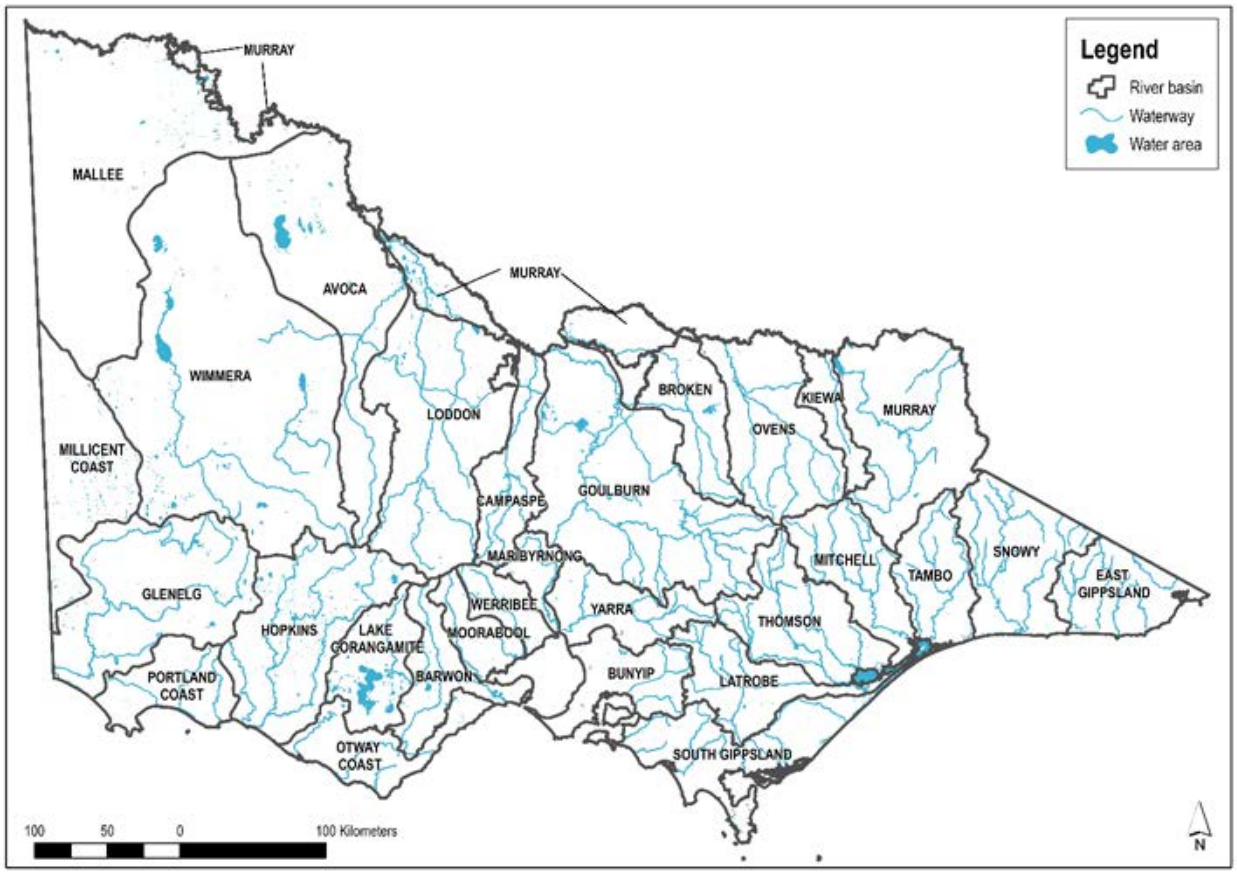
- **surface water**, which is water that occurs or flows on land. This includes water in waterways and in lakes, reservoirs, dams, wetlands and other water bodies. The term 'waterway' means a river, creek, stream, watercourse or a natural channel where water regularly flows, whether or not the flow is continuous
- **groundwater**, which is any water occurring in an aquifer: any geological formation that contains water either permanently or intermittently or allows water to pass through it
- **recycled water**, which is water derived from sewerage systems or industry processes that is then treated to a standard appropriate for its intended use
- **desalination water**, which is seawater treated to a standard appropriate for its intended use.

1.1.1 Surface water

Victoria's surface water resources include water that occurs or flows on land. For the purposes of these accounts, river basins are used as the primary reporting unit for surface water information. A river basin is the area of land drained by a river and its tributaries. Victoria is comprised of 29 major river basins[1]. The river basins in the south and east of the state drain to the sea, and those in the north drain to the Murray–Darling basin. The extent of each of Victoria's river basins is shown in Figure 1-1.

[1] The river basins defined by the former Australian Water Resource Council (AWRC) are used, except for the Murray basin. For the purposes of the water accounts, the Murray basin includes the Upper Murray basin as defined by the AWRC and the areas in Victoria that are supplied from the Murray River downstream of Lake Hume.

Figure 1-1 Victoria's river basins



Victoria's rivers and waterways can be broadly categorised as either regulated or unregulated systems.

In **regulated systems**, the flow of water in the waterway is regulated and captured through the operation of large dams or weirs. In these systems, the dams, weirs and other flow-regulating structures significantly transform the natural variability of streamflows into a more-reliable supply of water. Examples are Lake Eildon on the Goulburn system and the Dartmouth and Hume dams on the Murray system. Dams and reservoirs within waterways are known as on-stream storages.

Unregulated systems are waterways that do not have large dams or weirs controlling the streamflow. Water is taken directly from these systems by pumps or diverted to off-stream storages. The volume of water available is based purely on rainfall and run-off, not on storage. Therefore, water supplies are more susceptible to variation in streamflow, and less water is available in the drier months and in drought periods.

Surface water also includes the water captured and held in small catchment dams. In other jurisdictions, these are sometimes referred to as farm dams, hillside dams or run-off dams. These dams are not located on or fed by a waterway, and they are filled by rainfall in their catchment.

Chapter 6 provides the water accounts for each of Victoria's 29 river basins, tracking 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.

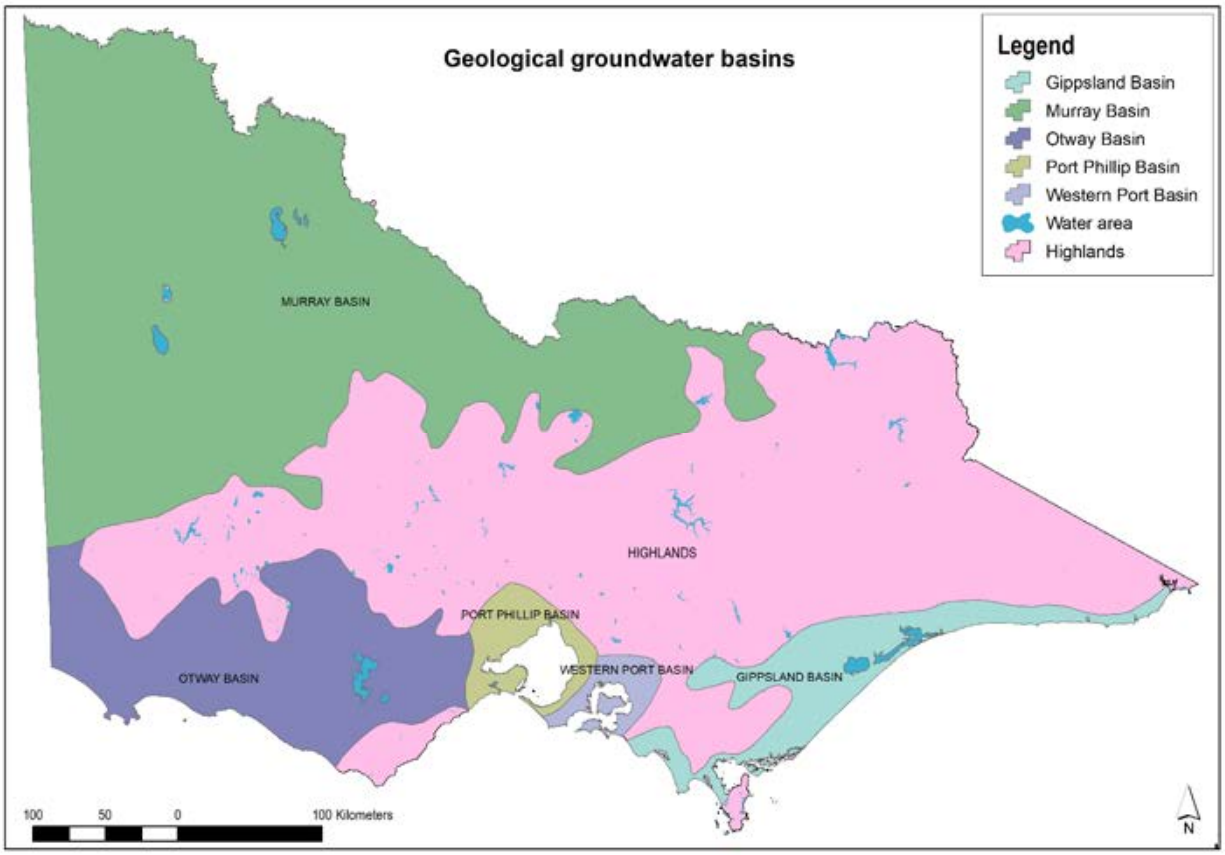
1.1.2 Groundwater

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 rainfall, surface water or snowmelt seeps from the surface and reaches the water table to form groundwater. Groundwater flows may eventually return to the surface as springs, baseflow into rivers and streams, lakes and wetlands, the ocean; or it may evaporate. Groundwater supports human consumption and agricultural, commercial and industrial uses, and groundwater-dependent ecosystems. It also contributes to environmental flows in streams.

Where groundwater is held within a geological formation which allows water to flow through – called an aquifer – it can be pumped to the surface for use. The flow of groundwater can vary. Some users pump groundwater from a bore and store it for use. Elsewhere, groundwater is artesian, flowing naturally due to pressure in a deep aquifer. The salinity of the groundwater often determines whether it is suitable for consumptive use.

The majority of Victoria's groundwater is contained in geological basins, which are shown in Figure 1-2. Each basin contains layers of sediment, which form Victoria's aquifers.

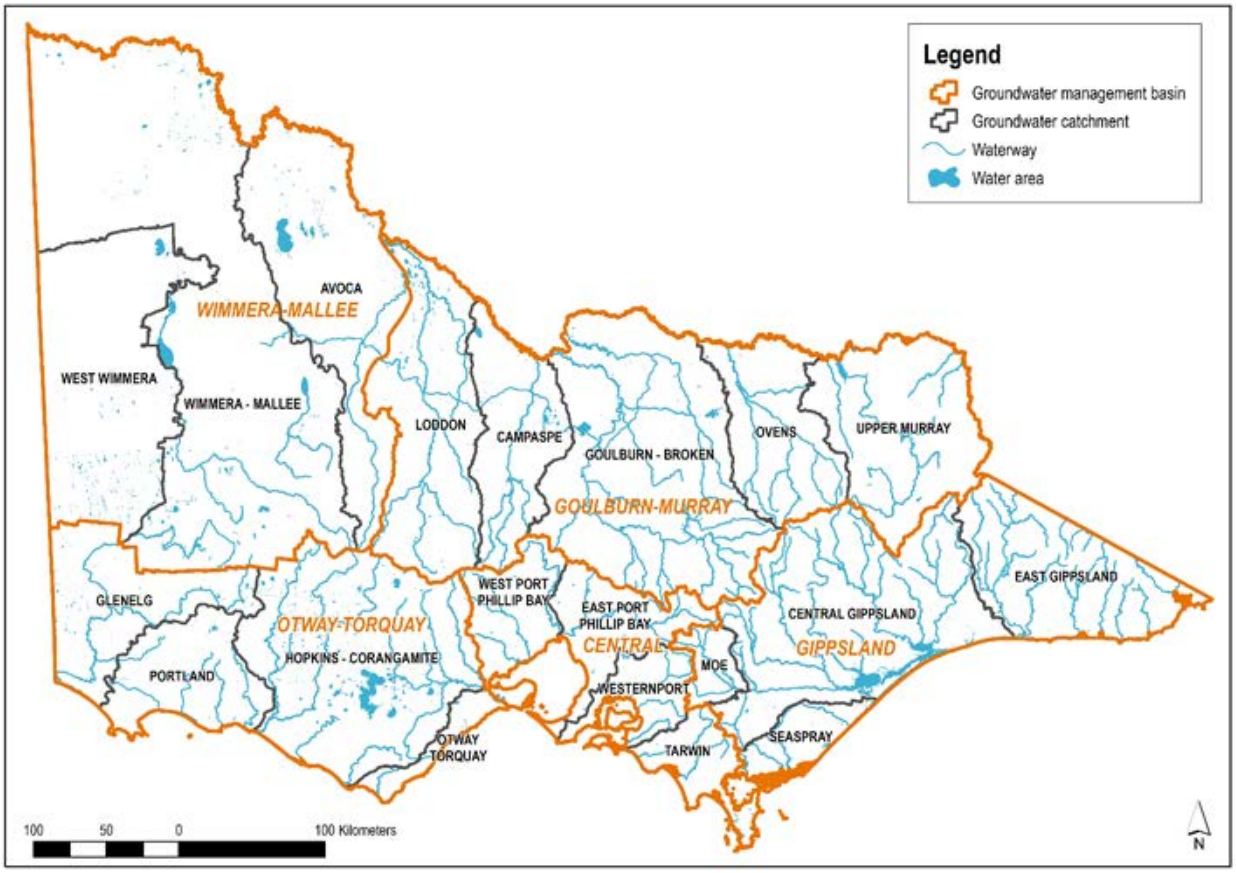
Figure 1-2 Victoria's geological groundwater basins



There is more information about Victoria's groundwater resources at https://www.water.vic.gov.au/groundwater/victorias-groundwater-resources.

The planning for and reporting of groundwater in Victoria uses administrative boundaries known as groundwater management basins. These basins are areas of connected groundwater resources and are based on groundwater flow systems with water corporation administrative management boundaries. Figure 1-3 shows Victoria's five groundwater management basins. Each contains several groundwater catchments, and they provide the basis for planning and reporting. See chapter 1.3.2 for more information about how groundwater is managed.

Figure 1-3 Victoria's groundwater management basins and catchments



Chapter 7 provides the water accounts for each of Victoria's 20 groundwater catchments. It further describes Victoria's groundwater resources and accounts for irrigation, urban and domestic and stock groundwater use in each catchment.

1.1.3 Recycled water

Highly treated wastewater can be recycled for a range of non-drinking uses.

Once treated, the recycled water is delivered by water corporations to their customers through a separate (purple) pipe system that has been installed in some new developments. Recycled water is suitable for a wide range of uses including irrigation and toilet flushing.

Recycled water produced in 2018–19 is described in chapter 3.3, and recycled water use in each river basin in chapter 6.

1.1.4 Desalinated water

Desalination is the process of removing salinity (dissolved salts) from salt water. In September 2009, construction started on the Victorian Desalination Project (VDP) at Wonthaggi. Construction was completed in December 2012. The VDP uses reverse-osmosis technology to remove salt from seawater and so create high-quality drinking water.

The rainfall-independent VDP can supply up to 150 GL of high-quality drinking water a year, or about one-third of Melbourne's annual water consumption. The project includes a two-way underground transfer pipeline, which connects the VDP to Melbourne's water network through a delivery point at Berwick and transfer main to Cardinia Reservoir. Offtakes are included along the pipeline so that areas in South Gippsland and Western Port can access the water from the plant or Cardinia Reservoir if required.

The first order from the VDP was made in March 2016 by the Minister for Water. Chapters 2.3, 3.4 and 6.17.1 (Yarra basin management arrangements) report on water produced in 2018–19.

1.2 Water sector institutional arrangements

Victoria's state-owned water sector is made up of 19 water corporations constituted under the Act. The water corporations provide a range of water services to customers within their service areas.

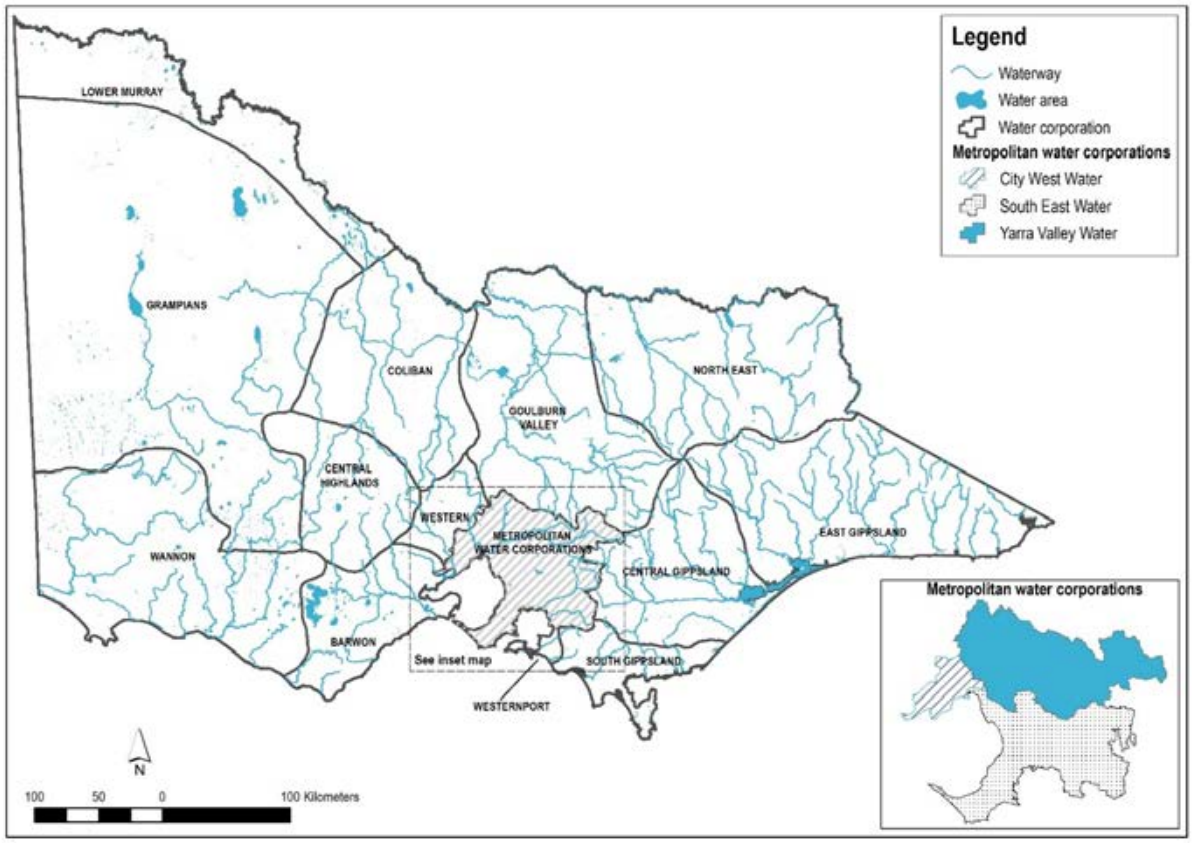
Sixteen **water corporations** provide urban water supply (including of recycled water) and sewage and trade waste disposal services to urban customers throughout Victoria. Figure 1-4 shows their areas. In regional Victoria, they are:

- Barwon Water
- Central Highlands Water
- Coliban Water
- East Gippsland Water
- Gippsland Water
- Goulburn Valley Water
- Grampians Wimmera Mallee Water
- Lower Murray Water
- North East Water
- South Gippsland Water
- Wannon Water
- Westernport Water
- Western Water.

In Melbourne, they are:

- City West Water
- South East Water
- Yarra Valley Water.

Figure 1-4 Urban supply

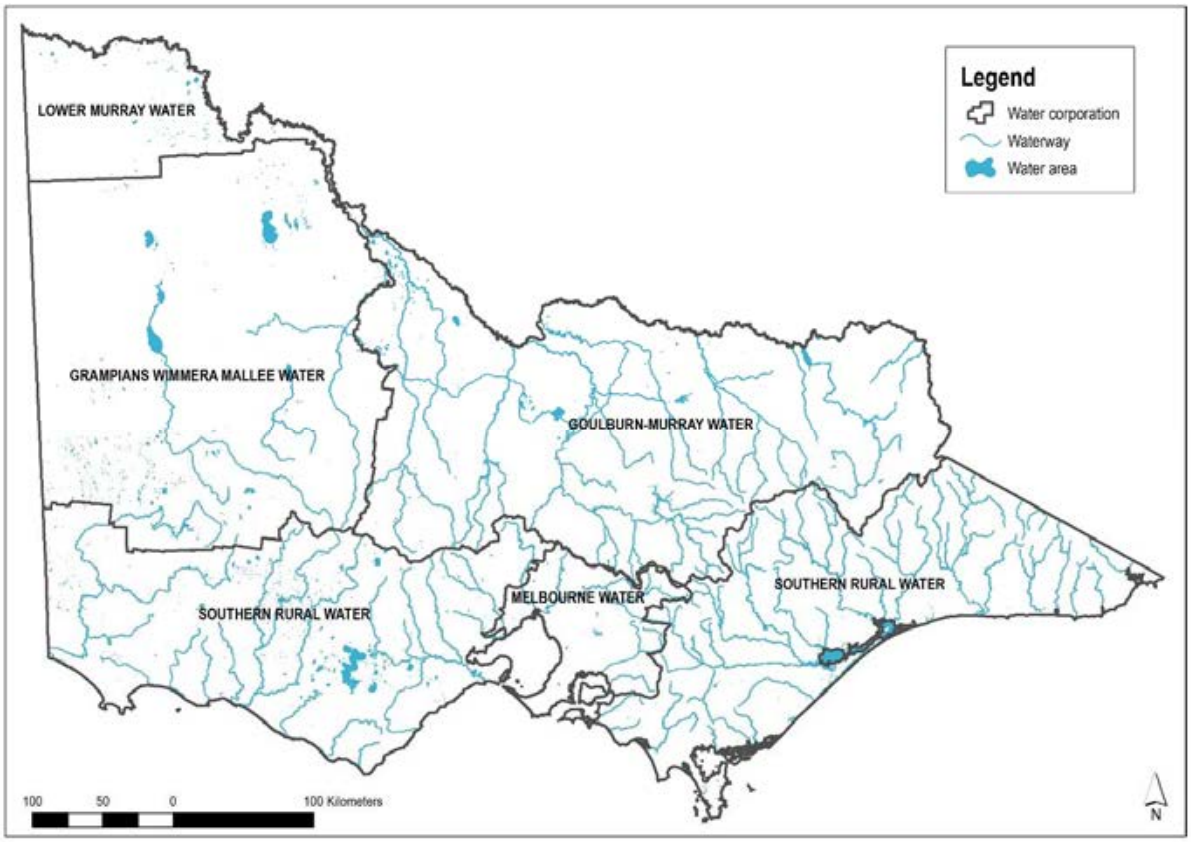


Six **rural water corporations** provide rural water services including water supply, drainage and salinity mitigation services for irrigation and domestic and stock purposes. They are:

- Southern Rural Water
- Goulburn-Murray Water
- Coliban Water
- Grampians Wimmera Mallee Water
- Lower Murray Water
- Melbourne Water.

Figure 1-5 shows the rural supply boundaries.

Figure 1-5 Rural supply



Southern Rural Water, Goulburn-Murray Water and Grampians Wimmera Mallee Water are also responsible for:

- providing bulk water supply services to other water corporations in regulated water supply systems in regional Victoria
- managing regulated systems
- administering the diversion of water from waterways
- issuing and administering groundwater licences
- developing and implementing management plans on behalf of the Minister.

Lower Murray Water also administers the diversion of water from waterways and issues and administers groundwater licences.

Coliban Water's rural system is for stock and domestic use, and it distributes water across their region via a network of open channel and pipeline systems. Water is sourced for this rural supply from their bulk entitlement to the Campaspe system.

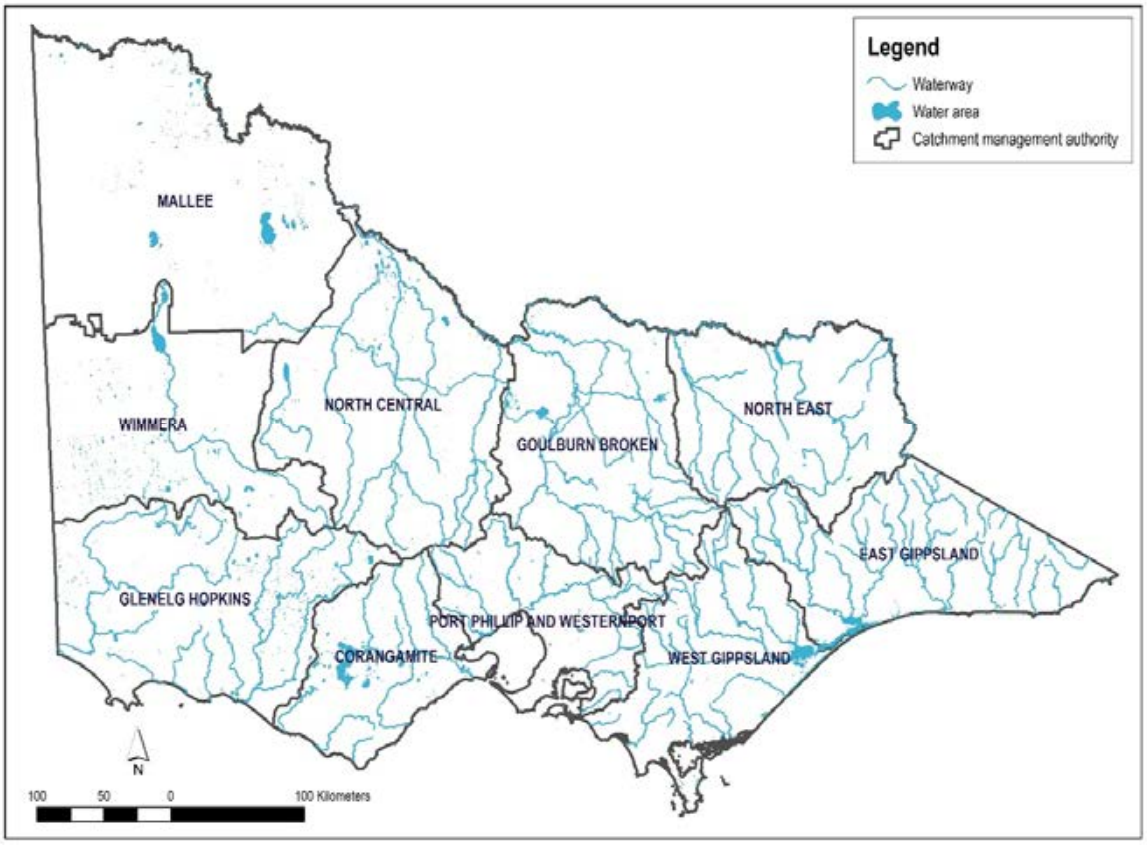
Melbourne Water provides bulk water supply and sewerage services to water corporations in the Melbourne metropolitan area. Its other responsibilities include:

- managing rivers, creeks and major drainage systems in the Melbourne, Port Phillip and Western Port areas
- developing and implementing management plans on behalf of the Minister
- administering the diversion of water from waterways
- supplying recycled water, through a number of retail water corporations, for irrigation and other purposes.

The Victorian economic regulation framework for water, established under the *Essential Services Commission Act 2001* and the *Water Industry Act 1994*, guides water corporations' 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*. The environmental performance of water corporations is independently regulated by the **Environment Protection Authority Victoria** (EPA) in accordance with the *Environment Protection Act 1970*. The EPA is responsible for controlling environmental standards for wastewater discharge.

Victoria's framework for the integrated management of catchments is established under the *Catchment and Land Protection Act 1994* (the CaLP Act). Integrated catchment management is the coordinated management of land, water and biodiversity resources based on catchment areas. It incorporates environmental, economic and social considerations. Victorian is divided into ten catchment and land protection regions (shown in Figure 1-6), each reflecting the unique biophysical qualities of its area. In each region, a **catchment management authority** (CMA) is responsible for the integrated planning and coordination of land, water and biodiversity management, in conjunction with local communities. Under the *Water Act 1989*, CMAs (except for the Port Phillip and Westernport CMA) are also responsible for regional waterway, floodplain, drainage and environmental water reserve management. The CaLP Act establishes the **Victorian Catchment Management Council** as the government's key advisory body on catchment management and the condition of land and water resources at the statewide level.

Figure 1-6 Catchment management authorities



The **VEWH** is the independent statutory body responsible for holding and managing Victoria's environmental water entitlements. The VEWH works with CMAs to ensure environmental water entitlements are used to achieve the best environmental outcomes with the available water. The VEWH holds a number of environmental water entitlements in its own right, and it manages some entitlements on behalf of the Snowy Water Initiative and The Living Murray program.

The **Murray–Darling Basin Authority** is responsible for ensuring compliance with the ***Murray–Darling Basin Plan***, which formally commenced in November 2012. The Basin Plan sets limits on the amount of water that can be extracted from the basin, which came into effect in 2019. These are known as sustainable diversion limits (SDLs) and are set to recover 2,750 gigalitres of water for the environment. This water will be used to help improve the environmental health of basin rivers, wetlands and floodplains and the habitats of plants and animals that rely on the river system.

1.3 Water entitlement and water resource planning frameworks

The Victorian water entitlement framework (Figure 1-7) sets out the ways in which individuals, companies, government and water corporations may take and use water in a system. The elements of the entitlement framework 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 water-sharing arrangements
- the ability to restrict annual water use in response to seasonal variability through seasonal allocations in systems with water shares; rosters, restrictions or bans on licence holders in unregulated surface water and groundwater systems; or water restrictions imposed on urban water customers
- clear, consultative processes before entitlements can be changed
- the ability to trade, using markets to facilitate the efficient movement of water by giving entitlement holders the flexibility to buy and sell entitlements
- private rights enabling individuals to take water for domestic and stock purposes in certain circumstances without a licence
- Traditional Owner rights to water.

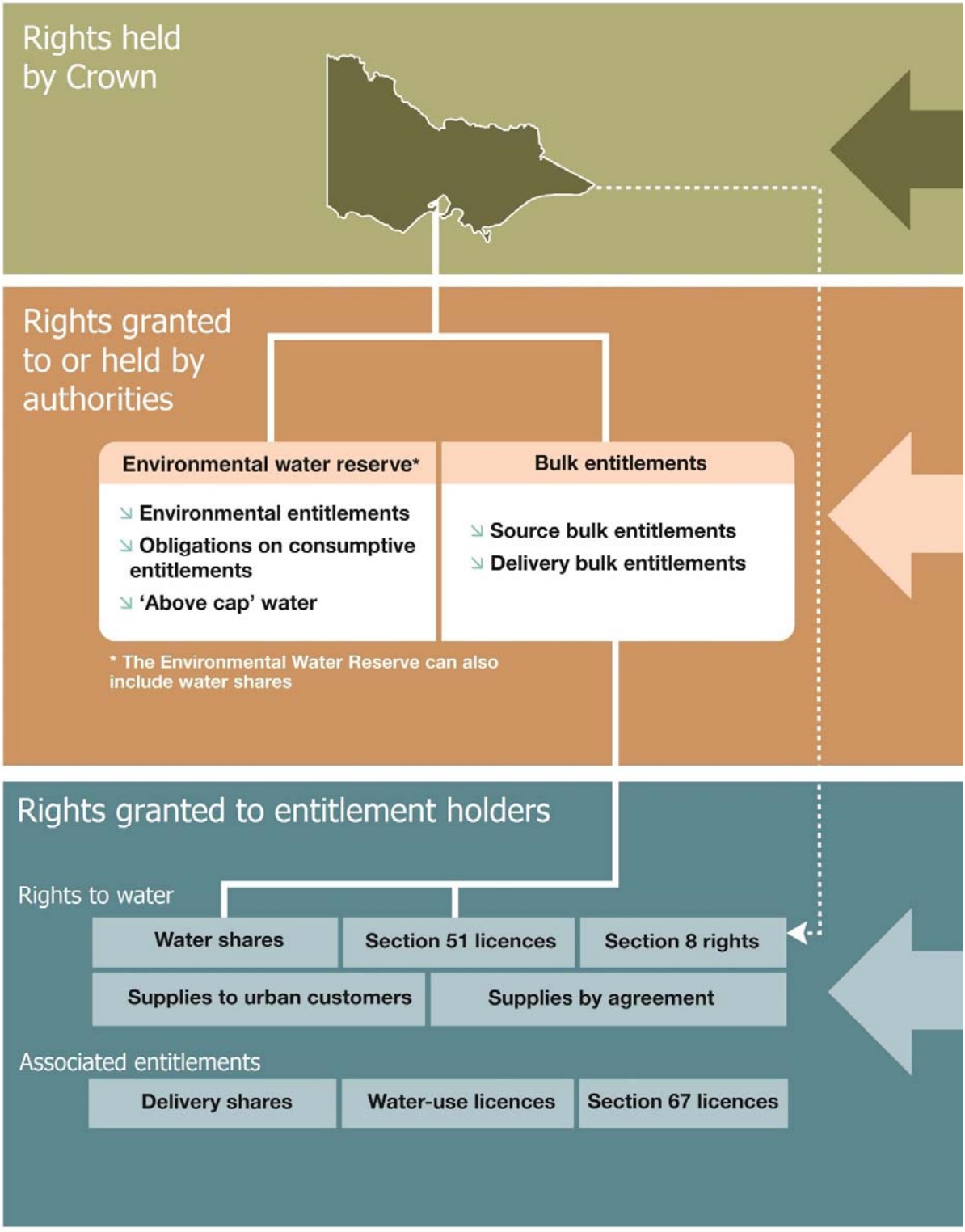
To support and guide management of water allocated under the entitlement framework, Victoria has a water resource planning framework comprising:

- year-to-year or short-term planning through measures such as seasonal resource determinations on rural regulated systems or drought response plans and annual water security outlooks in urban systems
- local planning to balance the demand of water and available supply in urban areas, through the development of urban water strategies
- statutory management plans for the equitable sharing of available water and long-term sustainability of unregulated surface water and groundwater
- local planning to maintain and improve the health of rivers and wetlands through the development of regional river health strategies every five years
- strategic planning through the development of regional sustainable water strategies (SWSs) every seven to ten years
- long-term water resource assessments (LTWRAs) of the resource base and river health every 15 years.

The first *Long-Term Water Resource Assessment for Southern Victoria* looked at long-term changes in water availability and the health of our waterways. It is a backwards-looking technical assessment to see if water availability has declined and to see if there have been changes in how water has been shared between the environment and consumptive uses, which includes water for farms, industry, cities and towns. The Victorian Government will use the assessment as one of many inputs to plan for the next 50 years as it begins work on the new Central and Gippsland Sustainable Water Strategy. The Long-Term Water Resource Assessment for Northern Victoria will start in 2025 and align with the Murray-Darling Basin Plan review scheduled for 2026.

One of the key principles of the water entitlement and water resource planning framework is that entitlement holders are responsible for managing their own water security and risks including during drought.

Figure 1-7 Victorian water entitlements



Water entitlements are defined in the *Water Act 1989* and are issued by the Minister for Water. A water entitlement is the amount of water authorised to be stored, taken and used by a person under specific conditions. Associated entitlements set conditions for water delivery or use.

Environmental water reserve (EWR)

The EWR is the legally recognised amount of water set aside to meet environmental needs. The objective of the EWR is to preserve the environmental values and health of water ecosystems.

Environmental entitlements are generally identical in nature to bulk entitlements. They provide for a share of the available resource.

Obligations on entitlements include the passing flows that water corporations or licensed diverters are obliged to provide out of storage or past a diversion point. The portion of passing flows that is provided to meet environmental needs is considered a part of the EWR.

'Above cap' water includes water that is left over after limits on diversions have been reached and unregulated flows which cannot be kept in storage. Most of the EWR is comprised of 'above cap' water, and this component is most susceptible to climate change.

Bulk entitlements

Held by water corporations with secure tenure in perpetuity. They provide the right to water for system operations, seasonal allocations and other rights and obligations.

Source bulk entitlements provide a share of inflows, storage capacity (if applicable) and releases.

Delivery bulk entitlements provide a set volume of water each year, subject to defined restrictions during periods of water shortages.

Water shares have secure tenure held in perpetuity. A share of the available resource in most regulated systems is allocated annually (through seasonal allocations), which can then be ordered to a specified location, at a specified time and rate.

Section 51 take and use licences allow for diversions from unregulated (and some regulated river systems) and extractions of groundwater. Licences are issued for a specified volume, period of time and with a range of conditions.

Section 8 rights provide for an individual to take and use water from a range of surface and groundwater sources for domestic and stock use under certain circumstances without a licence.

Supplies to urban customers must be provided by water corporations throughout their defined districts.

Supplies by agreement are arranged by water corporations to provide water outside of defined districts, and recycled and drainage water in special circumstances.

Delivery shares provide for water to be delivered to land in an irrigation district via a channel. Delivery shares are linked to delivery infrastructure and stay with the property if the water share is traded.

Water-use licences allow an irrigator to use water to irrigate land up to an annual use limit.

Section 67 licences provide for the construction and operation of a groundwater bore or any works on a waterway, such as a private pump or dam, when a section 51 licence is required.

1.3.1 Water entitlements

Under the *Water Act 1989*, a person may not take water unless they are authorised to do so. Authorisation for the take and use of water is provided under the Act through the water entitlement framework. A **water entitlement** specifies the volume of water authorised to be taken, extracted and used and may be limited by conditions. Water entitlements can be held by an individual, a water corporation, an environmental water holder or another specified body (such as a power company) (Figure 1-7). The conditions of an entitlement do not change based on who owns it.

Water entitlements manage surface water and groundwater resources for both consumptive and environmental purposes at all phases of the water cycle. Consumptive uses include urban, irrigation and industry uses, and power generation. Environmental uses include providing flows within a waterway and diverting flows to wetlands.

The Minister for Water issues water entitlements under the Act. These include:

- section 8 statutory rights
- bulk entitlements
- environmental entitlements
- water shares
- take and use licences.

Statutory rights are provided under sections 8 and 8A of the Act. These rights allow water to be taken without a licence under certain circumstances for specific uses, including:

- **domestic and stock:** under section 8(1) and section 8(4)(c) of the Act, individuals can take water for domestic and stock purposes from surface water and groundwater from a small catchment dam or a bore. The water must be used for the specific purposes set out in the Act.
- **Traditional Owners:** under section 8A of the Act, any member of a Traditional Owner group who has a natural resource agreement under the *Traditional Owner Settlement Act 2010* can take and use water from a waterway or bore for traditional purposes. Traditional purposes means providing for the personal, domestic or non-commercial communal needs of group members.

Bulk entitlements are a right to take and use water in a waterway, water in storage works of a water corporation and groundwater. Bulk entitlements are held by specified authorities (such as water corporations) and are subject to a range of conditions. Appendix D lists the bulk entitlement holders for 2018–19.

Environment entitlements are a right to water granted to the VEWH to improve the environmental values and health of water ecosystems and other uses, depending on the condition of the environment. Chapter 4 reports on environmental entitlements and their use in 2018–19.

A **water share** is a legally recognised perpetual entitlement to a secure share of the water available in a water system. To date, water shares have been issued only for large, regulated river systems with irrigation districts. These are systems with dams or storages that harvest large volumes of water for regulated release to a large number of irrigation customers. Water shares may be high-reliability or low-reliability. The amount of water that may be taken under a water share in any year will depend on the allocation that is made in relation to water shares in that system (see chapter 1.3.2.2). Systems containing water shares are declared and are unbundled (see box below).

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 (in unregulated systems), catchment dam or groundwater. Each licence is subject to conditions specified on the licence. Licences are issued and managed in accordance with *Policies for Managing Take and Use Licences (DELWP, 2014)*. These policies set out matters and actions the Minister requires delegates to consider or do.

Chapter 6 and chapter 7 describe the entitlements and use of water taken from river basins and groundwater catchments. Chapter 8 then describes the movement of this water through the constructed distribution systems that deliver water to users.

Victorian water entitlements are recorded in the Victorian Water Register, which provides an authoritative record of the entitlements, water available as carryover and associated transactions including 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, waterregister.vic.gov.au.

For more information about Victoria's entitlement framework visit the DELWP Water website: https://www.water.vic.gov.au/planning-and-entitlements/victorias-entitlement-framework.

Water systems may be **declared** in accordance with section 6A of the Act.

In declared water systems, entitlements previously called water rights and take and use licences (with some specific exceptions) have been separated, or 'unbundled', into three separate elements. These are a **water share**, a **delivery share** (or 'extraction share' in a works licence), a **water-use licence** or **a water-use registration**.

A **water share** is the legally recognised, perpetual entitlement to a secure share of the water available from a declared water system. Water shares may be high-reliability or low-reliability. A water share is an entitlement to a share of the available water. Seasonal resource determinations specify the percentage of a water share that is available annually.

A **delivery share** is an entitlement to have water delivered to land. It gives access to a share of the available capacity in a channel or piped network that supplies water to a property. A delivery share is tied to the land and stays with the property if it is bought or sold. It also stays with the property if the water share is sold separately.

A **water-use licence** is an entitlement to irrigate a specific parcel or parcels of land. The licence sets out the conditions for use (such as how much water you can use on your land in a single irrigation season). Water-use licences are required for irrigation from the regulated Murray, Goulburn, Broken, Loddon, Campaspe, Bullarook, Werribee or Macalister systems.

A **water-use registration** is similar to a take and use licence but has no fixed term. It authorises take and use from a dam, spring or soak. It is attached to the land and cannot be traded, except on sale of the land. It can however be converted into a take and use licence. Registration licences were able to be issued for one year, between 1 July 2002 and 30 June 2003 and were based on historical water use.

Most of the state's regulated water systems have been declared.

The regulated systems in northern Victoria were declared on 1 July 2007. These are the Broken, Bullarook, Campaspe, Goulburn, Loddon, Murray and Ovens systems.

The Werribee and Bacchus Marsh and Thomson–Macalister water systems in southern Victoria were declared on 1 July 2008.

1.3.2 Managing resources and responding to water availability

All water resources are managed in accordance with the Act and statewide policy. As mentioned in chapter 1.2, rural water corporations are responsible for managing regulated and unregulated systems.

In regulated water systems, rural water corporations manage the available water resource, with delegated responsibilities for the administration of entitlements and planning. They:

- plan for the management of their systems to supply the specified entitlements
- develop low-flow contingency plans for managing severe water shortages
- 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 plans may include such things as triggers for rosters, restrictions and bans on extractions during low-flow periods, trade rules, metering, monitoring and reporting requirements.

Most Victorian water supply systems also 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 issue of entitlements in these systems so that water allocation and diversions do not:

- impact on the resource and on access to the resource for other entitlement holders
- impact on important environmental values
- exceed the cap or limits on take from a resource.

In 2012, the Victorian Government developed a framework for the management and reporting of groundwater resources. The groundwater management and reporting framework comprises:

- **groundwater management basins**: the largest scale of connected hydrogeological resources, from highlands to sedimentary plains. This is also the scale of water resource plans for groundwater under the Basin Plan. Figure 1-3 Victoria's groundwater management basins
- **groundwater catchments**: the longitudinal flow path of connected groundwater resources, which are interconnected laterally within a region
- **groundwater management units (GMUs)**: defined areas where specific rules are used to manage the resource according to the needs of groundwater users and the environment. There are two types of GMUs:

- **water supply protection areas (WSPAs)**: areas declared to protect groundwater or surface water resources through the development of statutory management plans
- **groundwater management areas (GMAs)**: defined for the purposes of management, most commonly areas where no new groundwater entitlement is available. They may be intensively developed, or have the potential to be.

Figure 1-3 shows Victoria's groundwater management basins and groundwater catchments.

There were several changes to GMUs in 2018–19, which are explained in chapter 3.2.

Further details about the groundwater management framework in Victoria are available at https://www.water.vic.gov.au/groundwater/managing-groundwater.

Rural water corporations are responsible for managing groundwater. Rural water corporations continue to review management arrangements, to ensure objectives are being met and to respond to changing climate, knowledge, use and legislation. Water corporations are also gradually working towards management on a catchment scale to reflect connected resources, reduce costs and achieve better environmental outcomes.

Lessons from the Millennium Drought

Between 1996 and 2010, Victoria experienced unprecedented dry conditions – a period now known as the Millennium Drought. These 13 consecutive years of drought, including the lowest annual inflows to storages recorded (2006–07), resulted in conditions well outside the boundaries within which water supply systems and water-sharing rules across Victoria were designed to operate. By the 2006–07 summer, many areas faced severe water shortages. These shortages were more extreme than envisaged possible when water entitlements were developed, and the effectiveness of Victoria's water management frameworks was tested.

Despite water managers' efforts to adapt to the unprecedented conditions, water-carting was required to maintain essential water supplies for several towns and rural supply systems. Major infrastructure projects were brought forward, irrigation allocations were the lowest on record and the Minister for Water was required to declare water shortages and temporarily qualify rights to water because existing water-sharing arrangements had failed. In many rivers across Victoria, the environment was disproportionately impacted, compared to consumptive users. This occurred because most of the environmental flows were sourced from unregulated flows or spills from storage, which ceased during the drought, rather than secure entitlements that received a share of the limited water available.

The unprecedented nature of the Millennium Drought, particularly its length and severity, motivated and accelerated several responses to water scarcity including:

- major policy and planning initiatives (for example, SWSs)
- infrastructure upgrades (for example, the Wimmera Mallee Pipeline Project and Goulburn-Murray Water Connections Project)
- augmentations (for example, the Goldfields Superpipe)
- improved system management.

It should also be noted that a major water reform was implemented across northern Victoria in July 2007 and southern Victoria in July 2008: the unbundling of water rights from land to create water shares. This reform was unrelated to the drought but made the water market more accessible to individuals and water corporations during its last few years.

Significant hardship was endured during the Millennium Drought, but several positive outcomes were achieved that enable Victorian water managers to better manage water resources into the future. They included:

- amendments to entitlements to incorporate sharing arrangements for dry conditions
- clearer entitlements for the environment and more-efficient use of water for the environment
- reserve rules that reduce the likelihood of years with zero allocation (in large, regulated systems)
- improved flexibility and options through measures such as trade and carryover
- streamlining of water-trading options to enable water to move from low- to high-value uses
- creation of new and alternative sources
- a modernised and reconfigured irrigation system.

The Millennium Drought has highlighted that planning and system design cannot be based on the assumption that climate is a stationary phenomenon. While unplanned measures were necessary to respond to the unprecedented conditions, the experience of managing through the Millennium Drought has served to reinforce the relevance of Victoria's water entitlement and water resource planning frameworks and principles.

The uncertainty surrounding future conditions means that planning needs to be based on a wide range of plausible future climate scenarios. Guidelines for urban water supply-demand strategies, developed after the drought, emphasise scenario planning and adaptive management to ensure urban water supply security in the medium to long terms.

Responding to water availability

The amount of water available for consumptive and environmental uses will vary from year to year. The entitlement and planning frameworks include 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. Chapter 2.5.5 reports on water-carting in 2018–19.

The Minister for Water also has powers under section 33AAA of the Act to declare that a water shortage exists and to temporarily qualify rights to water. Temporary qualification of rights is a measure of last resort to be used during unforeseen and emergency events. Temporary qualification of rights results in a temporary change in water-sharing arrangements in a specified area to ensure critical water needs are met under these circumstances. Rights to water that may be qualified include licences, water shares, bulk entitlements and environmental entitlements. Chapter 2.5.6 reports on the temporary qualification of rights in 2018–19.

To facilitate the efficient use of water resources in Victoria, water can be traded between users and locations in accordance with trading rules, which are designed to protect third parties from unacceptable impacts. Water markets and trading water are important mechanisms for individual entitlement holders to manage seasonal variations in water availability, and they facilitate the sharing of available resources. Chapter 5 reports on water trading in 2018–19.

1.3.2.1 Urban water restrictions

As explained in chapter 1.3, in line with the water resource planning framework, water corporations undertake short-term and long-term planning to balance the demand for water with the available supply and to plan for the year ahead.

Water corporations develop long-term urban water strategies to support the development of resilient, liveable communities as well as to balance social, environmental and economic costs and benefits across the environment, agriculture, towns and businesses.

Each year on 1 December, water corporations also publish an annual water outlook. Outlooks report on the current condition of each water supply system including storage positions and predicted future water availability, and they outline strategies to meet customer demand over the next 12 months. Outlooks also indicate the likelihood of urban water restrictions under different climate scenarios.

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 is consistent across the state. The trigger points for each stage of water restrictions are stated 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 permanent water-saving rules which apply at all times and set basic conditions for water use when water restrictions are not in place.

Chapter 2.5.1 reports urban water restrictions in 2018–19.

1.3.2.2 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 storages 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.

Goulburn-Murray Water is the Northern Victorian Resource Manager appointed by the Minister for Water and has been given responsibility for making the seasonal determination for all northern Victorian declared water systems.

Southern Rural Water also has responsibility for announcing seasonal allocations in their declared water systems.

Chapter 2.5.2 reports on seasonal allocations in regulated systems in 2018–19.

1.3.2.3 Restrictions on licence holders in unregulated systems

Statutory management plans and local management plans set out how water in unregulated streams will be shared between consumptive uses and the environment. Streamflow and/or groundwater statutory management plans are prepared to manage the unregulated surface water and/or groundwater resources of the area. (Non-statutory) local management plans advise how the water corporation is managing resources outside a WSPA.

Under statutory plans, water corporations may 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 may 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 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. Victoria now only issues winterfill licences that permit take between July and October.

Chapter 2.5.3 reports on restrictions on diversions from unregulated streams in 2018–19.

Groundwater licences are all-year licences. Management plans for some GMUs may include levels that will trigger the introduction of a restriction that will reduce the volume water users can take under their licence.

A management plan may include restrictions 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.

Chapter 2.5.4 reports on groundwater restrictions in 2018–19.

1.4 Monitoring and reporting

Local factors influence how much rainfall flows into streams and recharges groundwater aquifers. These factors include subsurface 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 about 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.

Surface water and groundwater

Information gathered through monitoring enables us to make informed water resource management decisions. In Victoria, data is collected from about 1,400 groundwater sites from the State Observation Bore Network and about 780 surface water monitoring sites under Victoria's Regional Water Monitoring Partnerships program. The partnership allows data to be collected to a well-defined standard once, then used for multiple business needs such as:

- availability and allocation management
- quality and compliance monitoring
- flood warning
- water resource assessment
- river health management
- linkages between groundwater and surface water systems.

The partnerships provide a coordinated and efficient approach to the statewide collection of information required for delivering a continuous program of water resource assessment for Victoria, as required by the *Water Act 1989*. About 40 organisations invest in the program, and DELWP acts as both a partner and overarching program manager.

The **Bureau of Meteorology** (BoM) is Australia's national weather, climate and water agency. The BoM provides observational, meteorological, hydrological and oceanographic services and researches science- and environment-related issues in support of its operations and services. The BoM monitors rainfall and evaporation across Victoria. It is also one of the 40 partners involved in the Regional Water Monitoring Partnerships program. Chapter 2.1 reports on rainfall across the state in 2018–19. Evaporation and rainfall in each basin are reported for each of the river basins in chapter 6.

In Victoria, the EPA oversees the quality of recycled water, and the 16 urban water corporations monitor the production and use of recycled water.

All of the water sector organisations mentioned in chapter 1.2 report annually on their operations and functions during the financial year. Information published in these reports and the monitoring data mentioned above is used in the accounts, to report on Victoria’s water resources each year.

2. Water availability

This chapter presents an overview of surface water and groundwater availability in Victoria in 2018–19. It reports rainfall, streamflows and levels in major reservoirs, compared to previous years and the long-term average. It also reports the annual trend in groundwater levels in groundwater catchments and the management responses to water availability in 2018–19.

The following were the key water availability events in 2018–19.

- Conditions in 2018–19 were drier again than in the previous year, with below-average rainfall received across most of Victoria throughout the year. It was the driest July since 2002, ninth-driest spring and second-driest September on record. It was also Victoria's warmest summer and eighth-warmest autumn on record (see chapter 2.1).
- As at the end of June 2019, a severe multi-year drought was affecting large parts of eastern Australia.
- There was a positive Indian Ocean Dipole toward the end of 2018 and an El Niño watch (see chapter 2.1).
- Overall, 47% of long-term annual average streamflows were received in Victoria, and 23 river basins had annual streamflow volumes lower than those received in 2017–18 (see chapter 2.2).
- Storages once again ended the year lower than they began, and only 15 of Victoria’s regional storages reached at least 90% of capacity by September 2018, compared to 28 the previous year. Four of those reached full capacity and were spilling (see chapter 2.3).
- Groundwater level trends in 2018–19 were declining more than in 2017–18 (see chapter 2.4).

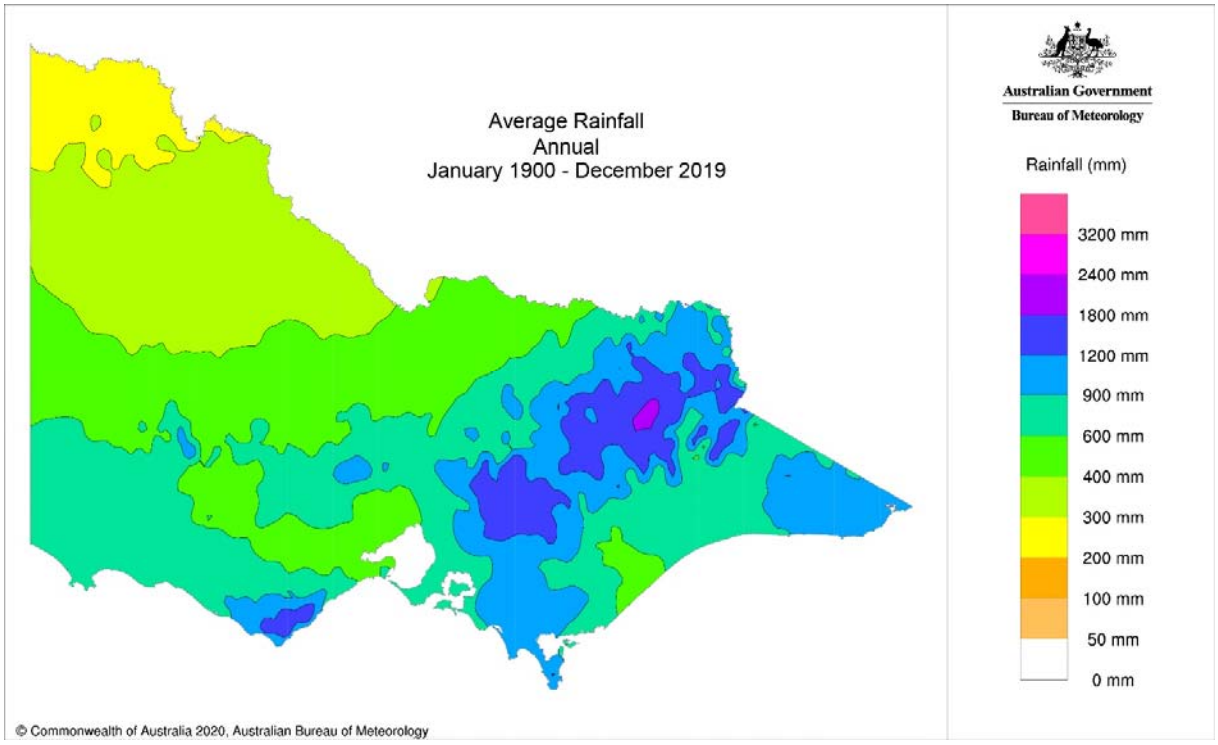
Restrictions and allocations were similar to the previous year in 2018–19:

- six towns were on urban water restrictions in 2018–19, five more than in 2017–18 (see chapter 2.5.1)
- almost all high-reliability entitlements received 100% allocation in regulated systems except the Broken system in the north and the Werribee and Bacchus Marsh district in the south, one less than the previous year (see chapter 2.5.2)
- there were 162 streams subject to restrictions on diversions in March 2019, compared to 130 at the same time in the previous season (see chapter 2.5.3).

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, 1900–2019



Note: long-term average annual rainfall is amount of rainfall across the geographical spread of an area, which is averaged over a grid of about 25 by 25 km.

The Millennium Drought highlighted that planning and management cannot assume that the climate will always remain the same (see chapter 1.3.2). Victoria's climate has shown a warming and drying trend over recent decades, and this trend is expected to continue. Compared to historical conditions, we are already experiencing:

- higher temperatures, particularly during the warmer months of the year
- reductions in rainfall in autumn and early winter, and in some locations increases in rainfall during the warmer months
- in some catchments, a shift in the streamflow response to rainfall, with less streamflow generated for the same amount of rain.

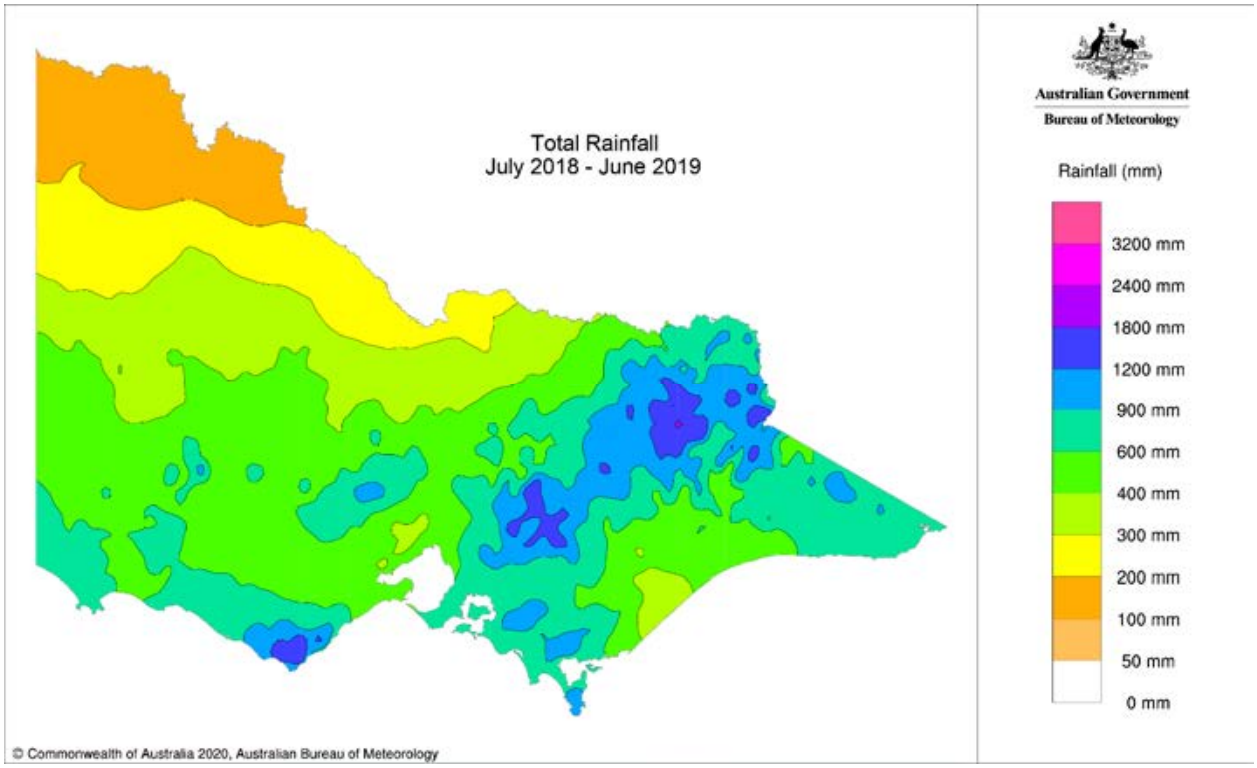
As part of implementing *Water for Victoria*, the Victorian Government is investing in further research to better understand how Victoria's climate is changing and the water-resource implications. For the 2018–19 accounts, the Bureau of Meteorology has produced the usual rainfall maps for the year, with a comparison to the average rainfall received from January 1900 to December 2019.

2018–19 began with an El Niño watch. Although sea surface temperatures in the central to eastern tropical Pacific Ocean remained neutral at this time, they had been slowly warming since April 2018. In October 2018, the El Niño–Southern Oscillation (ENSO) outlook was raised to an El Niño alert, when there were signs of a positive Indian Ocean Dipole (IOD) underway in the Indian Ocean. The positive IOD was confirmed in November but started to weaken in December 2018. The El Niño alert was downgraded back to a watch until the tropical Pacific Ocean began to warm again in March when it was again raised to an alert. This was downgraded again to an El Niño watch when waters below the surface of the tropical Pacific Ocean began to cool. The ENSO outlook was downgraded to inactive by the end of June, with the possibility of a positive IOD forecast for the 2019 winter and spring. Typically, a positive IOD brings below-average winter-spring rainfall and snow depths, above-average temperatures and an earlier start to the fire season for southern and central Australia.

In 2018–19, rainfall was generally below average, and temperatures were above average for most of the state, except in winter when nighttime temperatures were cooler than average in much of northern Victoria.

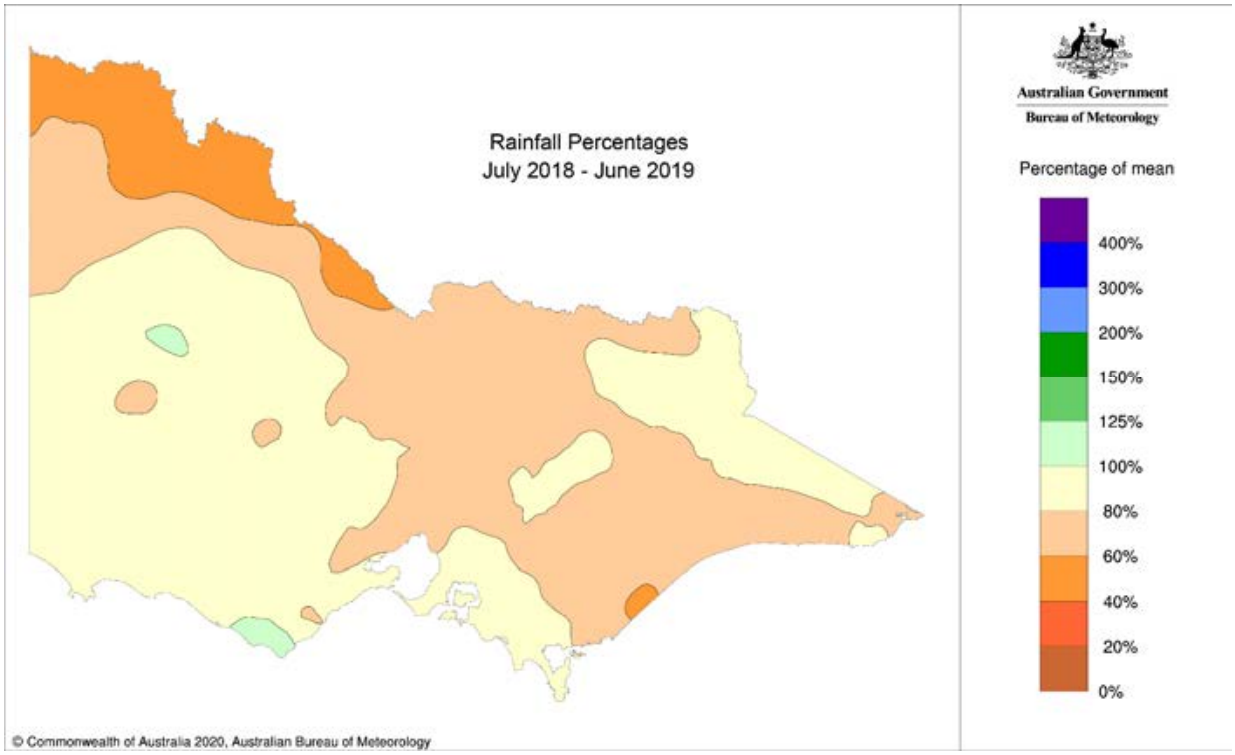
The range for total annual rainfall varied from 100 to 300 mm in the north-west and from 300 to 600 mm in the centre, north-west and south-east (from below Lake Wellington to above Swifts Creek). Between 600 and 900 mm of rainfall was received along the south-west coast and in east Gippsland. From 900 to 1,200 mm was received in the east and in a small area above Ballan in the south-west. Between 1,200 and 1,800 mm of rainfall was received in the Otway and Alpine regions and in the Yarra Ranges, with a small area near Falls Creek receiving up to 3,200 mm (Figure 2-2).

Figure 2-2 Victorian rainfall, 2018–19, millimetres



Annual rainfall across Victoria was typically between 60% and 100% of the average (Figure 2-3). Above-average rainfall was received in two small areas: one at Cape Otway and the other in the west around Warracknabeal. Close-to-average rainfall (between 80% and 100%) was received in much of the west, north-east and south-east. Below-average rainfall was again received in the north-west and in Gippsland and also in the central-eastern part of the state. The greatest rainfall deficiencies were recorded in Gippsland near Seaspray and along the New South Wales border in the north-west, from the far north-west corner to the Rochester Irrigation District in the Murray basin.

Figure 2-3 Victorian rainfall, 2018–19, as a percentage of long-term average (1900–2019) rainfall



Averaged across Victoria as a whole, evapotranspiration in 2018–19 was estimated to be 490 mm. This is about 11% below long-term (1961–90) average evapotranspiration. However, evapotranspiration resembled the mean most closely in the basins that recorded the highest rainfall as a percentage of long-term average rainfall. These included the Kiewa basin in the north-east, which received 82% of its average annual rainfall and the Lake Corangamite, Hopkins, Millicent Coast and Otway Coast basins in the south-west, which received 84%, 86%, 86% and 90% respectively of their average annual rainfall. Conversely, some of the lowest rates of evapotranspiration, expressed as a percentage of the long-term average, were modelled for the Mallee, North Central and Gippsland regions, due to lower-than-average rainfall. These regions had modelled evapotranspiration that was 15–30% below the long-term average. Across most of the state, evapotranspiration represented a greater-than-average proportion of rainfall. As a result, less rainfall flowed into streams and recharged groundwater aquifers than would be the case in an average year (Appendix A).

In 2018–19, Victoria was hotter than the long-term average: the annual mean anomaly varied between 0.5 and 1.5° C across the state. The highest anomalies were recorded in December 2018 and January 2019.

Winter 2018 rainfall in Victoria was below average across the north and east of the state, while in the south-west and south it was generally close to average (Figure 2-4A). Daytime temperatures were warmer than average for much of the state during winter, tending to average in the south-west. Nighttime temperatures were cooler than average in much of northern Victoria and warmer than average in East Gippsland.

Victoria in spring 2018 was drier than average, with areas of very much below average rainfall totals covering large parts of the state (Figure 2-4B). Daytime temperatures were warmer than average across most of Victoria, while nighttime temperatures were mostly close to average, with areas of cooler-than-average nights in Victoria's west and parts of the north, and warmer-than-average nights in isolated areas along the coast. It was Victoria's ninth-driest spring on record.

In summer 2018–19, averaged across Victoria, rainfall was 12% below the long-term average, and the mean temperature was 2.54° C warmer than the long-term average, making it the warmest summer on record. Rainfall was above average in parts of Victoria's north, while in parts of the south and south-east it was below average (Figure 2-4C).

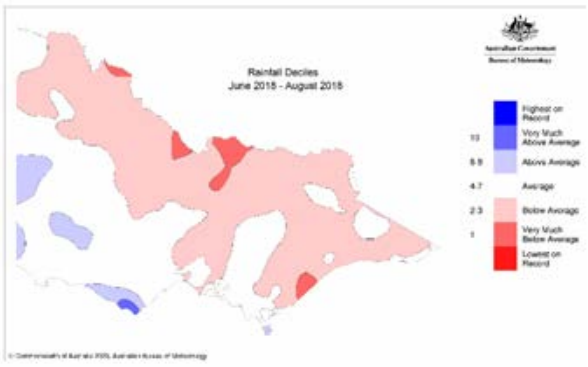
Other significant events of the 2018–19 summer were:

- flash flooding in north-eastern Victoria when strong winds, heavy rain and severe thunderstorms swept across Victoria on 13 and 14 December, which received about a month's worth of rain
- power blackouts affected about 200,000 homes across Victoria as temperatures soared on 25 January
- extreme temperatures and sudden changes in wind direction and strength produced conditions conducive to bushfires across eastern Victoria in early January. There were 200 fires across Victoria including a large fire near Rosedale in Gippsland that burnt more than 550 ha and a complex fire in the Thomson catchment (just north of Mount Baw Baw) that burnt through about 4,770 ha by 1 February.

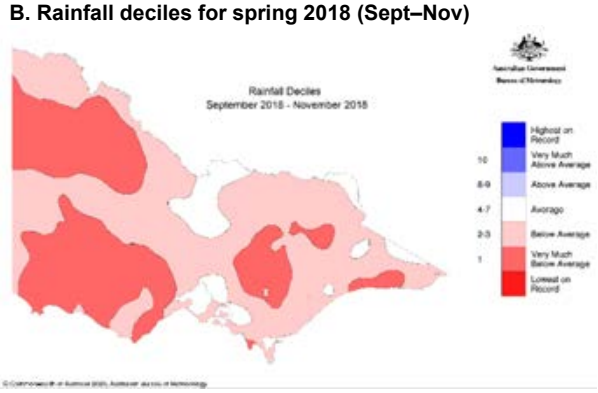
Averaged across the state, rainfall in autumn 2019 was 21% below the average of 157 mm (Figure 2-4D), continuing a run of five consecutive seasons of drier-than-average conditions in Victoria. Parts of the state recorded close-to-average rainfall, and above-average autumn rainfall was recorded in the north-east and Western Plains districts in autumn. Most of western Victoria and parts of north-central, upper-north, east-central and west Gippsland had below-average rainfall. A cold front and a low-pressure system which crossed the state on 9 and 10 May brought heavy rainfall and flash flooding to Ballarat and Geelong, as well as snowfalls in the Victorian Alps. Both mean daytime and overnight temperatures were warmer than usual across most of Victoria in autumn. This was Victoria's eight-warmest autumn on record.

Figure 2-4 Victorian seasonal rainfall deciles, 2018–19

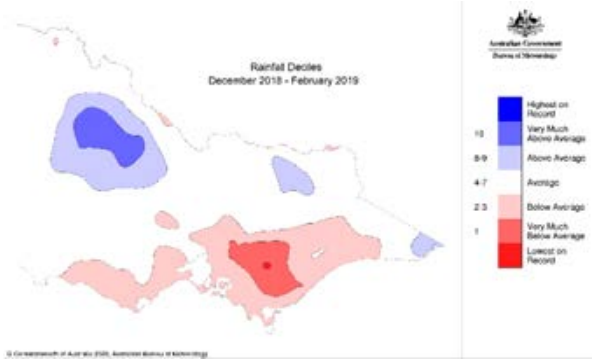
A. Rainfall deciles for winter 2018 (June–Aug)



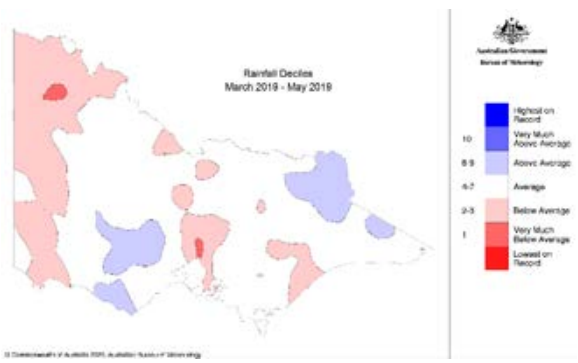
B. Rainfall deciles for spring 2018 (Sept–Nov)



C. Rainfall deciles for summer 2018–19 (Dec–Feb)

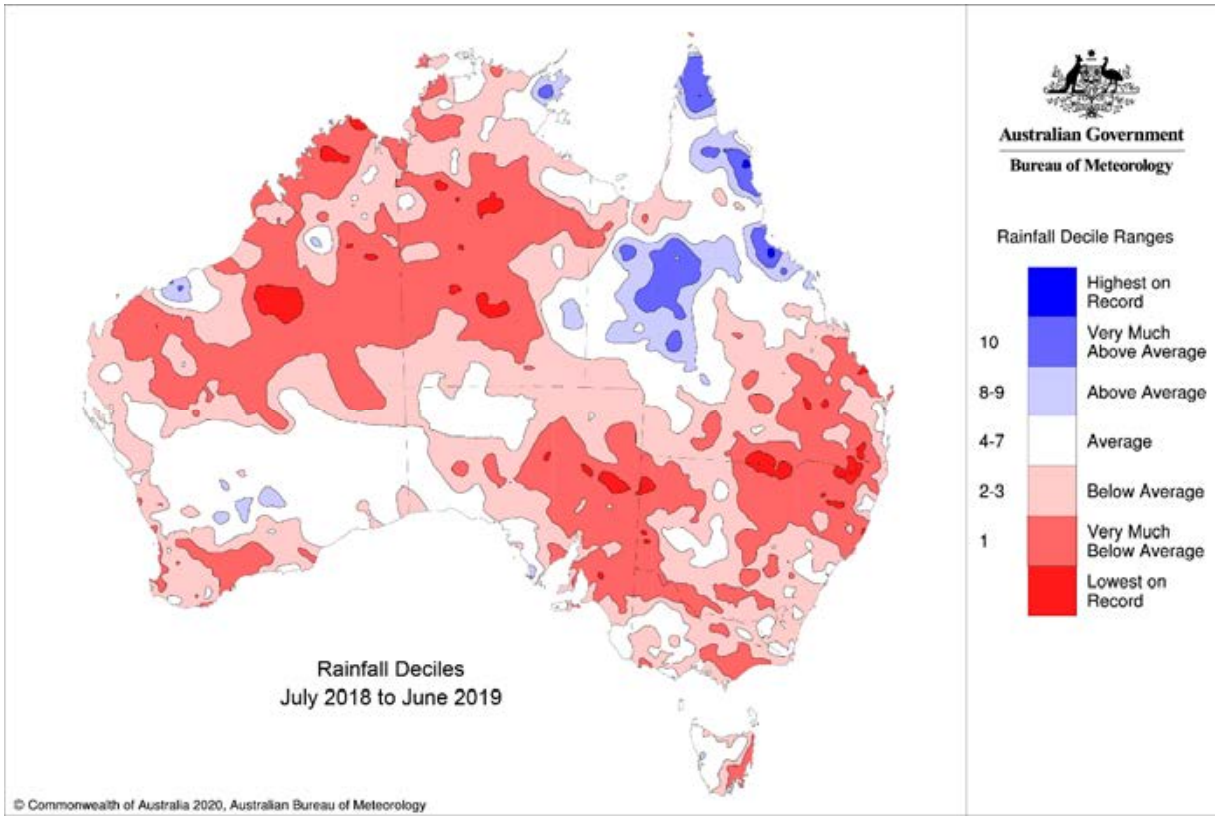


D. Rainfall deciles for autumn 2019 (Mar–May)



Overall, most of Victoria received below-average rainfall, and parts of the north and large parts of the east received very-much-below-average rainfall in 2018–19. As at the end of June 2019, a severe, multi-year drought was affecting large parts of eastern Australia. A warmer-than-average June across south-eastern Australia continued to add to soil moisture stress. However, rainfall deficiencies at 6- and 9-month timescales were reduced in some areas of Victoria after above-average rainfall in June 2019. (Figure 2-5).

Figure 2-5 Australian rainfall deciles, 1 July 2018 to 30 June 2019



2.2 Streamflow

In these accounts, streamflow is equivalent to 'catchment inflow' in the water balances presented in chapter 6. It provides an assessment of surface water availability by river basin. While streamflow in waterways varies month-by-month, this account makes an estimate of the annual volume only.

2.2.1 Review of long-term surface water availability

As part of the *Long-Term Water Resource Assessment for Southern Victoria*, the original estimates of long-term water availability — also known as long-term average inflows — were refined using improved data and methods and a period that better represents the current climate (based on data from 1975 to the present).

Further work has been completed for the 2018–19 accounts to update the long-term average inflow estimates so they come from one consistent data source. Changes were made to all long-term average inflow estimates except for the Mallee and Millicent Coast basins (see chapter 6.1.2 and Appendix E for more information).

2.2.2 Streamflow in 2018–19

In 2018–19, 21 river basins had annual streamflow volumes lower than those in 2017–18 (Table 2-1). When compared to the **new** long-term annual average streamflows, only two basins — Otway Coast and Corangamite — had above-average streamflows for 2018–19, compared to the previous year when three basins had above-average streamflows. Overall, the total annual streamflow volume for Victoria was 10,681,744 ML, 47% of the **new** long-term average, as Table 2-1 shows. This is less than the volume in 2017–18, which was 13,957,993 ML, 61% of the **new** long-term average.

Compared to last year, there was much less rainfall in 2018–19 across most of the state, which meant most streams received less rainfall. Winter rainfall was below average in the north and east, above average in the Western District and near average in eastern parts of the Central district into West Gippsland. In 2018–19, Victoria also experienced its ninth-driest spring on record and warmest summer on record.

The Avoca basin was the driest again in 2018–19, receiving 4% of **new** long-term average inflows: the same as the previous year. The Corangamite basin received the highest percentage of the long-term average inflows: 128%, or 111,426 ML.

The Avoca, Bunyip, Campaspe, East Gippsland, Maribyrnong and Werribee basins all received higher volumes of streamflows in 2018–19 than in 2017–18.

In the east:

- the East Gippsland, Tambo and Snowy basins received below-average streamflows again (21%, 49% and 15% respectively), and all of them except East Gippsland had a reduction in streamflows, compared to 2017–18. East Gippsland received slightly more streamflows in 2018–19 than the previous year
- the South Gippsland, Thomson, Mitchell and Latrobe basins all received between 57% and 46% of the long-term annual average
- the Bunyip basin received more streamflows in 2018–19 than in the previous year and the highest percentage of the long-term annual average in the east (87%).

In the north:

- the Loddon, Campaspe and Broken basins again received very much below-average streamflows (24%, 20% and 13% respectively of the long-term average).
- the Kiewa, Goulburn, Murray and Ovens basins also received below-average streamflows (68%, 51%, 41% and 41% of the long-term annual average).

In the west and north-west, less streamflow was received than in the previous year in the Wimmera basin, which received 11% of the long-term annual average, compared to 15% in 2017–18. The Avoca basin received about the same volume of streamflows as in the previous year (3,397 ML in 2018–19, compared to 3,366 ML in 2017–18).

In the south-west, the Hopkins and Portland basins received 42% and 44% respectively of the long-term annual average. The inflows received in the Glenelg, Otway Coast and Corangamite basins in 2018–19 were between 66% (Glenelg) and 128% (Corangamite) of the long-term annual average.

In the centre of the state, the Werribee basin received a greater volume of streamflows than in the previous year (46,029 ML, compared to 16,847 in 2017–18), as did the Maribyrnong (26,319 ML in 2018–19, compared to 23,944 ML in 2017–18). The Moorabool basin received a lesser volume of streamflows in 2018–19 (37,362 ML, compared to 48,573 ML in 2017–18).

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

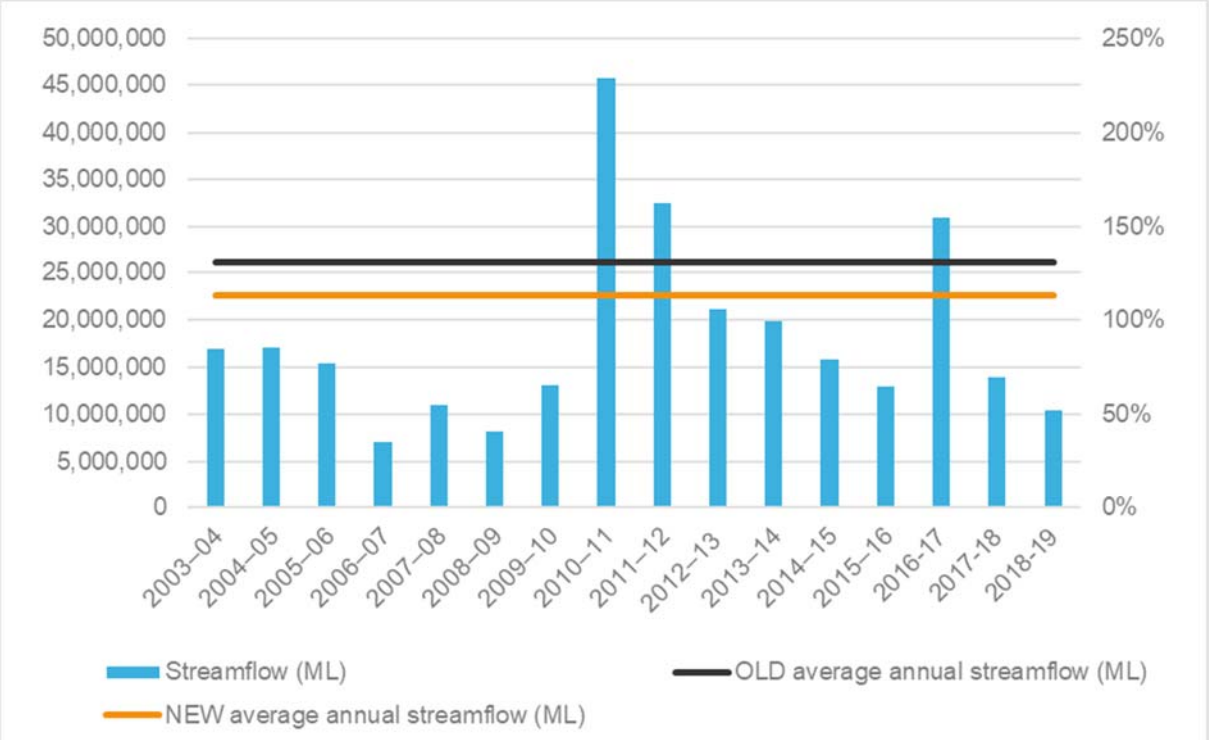
Basin	OLD LTA inflows before 2017–18 (ML/year)	NEW 2018–19 VWA LTA inflows (ML/year)	2018–19 streamflows [1]			2017–18 streamflows [1]		
			(ML)	(% NEW LTA)	(% OLD LTA)	(ML)	(% NEW LTA)	(% OLD LTA)
Avoca	136,200	87,100	3,397	4%	2%	3,366	4%	2%
Barwon	360,000	248,000	97,286	39%	27%	145,446	59%	40%
Broken	308,000	260,800	32,924	13%	11%	100,463	39%	33%
Bunyip	541,000	564,400	489,980	87%	91%	478,488	85%	88%
Campaspe	352,000	258,600	51,918	20%	15%	39,477	15%	11%
Corangamite	316,000	86,800	111,426	128%	35%	282,555	326%	89%
East Gippsland	714,000	857,700	182,905	21%	26%	152,362	18%	21%
Glenelg	964,000	527,300	347,250	66%	36%	617,198	117%	64%
Goulburn [2]	3,363,000	2,859,000	1,444,085	51%	43%	1,842,064	64%	55%
Hopkins	635,000	325,100	135,766	42%	21%	239,748	74%	38%
Kiewa	689,000	676,700	457,330	68%	66%	555,611	82%	81%

Latrobe	847,400	843,300	387,496	46%	46%	487,699	58%	58%
Loddon	373,000	243,400	58,090	24%	16%	71,767	29%	19%
Mallee (3)	-	-	-	-	-	-	-	-
Maribyrnong	113,000	92,800	26,319	28%	23%	23,944	26%	19%
Millicent Coast (3)	-	-	-	-	-	-	-	-
Mitchell	884,500	804,100	385,870	48%	44%	417,895	52%	47%
Moorabool	97,000	103,400	37,362	36%	39%	48,573	47%	50%
Murray	7,618,000	6,649,300	2,737,418	41%	36%	3,807,603	57%	50%
Otway Coast	884,000	733,300	816,710	111%	92%	843,521	115%	95%
Ovens	1,758,000	1,729,300	702,562	41%	40%	1,004,509	58%	57%
Portland Coast	361,000	462,200	202,080	44%	56%	344,469	75%	95%
Snowy (4)	1,022,000	795,600	388,996	49%	38%	509,899	64%	50%
South Gippsland	911,500	932,900	528,478	57%	58%	693,510	74%	76%
Tambo	297,800	297,200	43,687	15%	15%	52,882	18%	18%
Thomson	1,101,760	936,400	451,419	48%	41%	546,194	58%	50%
Werribee	102,000	88,600	46,148	52%	45%	16,847	19%	17%
Wimmera	316,400	223,100	24,306	11%	8%	32,478	15%	10%
Yarra	1,054,000	954,200	490,538	51%	47%	599,427	63%	57%
Total	**26,119,560**	**22,640,600**	**10,681,744**	**47%**	**41%**	**13,957,993**	**61%**	**53%**

Notes

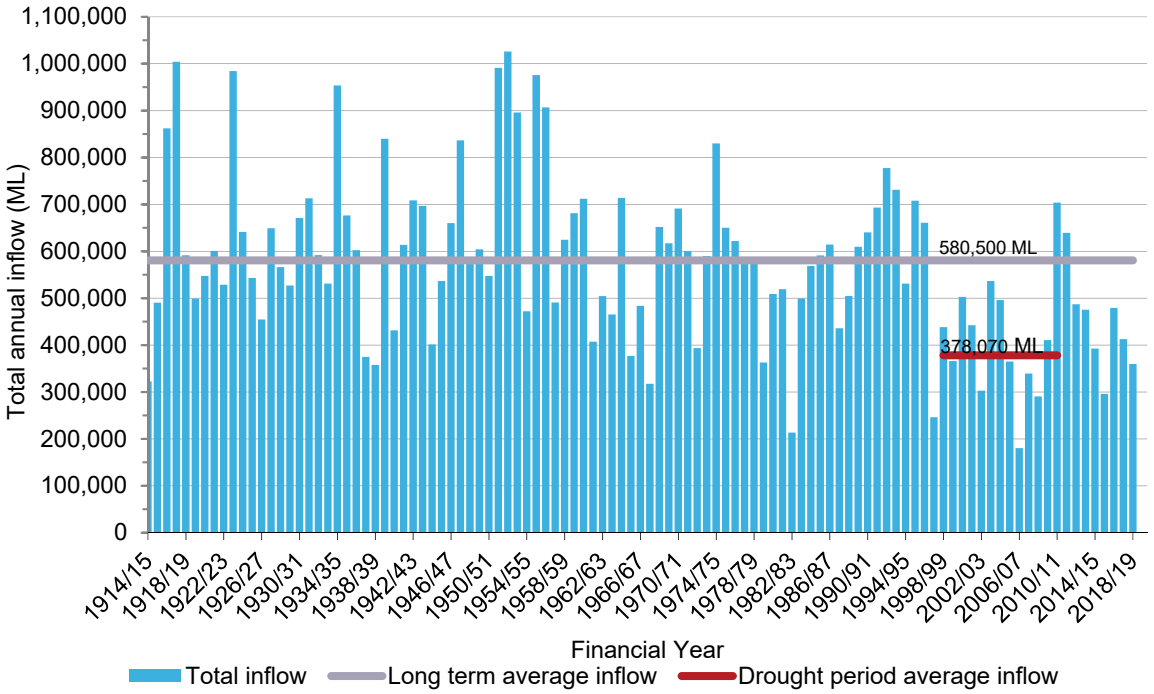
(1) 'Streamflow' is equivalent to 'catchment inflow' in the water balances in chapter 6.
(2) Only includes inflows within the Goulburn basin.
(3) Surface water resources within the Mallee and Millicent Coast basins are limited and there are currently no streamflow gauges in these basins. Streamflows in the Millicent Coast 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.
(4) Volumes shown for the Snowy basin exclude catchment inflows from New South Wales (upstream of Burnt Hut Crossing).

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



Streamflows have a major influence on Victoria's water storages. As Figure 2-6 and Figure 2-7 show, the total annual streamflows received in 2018–19 were the lowest in ten years. The annual inflows to Melbourne's harvesting reservoirs in the Yarra and Thomson basins in 2018–19 were 62% (359,585 ML) of the 100-year, long-term average of 580,500 ML. They were lower than in the year before when 412,526 ML was received (71% of the long-term average) and lower than the average inflows of the last drought (378,070 ML) (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.

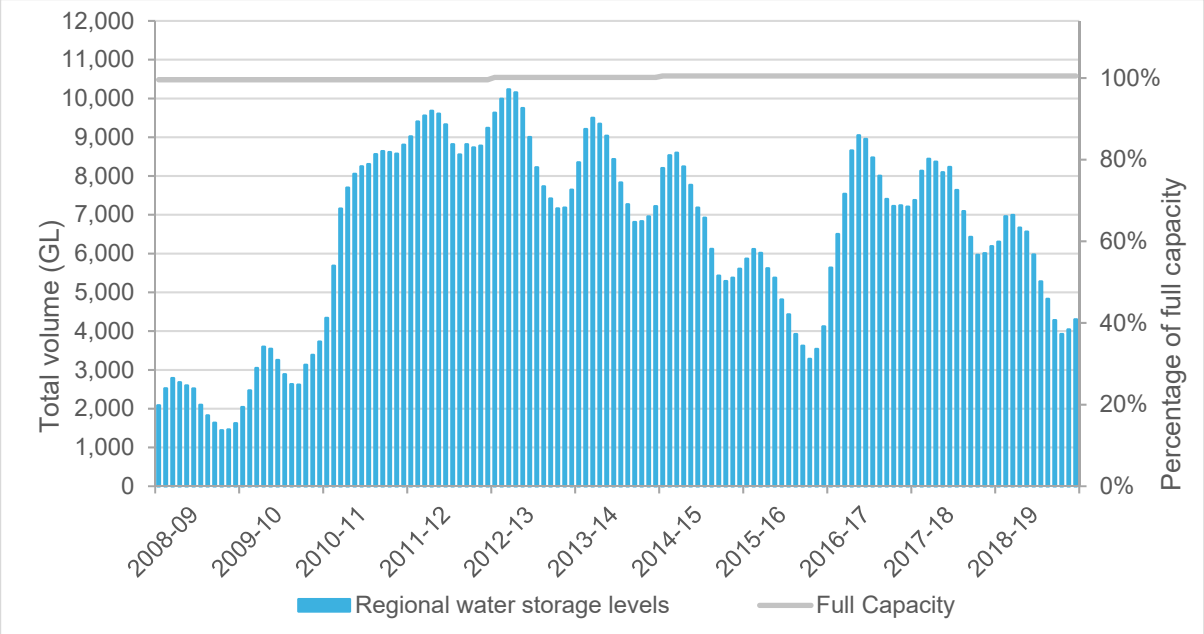
2.3 Storages

Victoria's major water storages can hold 12,521,909 ML. Of this, Melbourne's storage capacity is 1,812,175 ML and the combined capacity of the state's major regional storages is 10,709,734 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. In 2018–19, Victoria's total storage levels started the year at 7,377,772 ML (60% of capacity) and ended at 5,207,501 ML (42% of capacity). The combined volume of water stored in Victoria's reservoirs varies both within a given year and between years.

Storage levels in Victoria's regional reservoirs started the year at 6,301,410 ML (60% of capacity) and ended at 4,299,295 ML (41% of capacity). Storage levels increased during autumn, reaching a peak of 66% of capacity in September, and they declined slowly through the summer to a minimum of 37% of capacity by April 2019 (Figure 2-8).

Figure 2-8 Volume in major regional water storages, 1 July 2008 to 30 June 2019 [1] [2] [3]



Notes

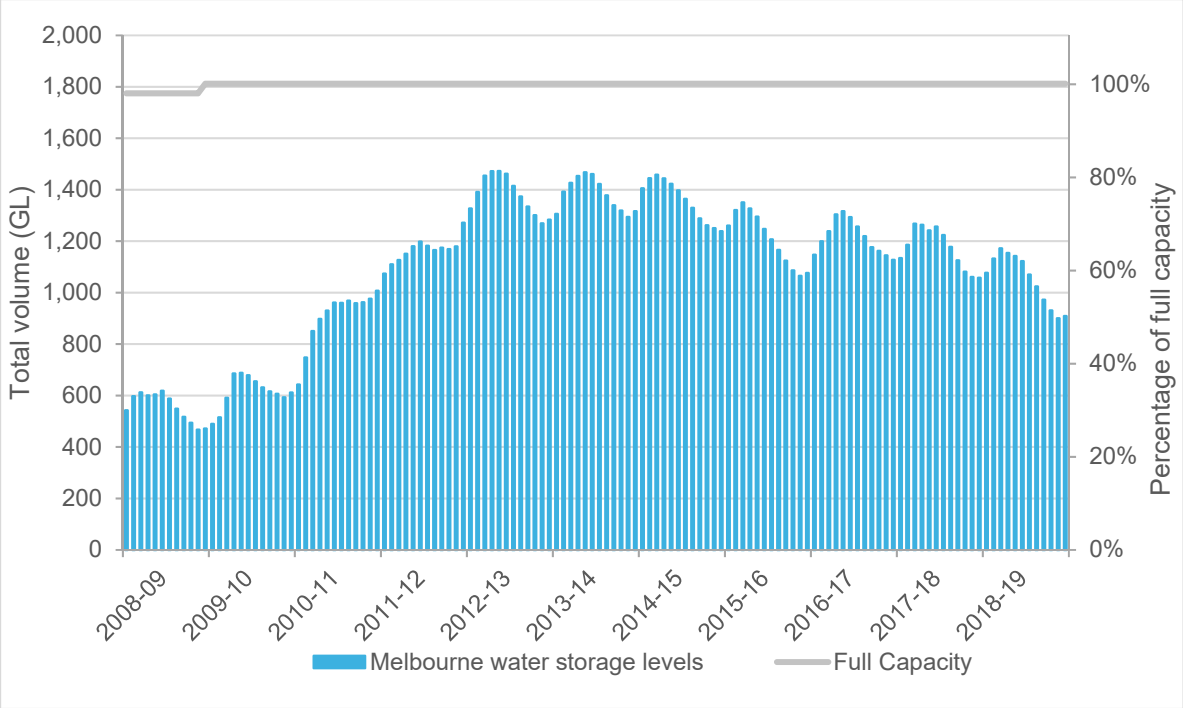
(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of the Menindee Lakes 240,000 ML in 2015–16).

(2) The mid-Murray storages have been included for the first time in the *Victorian Water Accounts 2016–17*. Reporting on storage levels began in mid-2012.

(3) The maximum operating capacity of Rocklands Reservoir was changed in 2014–15 from 261,510 ML to 296,000 ML.

In 2018–19, Melbourne's water storages started the year at 1,057,125 ML (58% of total capacity) and ended at 908,206 ML (50% of total capacity) after reaching a peak of 66% in September 2018 (Figure 2-9). Melbourne's water storage levels in 2018–19 were once again lower at the end of the year than they were at the start. During the latter years of the Millennium Drought (chapter 1.3.2) — between 2006–09 — storages consistently ended each year at lower levels than they had begun. Inflows were below average every month except August 2018, and rainfall was also below average from January to April 2019. The low inflows and low rainfall will have influenced the storage volumes ending the year lower than they began. Melbourne has experienced below-long-term-average inflows into storages in 19 out of the past 22 years (Figure 2-9) and Melbourne's largest reservoir, the Thomson Dam, has not been full since 1996.

Figure 2-9 Volume in Melbourne's water storages, 1 July 2008 to 30 June 2019 (1)



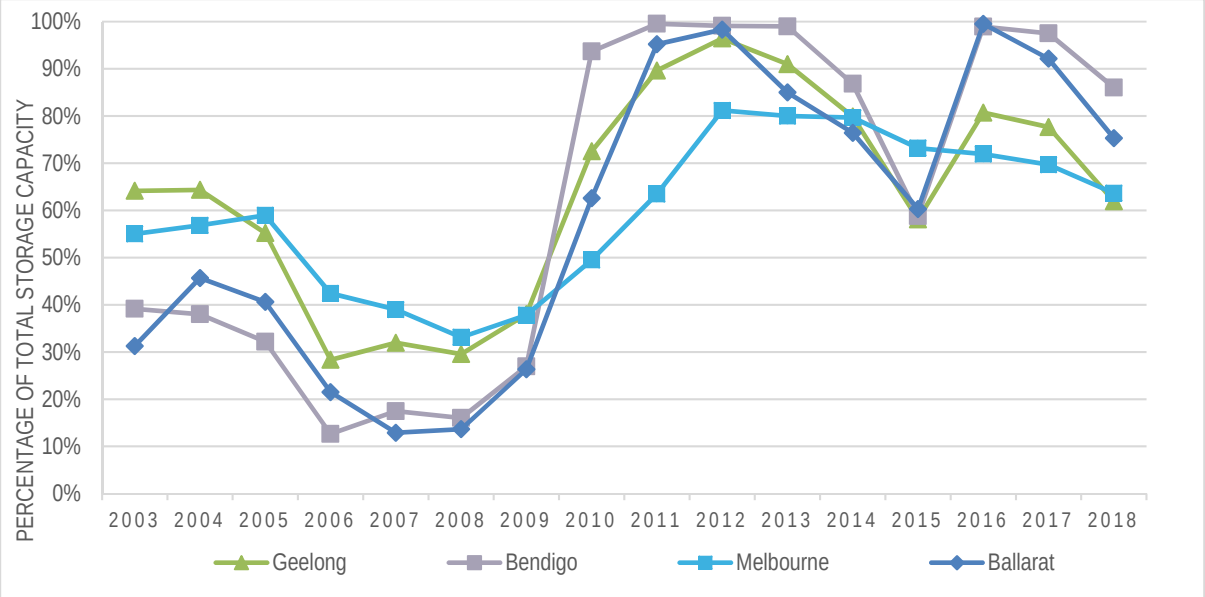
Note
(1) The Y axis percentage relates to the current storage capacity (i.e. after the addition of Tarago's 37,580 ML in 2010).

The Victorian Desalination Project began producing water in March 2017. The total volume delivered for the year to 30 June 2019 was 22 GL, representing 1.21% of Melbourne's storage capacity. This was more than the 15 GL (or 0.83%) delivered in 2017–18, and it includes a brought-forward water volume of 7 GL from the 2019–20 water order. A brought-forward water volume is water delivered during one year and paid for in the next. Without the water delivered since 2016–17, Melbourne's storages would have finished the year at 45% in 2018–19. See chapter 1.1.4 for more information about the Victorian Desalination Project.

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 a good indication of water availability for the remainder of that year. Figure 2-10 presents end-of-October storage levels as a percentage of storage capacity for Melbourne and selected major regional centres from October 2003 to October 2018.

During the Millennium Drought, October storage levels generally declined from 2003 to 2007 (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 Victoria. By October 2010, storage levels had recovered significantly, with further recovery in 2011–12 across all major centres. At the end of October 2018, storages in Melbourne and the selected regional centres were between 62% and 86%. The regional storages were between 62% and 86%, which was on average lower than in the previous year when regional storages were between 78% and 98%. Melbourne storages in October 2018 were at 64%, lower than in the previous year when they were at 70% (Figure 2-10).

Figure 2-10 Water in reservoirs for major urban centres at the end of October, each year from 2003 to 2018, as a percentage of total storage capacity



2.4 Groundwater

Long-term trends in groundwater levels reflect differences between the amount of water flowing into (recharge) and out of (discharge) an aquifer, and they are affected by how much is used for consumptive purposes. Groundwater level trends in shallow aquifers are more likely to reflect more-rapid changes in annual recharge from either rainfall or discharge from irrigation, whereas confined aquifer trends may show a seasonal influence from pumping within a longer-term trend.

Short-term groundwater level trends for GMUs have been determined based on five years' consistent monitoring data from key bores in the State Observation Bore Network. Trend determinations are made quarterly, when each reading is compared to previous readings in the same season (that is, a summer record is compared to previous summer records) to account for seasonality.

In 2018–19, WSPA trends were similar to the previous year, whereas there were more GMAs with declining groundwater-level trends than there were in 2017–18.

In the WSPAs in 2018–19, six were again categorised as declining and five as stable, compared to six declining, one rising and four stable in 2017–18 (Table 2-2 and

Figure 2-11). In the state's GMAs in 2018–19, 22 were declining, compared to 14 in 2017–18; 16 were stable, compared to 25 in 2017–18; and two were categorised as rising, compared to one in 2017–18 (Table 2-3 and Figure 2-12).

Groundwater levels in some bores remained within historical averages, while others ended the year at historical lows. Resource managers monitor and manage declining levels through groundwater management plans and restrictions on use (see chapter 2.5.4).

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

Water supply protection area	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep–18	Dec–18	Mar–19	Jun–19	
Central groundwater management basin					
Westernport groundwater catchment					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Declining**
West Port Phillip Bay groundwater catchment					
Deutgam	Declining	Declining	Declining	**Declining**	**Declining**
Gippsland groundwater management basin					
Central Gippsland groundwater catchment					
Sale	Declining	Declining	Stable	**Stable**	**Stable**
Yarram [1]	Declining	Declining	Declining	**Declining**	**Declining**
Goulburn-Murray groundwater management basin					

Campaspe groundwater catchment					
Lower Campaspe Valley	Declining	Declining	Declining	**Declining**	**Declining**
Goulburn–Broken groundwater catchment					
Katunga	Declining	Declining	Declining	**Declining**	**Declining**
Loddon groundwater catchment					
Loddon Highlands	Declining	Declining	Declining	**Declining**	**Declining**
Ovens groundwater catchment					
Upper Ovens	Declining	Declining	Stable	**Stable**	**Stable**
Otway–Torquay groundwater management basin					
Glenelg groundwater catchment					
Glenelg	Declining	Declining	Stable	**Stable**	**Stable**
Hopkins–Corangamite groundwater catchment					
Warrion	Rising	Rising	Stable	**Stable**	**Rising**
Portland groundwater catchment					
Condah	Declining	Declining	Stable	**Stable**	**Stable**

Note
(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.

Figure 2-11 Groundwater trends in water supply protection areas

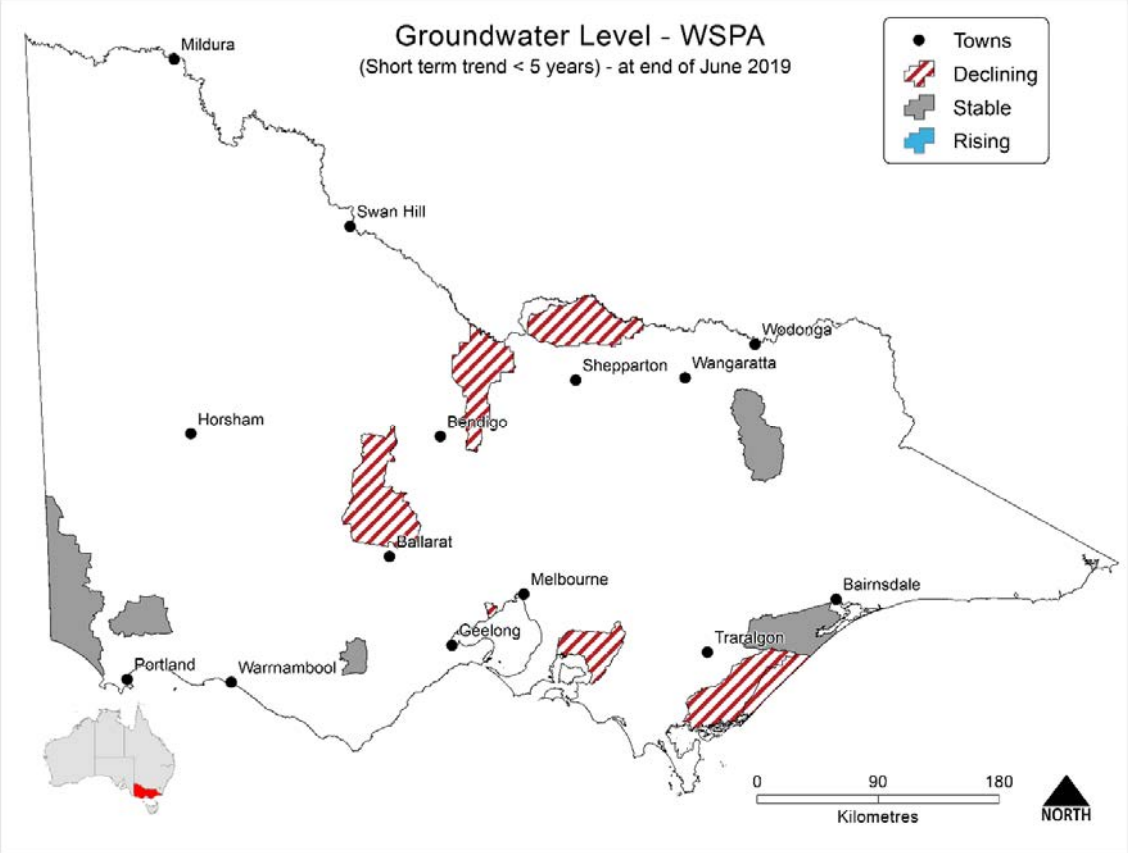


Table 2-3 Groundwater level trends in groundwater management areas

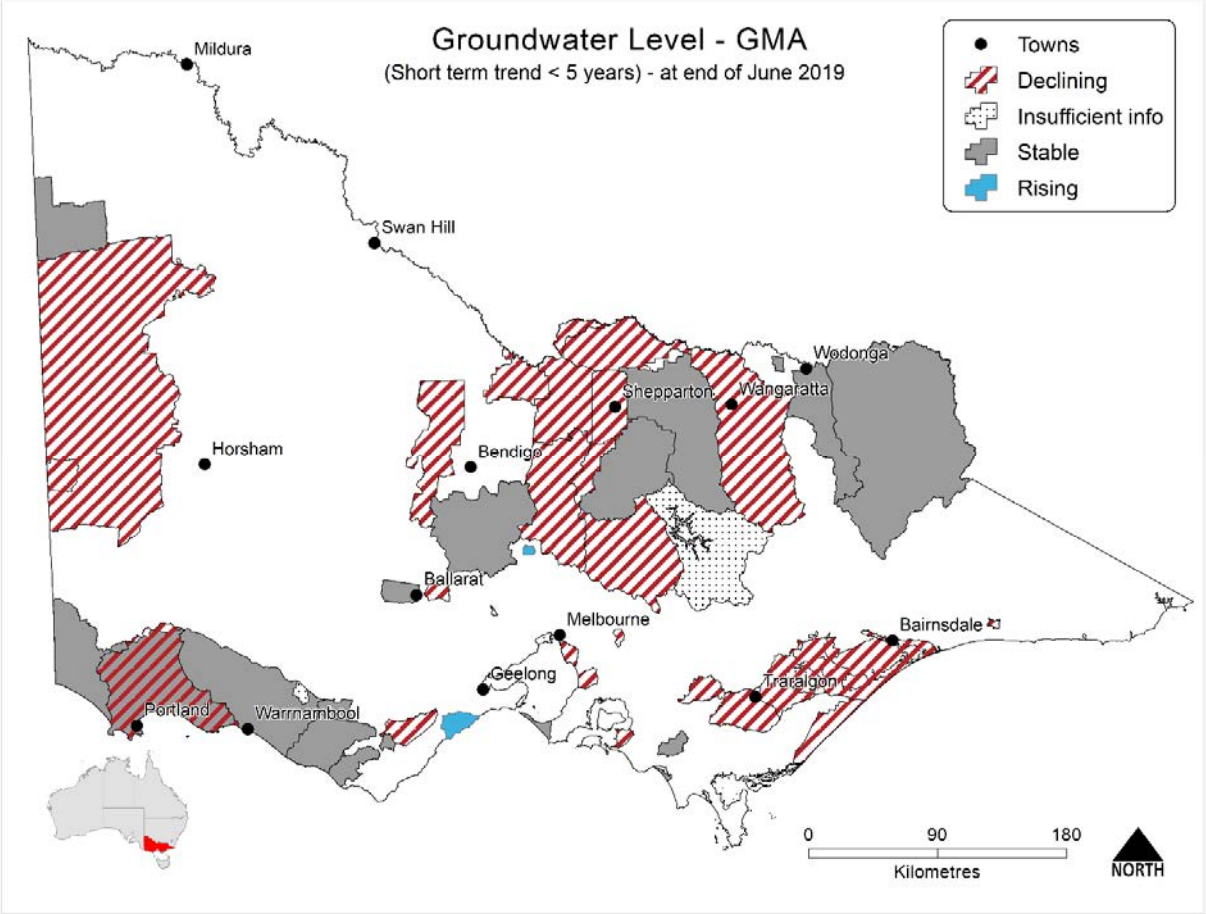
Groundwater management area [1]	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep–18	Dec–18	Mar–19	Jun–19	
Central groundwater management basin					
East Port Phillip Bay groundwater catchment					
Frankston	Declining	Declining	Declining	**Declining**	**Declining**
Moorabbin	Declining	Declining	Declining	**Declining**	**Stable**
Nepean	Stable	Stable	Stable	**Stable**	**Stable**
Wandin Yallock	Declining	Declining	Declining	**Declining**	**Stable**
Tarwin groundwater catchment					
Leongatha	Declining	Declining	Declining	**Stable**	**Stable**
Tarwin	Stable	Stable	Declining	**Stable**	**Stable**
Westernport groundwater catchment					
Corinella	Declining	Declining	Declining	**Declining**	**Declining**
West Port Phillip Bay groundwater catchment					
Lancefield	Rising	Rising	Stable	**Rising**	**Stable**
Merrimu	Declining	Declining	Declining	**Declining**	**Stable**
Gippsland groundwater management basin					
Central Gippsland groundwater catchment					
Rosedale [2]	Declining	Declining	Declining	**Declining**	**Declining**
Stratford [2]	Declining	Declining	Declining	**Declining**	**Declining**
Wa De Lock	Declining	Declining	Declining	**Declining**	**Declining**
Wy Yung	Declining	Declining	Declining	**Declining**	**Stable**
East Gippsland groundwater catchment					
Orbost	Declining	Declining	Declining	**Declining**	**Declining**
Moe groundwater catchment					
Moe	Declining	Declining	Declining	**Declining**	**Declining**
Seaspray groundwater catchment					
Giffard	Declining	Declining	Declining	**Declining**	**Declining**
Goulburn–Murray groundwater management basin					
Campaspe groundwater catchment					
Central Victorian Mineral Springs [3]	Stable	Stable	Stable	**Stable**	**Stable**
Goulburn–Broken groundwater catchment					
Broken	Stable	Stable	Stable	**Stable**	**Stable**
Mid-Goulburn	Declining	Declining	Declining	**Declining**	**Declining**
Shepparton Irrigation	Declining	Declining	Declining	**Declining**	**Stable**
Strathbogie	Stable	Stable	Stable	**Stable**	**Stable**
Upper Goulburn	Declining	Declining	Declining	**Declining**	**Stable**
West Goulburn	Stable	Stable	Stable	**Declining**	**Stable**
Loddon groundwater catchment					
Mid-Loddon	Declining	Declining	Declining	**Declining**	**Declining**
Ovens groundwater catchment					
Barnawartha	Stable	Stable	Declining	**Stable**	**Stable**
Lower Ovens	Declining	Declining	Stable	**Declining**	**Stable**
Upper Murray groundwater catchment					
Kiewa	Declining	Declining	Declining	**Stable**	**Stable**
Upper Murray	Declining	Declining	Stable	**Stable**	**Stable**
Otway–Torquay groundwater management basin					
Hopkins–Corangamite groundwater catchment					
Bungaree	Stable	Stable	Declining	**Declining**	**Declining**
Cardigan	Stable	Stable	Declining	**Stable**	**Stable**
Colongulac	Stable	Stable	Stable	**Stable**	**Rising**
Gellibrand	Stable	Stable	Stable	**Stable**	**Stable**
Gerangamete	Rising	Rising	Declining	**Declining**	**Stable**
Newlingrook	Stable	Stable	Stable	**Stable**	**Stable**
Paaratte	Stable	Stable	Stable	**Stable**	**Stable**
Southwest Limestone [4]	Declining	Declining	Declining	**Stable**	**Declining**

Otway–Torquay groundwater catchment					
Jan Juc	Rising	Rising	Rising	**Rising**	**Declining**
Portland groundwater catchment					
Portland	Declining	Declining	Declining	**Declining**	**Declining**
Wimmera Mallee groundwater management basin					
West Wimmera groundwater catchment					
West Wimmera	Stable	Stable	Stable	**Declining**	**Stable**
West Wimmera – Neuarpur subzone 1 (5)	Declining	Declining	Declining	**Declining**	**Declining**
Wimmera Mallee groundwater catchment					
Murrayville	Stable	Stable	Stable	**Stable**	**Stable**

Notes

(1) The following GMAs 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: Cut Paw Paw, Denison, Eildon and Glenormiston.
(2) Rosedale and Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.
(3) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe and Loddon groundwater catchments.
(4) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.
(5) Restrictions on seasonal allocations are in place to address the trend deviation in the Neuarpur subzone in the West Wimmera GMA.

Figure 2-12 Groundwater trends in groundwater management areas

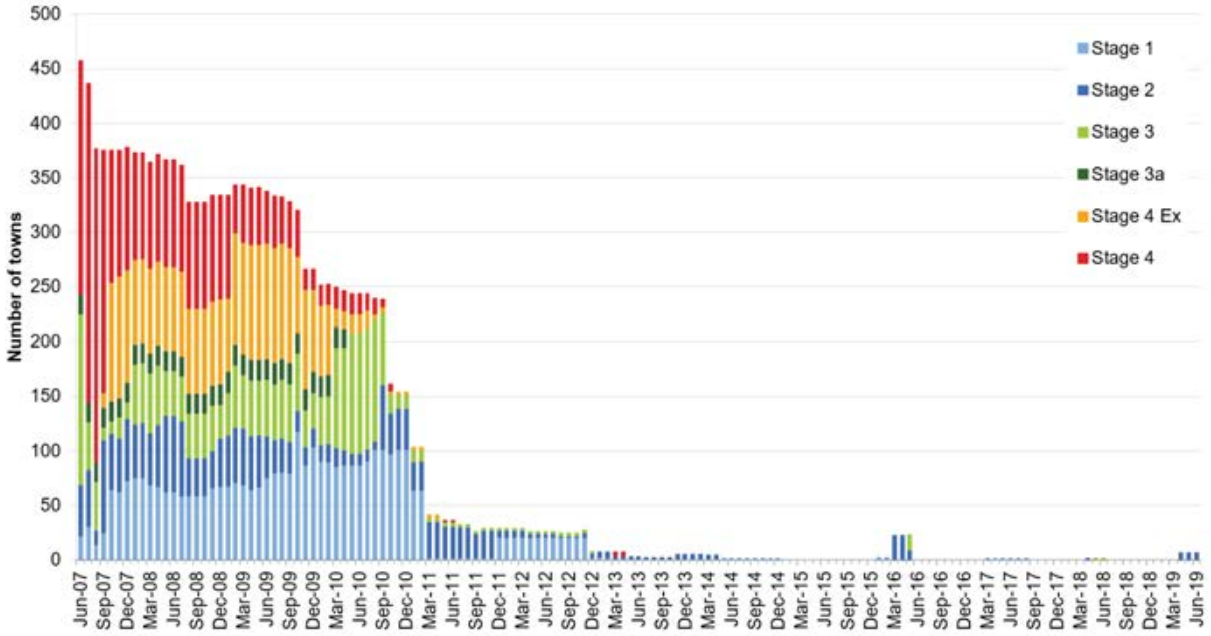


2.5 Response to water availability

2.5.1 Urban water restrictions

Urban water restrictions were applied to six towns in 2018–19, five more than the previous year. In April 2019, Goulburn Valley Water (GVW) implemented stage 2 restrictions in Kilmore, Kilmore East, Wandong, Heathcote Junction, Euroa and Violet Town after low storages in the Euroa and Sunday Creek systems in GVW's area triggered its drought response plan. These restrictions remained in place until the end of June 2019. All other towns were on permanent water-savings rules throughout the year (Table 2-4). 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, June 2007 to June 2019



Note
The restriction policy outlined in 1.3.2.1 was implemented in 2011 to standardise the application of water restrictions throughout the state. Before this, water corporations could use other restriction levels stage 3a and stage 4ex.

Table 2-4 Urban water restrictions in 2018–19

Water corporation	Water system and towns	Level of water restrictions in 2018–19
Central region		
Barwon Water	All towns	PWSR applied all year
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	Six towns	Stage 2 restrictions
Lower Murray Water	All towns	PWSR applied all year
North East Water	All towns	PWSR applied all year
Western region		
Grampians Wimmera Mallee Water	All 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	All town	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 allocation determinations in regulated systems

In 2018–19, aside from the Campaspe and Coliban rural systems, opening allocations announced in July 2018 were low for almost all systems. By February 2019, about half of the systems in Victoria received seasonal determinations of 100% high-reliability water shares (Table 2-5).

In Victoria's declared systems, both in the north and south, almost all high-reliability entitlements reached 100% allocation in 2018–19, except for the Broken system (37%) and the Werribee and Bacchus Marsh district (45%).

In northern Victoria, only the Bullarook system reached 100% allocation for low-reliability entitlement, unlike in the previous year when three systems had low-reliability allocations.

In southern Victoria, the Thomson–Macalister irrigation system received a 35% allocation against low-reliability entitlement, higher than the previous year of 20%.

Allocations for the Wimmera Mallee Pipeline Product began with initial allocations of 9%, which then reached 45% in February 2018 and ended with 55% in March. In the Coliban Rural system, entitlement holders had access to 100% of their entitlement for the entire year.

Table 2-5 Seasonal water allocations in regulated water systems

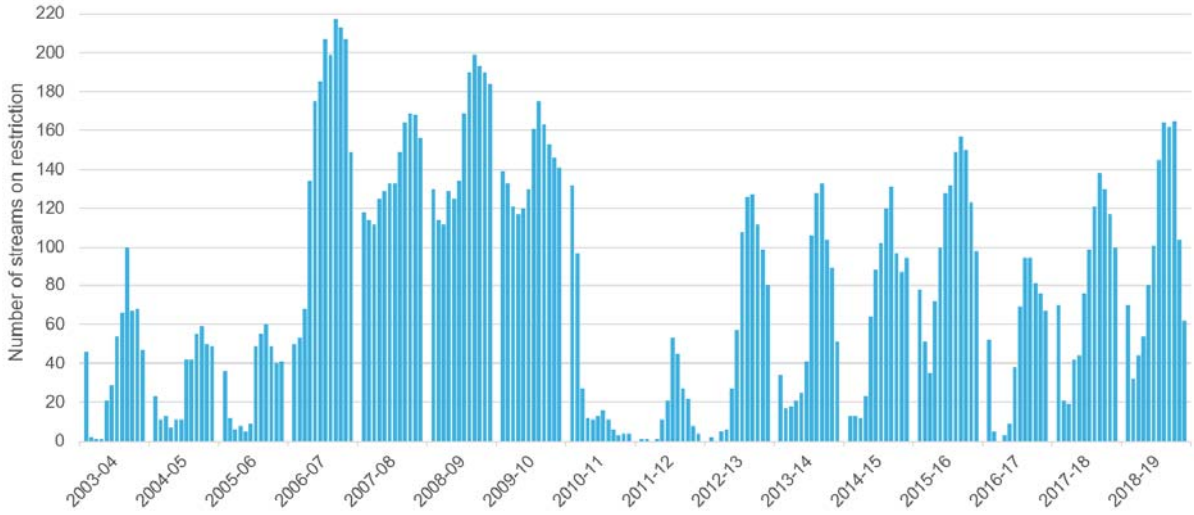
Water system	Water shares	2018–19			2017–18
		Opening allocation [1] (% of entitlement)	Mid-season allocation [2] (% of entitlement)	Final allocation [3] (% of entitlement)	Final allocation (% of entitlement)
Northern declared systems					
Murray	High-reliability	41	100	**100**	**100**
	Low-reliability	0	0	**0**	**0**
Goulburn	High-reliability	32	96	**100**	**100**
	Low-reliability	0	0	**0**	**0**
Broken	High-reliability	0	33	**37**	**100**
	Low-reliability	0	0	**0**	**100**
Campaspe	High-reliability	100	100	**100**	**100**
	Low-reliability	0	0	**0**	**59**
Loddon	High-reliability	32	95	**100**	**100**
	Low-reliability	0	0	**0**	**0**
Bullarook	High-reliability	0	100	**100**	**100**
	Low-reliability	0	100	**100**	**100**
Southern declared systems					
Thomson–Macalister	High-reliability	40	100	**100**	**100**
	Low-reliability	0	35	**35**	**20**
Werribee and Bacchus Marsh	High-reliability	10	40	**45**	**45**
	Low-reliability	0	0	**0**	**0**
Non-declared systems					
Wimmera Mallee	Pipeline product	9	45	**55**	**81**
Coliban Rural	Rural licences	100	100	**100**	**100**

Notes
(1) Opening allocations are taken as the initial determination made by each resource manager at the start of July.
(2) Allocations in February are provided as an indication of mid-season allocations.
(3) Goulburn-Murray Water (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 a peak of 162 in March 2019, compared to 138 in the previous year (Figure 2-14). There were 104 streams subject to restrictions in May 2019, compared to 117 at the same time in the previous year. There were 62 streams on restrictions at the end of 2018–19, compared to 100 at the end of 2017–18.

Figure 2-14 Number of Victorian unregulated streams on restrictions, June 2003 – June 2019



2.5.4 Groundwater restrictions

Entitlement holders in three GMUs were subject to restrictions on groundwater use in 2018–19, one less than the previous year.

In the West Wimmera groundwater catchment, an 80% seasonal allocation remained in place in the Neuarpur subzone 1, a trading zone in the West Wimmera GMA.

In the Loddon groundwater catchment, all management zones in the Loddon Highlands WSPA had an allocation of 100% except for the Newlyn Zone, which had an allocation of 75% in 2018–19.

In the West Port Phillip Bay groundwater catchment, the Deutgam WSPA had a seasonal allocation of 50% in 2018–19.

2.5.5 Water-carting

Water-carting is an option that water corporations use to augment town supplies when local sources cannot meet demand. Doing so can be a time-consuming, expensive exercise and is usually a last resort to supply smaller towns. In recent years, water-carting has been required to address water scarcity, particularly during drought periods. In 2018–19, drought led to Lake Glenmaggie's water level dropping below 8%, and short-term water cartage arrangements were put in place to supply Coongulla between April and June 2018.

2.5.6 Temporary qualification of rights to water

In 2018–19, the Minister for Water did not qualify any rights to water in regulated systems.

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.

A small catchment dam can be either registered and licensed or unlicensed, depending on the amount of use and capacity. If the dam's capacity is small and use is restricted to domestic household and stock watering, the dam does not require a licence, consistent with section 8 of the Act. Where its capacity is larger and/or use is for commercial purposes including irrigation, 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). Environmental use is not reported in this chapter.

Table 3-1 shows the volume of water defined in entitlements for consumptive use in Victoria in 2018–19 and 2017–18. The accounts do 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 that 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, 2018–19 and 2017–18

Entitlement type	Volume 2018–19 (ML)	Volume 2017–18 (ML) [4]
Surface water		
Bulk entitlements [1]	4,715,665	4,740,120
Licences [2]	226,958	228,499
Small catchment dams [3]	108,222	137,502
Total surface water entitlements	**5,050,845**	**5,106,120**
Groundwater		
Licences	955,641	957,100
Bulk entitlements	10,000	10,000
Total groundwater entitlements	**965,641**	**967,100**
Total entitlements	**6,016,486**	**6,961,524**

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 carryover available, trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the VEWH 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, but it excludes 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.

(4) Prior-year entitlement volumes have been adjusted to match new accounting methods in the current year.

The availability and use of Victoria's water resources for 2018–19 is summarised in Table 3-2.

The volume of water taken or the water-use data presented in this overview and in the surface water river basin 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 end use on a farm or in a town.

Overall, the total available volume of Victoria's surface water, groundwater and recycled water in 2018–19 was 12,072,626 ML, much less than the amount available in the previous year. Of this, 3,976,057 ML was taken for consumptive uses, lower than the 4,087,408 ML taken in 2017–18.

The volume of surface water taken in 2018–19 was 67% of the total entitlement volume.

Table 3-2 Victoria's water availability and water taken for consumptive use, 2018–19

Water source	Available resource (ML)	Total entitlements (ML)	Total taken (ML)
Surface water (1)	10,681,744	5,050,845	3,377,486
Groundwater (2)	929,598	965,641	498,229
Recycled water (3)	461,285	n/a	100,342
Total 2018–19	**12,072,626**	**6,016,486**	**3,976,057**
Total 2017–18	15,375,034	6,961,524	4,087,408

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 permissible consumptive volume (PCV) of each GMU plus entitlement volume where the GMU does not have a PCV.

(3) The volume of available recycled water is assumed to be the volume of wastewater produced at treatment plants. There is no applicable entitlement volume for recycled water.

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 2018–19. Part 2 has more information about diversions under surface water entitlements in each basin. The entitlements and their volumes are detailed in chapter 6 for each basin. Environmental entitlements are explained separately in chapter 4, as they are not considered to be consumptive uses entitlements.

The amount of water taken for consumptive uses decreased in 2018–19, compared to the previous year. Most of the decrease was in the bulk entitlement volume taken, with decreases primarily in the north of Victoria. The volume of water taken under bulk entitlements in 2018–19 was 68% of the total volume of bulk entitlements, lower than the previous year when 70% was taken. The volume of water taken under unregulated take and use licences was 29% of the total volume of licences, which was lower than the previous year (32%).

Table 3-3 Volume of surface water entitlements and volume and percentage taken for consumptive use, 2018–19

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 (4)	1,484,124	1,265,216	85%	13,787	3,461	25%	4,779
Kiewa	2,206	1,086	49%	13,664	5,023	37%	2,311
Ovens	49,169	16,450	33%	13,820	4,545	33%	5,138
Broken	24,632	9,418	38%	1,411	722	51%	1,809
Goulburn	1,703,728	1,001,433	59%	15,791	5,887	37%	11,581
Campaspe	98,658	39,379	40%	970	546	56%	6,519
Loddon	33,236	15,328	46%	15,954	4,994	31%	7,442
East Gippsland	622	97	16%	657	64	10%	285
Snowy	2,201	755	34%	3,919	1,433	37%	963
Tambo	342	29	9%	4,043	900	22%	781
Mitchell	9,208	4,654	51%	16,238	12,746	78%	499
Thomson (4) (5)	404,559	420,291	104%	17,207	4,171	24%	335
Latrobe (4)	221,692	82,096	37%	12,967	1,550	12%	6,149
South Gippsland	18,887	7,207	38%	9,510	2,327	24%	11,736
Bunyip	36,595	26,243	72%	16,911	5,246	31%	9,027
Yarra	400,000	213,031	53%	39,505	6,835	17%	4,899
Maribyrnong	10,711	2,602	24%	1,925	201	10%	1,833
Werribee (4)	37,617	13,300	35%	697	0	0%	1,048
Moorabool	40,600	14,420	36%	2,105	833	40%	2,647
Barwon	54,733	34,123	62%	4,627	1,140	25%	4,123
Corangamite	0	0	0%	874	60	7%	1,884
Otway Coast	19,667	13,531	69%	4,467	175	4%	8,914
Hopkins	629	221	35%	9,176	2,401	26%	3,099
Portland Coast	0	0	0%	1,011	0	0%	1,217
Glenelg	4,554	1,619	36%	974	124	13%	5,938

Millicent Coast	0	0	0%	4	4	100%	367
Wimmera	57,016	20,686	36%	2,179	422	19%	1,986
Mallee	0	0	0%	0	0	0%	0
Avoca	278	30	11%	2,566	48	2%	911
Total 2018–19	**4,715,665**	**3,203,245**	**68%**	**226,958**	**65,857**	**29%**	**108,222**
Total 2017–18 (1)	4,740,120	3,339,628	70%	228,499	73,275	32%	137,502

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 carryover available, trade, caps that are climatically adjusted or caps that are long-term rolling averages. Bulk entitlements and environmental entitlements held by the VEWH are not included as water taken under these entitlements as they are not considered to be for consumptive purposes. In previous years, the bulk entitlement volume included water shares held by the environment. These water shares have now been removed from the total for each basin. The 2017–18 bulk entitlement volume has been amended from the previous year published amount to reflect this change.

(2) This 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) This volume includes all licensed and unlicensed small catchment dams. 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) The volume taken under bulk entitlements in the Murray, Thomson, Latrobe and Werribee basins is net of returns to the waterway.

(5) Melbourne Water's Thomson River bulk entitlement has an annual diversion volume of 171,800. In 2018–19, Melbourne Water took 198,850 ML under this entitlement. Annual exceedance is acceptable as long as the cumulative credit/debit balance meets the requirement of the diversion limit compliance method.

During 2018–19, 14 amendments were made to the following entitlements:

- *Bulk Entitlement (River Murray – North East Water) Conversion Order 1999*: water shares were converted to bulk entitlements to provide a new offtake to Dartmouth township
- *Bulk Entitlement (Daylesford-Hepburn Springs) Conversion Order 2004*: the rate of take from Hepburn Reservoir was adjusted to reflect the capacity of the permanent offtake infrastructure at the reservoir and the storage capacity volume and full supply volume at Hepburn Reservoir and full supply volume at Bullarto Reservoir
- *Bulk Entitlement (Eildon-Goulburn Weir) Order 1995* and *Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999*: the loss allowances were adjusted to enable the transfer of water savings from the GMW Connections Project to the Commonwealth Environmental Water Holder (CEWH)
- *Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005, Environmental Entitlement (Goulburn System – Living Murray 2007* and *Environmental Entitlement (Campaspe River – Living Murray Initiative)*: these were amended so the Water Holder is provided with a right to re-use or be credited for return flows in a manner consistent with policy developed in the *Northern Region Sustainable Water Strategy*
- *Bulk Entitlement (Eildon-Goulburn Weir) Conversion Order 1995* and *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999*: the Greens Lake storage was removed from the Goulburn Headworks system and allocated a new 9 GL unregulated entitlement to the Victorian Environmental Water Holder
- *Bulk Entitlement (Eildon-Goulburn Weir) Conversion Order 1995, Bulk Entitlement (River Murray – GMW) Conversion Order 1999, Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999, Goulburn River Environmental Entitlement 2010, Environmental Entitlement (River Murray NVIRP Stage 1) 2012* and *Environmental Entitlement (Goulburn System- NVIRP Stage 1) 2012*: loss allowances and transfer water were savings adjusted from the GMW Connections Project Stage 1 to the VEWH
- *Bulk Entitlement (Eildon-Goulburn Weir) Conversion Order 1995*: corrections were made to the data relating to East Loddon Waterworks District and the separation of East Loddon (north) and East Loddon (South) Waterworks District formalised.

All changes to bulk entitlements are administered under part 4, division 1 of the Act and require consultation and consideration of matters including the impact on current users and the environment.

Figure 3-1 shows the volume of water taken under surface water entitlements in the past 13 years.

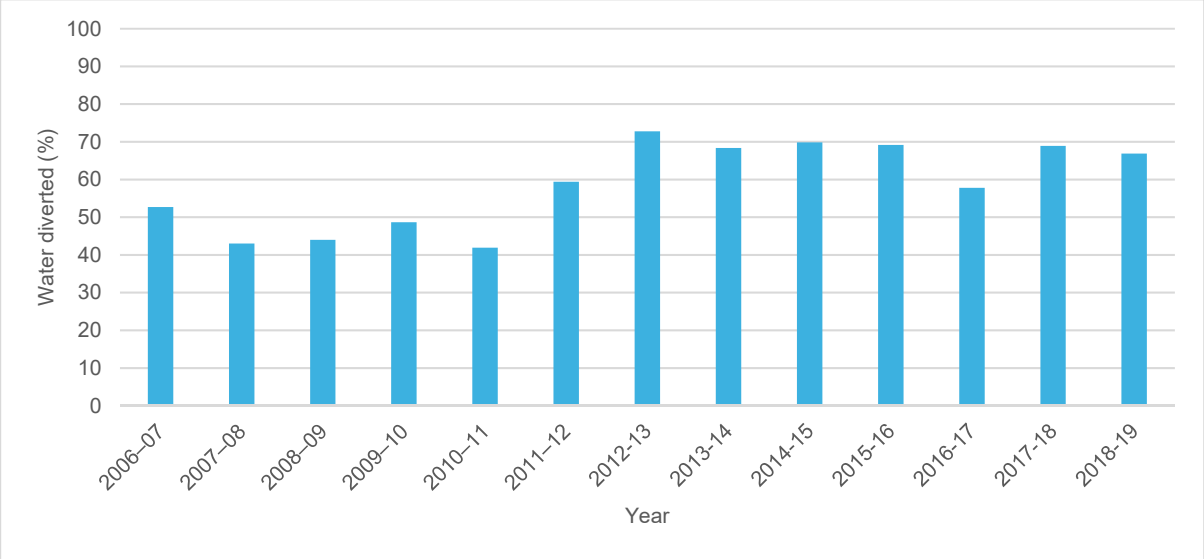
In any given year, there is typically a gap between the total volume of entitlements — water that can be legally used — and the actual volume of water taken. This is due to various reasons including:

- dry climatic conditions: there is not enough water available to take the total volume of entitlements
- wet climatic conditions: there is less 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 during these years. Lower water use was again observed in 2018–19.

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



Note

(1) Prior-year data in this figure has been updated from previous years accounts — 2009–10 to 2017–18 — to reflect the removal of water shares held by the environment in the total entitlement volume.

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).

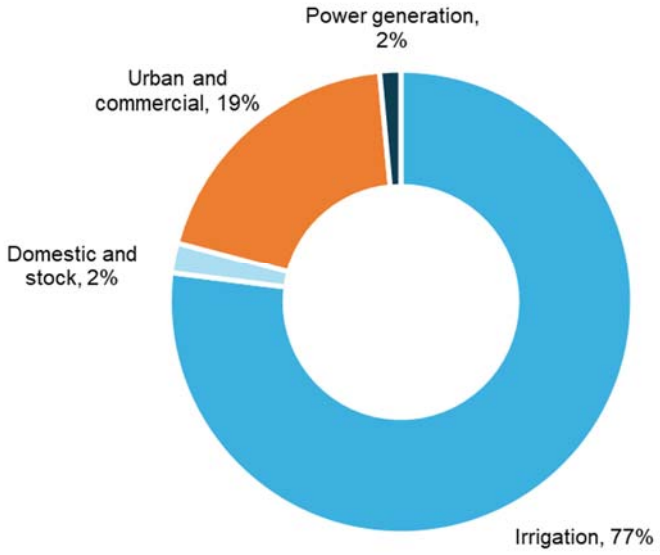
As shown in Table 3-4, the volume of water taken for consumptive use under surface water entitlements in 2018–19 was less than in 2017–18.

Irrigation is the largest consumptive use of surface water in the state, comprising 83% of all water taken in 2018–19, as shown in Figure 3-2.

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

Consumptive end use	2018–19		2017–18	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation	2,599,879	77%	2,781,684	78%
Domestic and stock	72,208	2%	89,861	3%
Urban and commercial	655,647	19%	630,414	18%
Power generation	49,753	2%	48,446	1%
Total	**3,377,486**	**100%**	**3,550,404**	**100%**

Figure 3-2 Percentage of water taken for different consumptive uses under surface water entitlements, Victoria, 2018–19



3.2 Groundwater entitlements and use

The following changes were made to GMUs in 2018–19:

- on 28 June 2019, amendments were made to the PCV Groundwater Order 2011 published in the *Victoria Government Gazette* G28 on 14 July 2011 to declare new PCVs for the Gellibrand and Gerangamete GMAs and to make provision for test pumping to be carried out in the Gerangamete GMA
- on 5 December 2019, an amendment was made to the Paaratte GMA PCV Order published in the *Victoria Government Gazette* G18 published on 3 May 2018 at pages 857–859 (the Original Order) to clarify the technical description of the depth boundaries as identified in the Original Order.

Full details of water entitlements and use from each GMA and WSPA in 2018–19 are in Appendix C.

In 2018–19, total groundwater licensed entitlement was 956,641 ML across the state. The total groundwater use across the state including domestic and stock use was 498,229 ML, which was more than the volume used in 2017–18 (439,845 ML).

There are 19,012 stock and domestic bores in Victoria. Domestic and stock use (31,716 ML) was estimated to account for about 6% of total groundwater use.

In 2018–19, metered use was higher than in 2017–18. In Victoria's GMAs, licensed groundwater entitlements totalled 629,597 ML with total metered use of 292,099 ML (254,820 ML in 2017–18). Licensed groundwater entitlements in WSPAs totalled 242,367 ML with total metered use of 153,898 ML (121,659 ML in 2017–18). The volume of groundwater entitlements outside GMUs (previously known as unincorporated areas) was 93,677 ML, with 20,516 ML of metered extraction (17,922 ML in 2017–18).

The total volume of groundwater extracted for urban use in 2018–19 was 9,576 ML, (higher than the previous year of 8,925 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 2018–19, 58 of these cities and towns recorded some level of groundwater extraction. The largest urban users were Portland and Sale, with extractions of 1,738 ML and 1,850 ML respectively.

Figure 3-3 shows cities and towns where there is an entitlement to extract groundwater and where groundwater was extracted for urban water supply in 2018–19.

Figure 3-3 Towns with groundwater extraction entitlement and extractions for urban supply, 2018–19

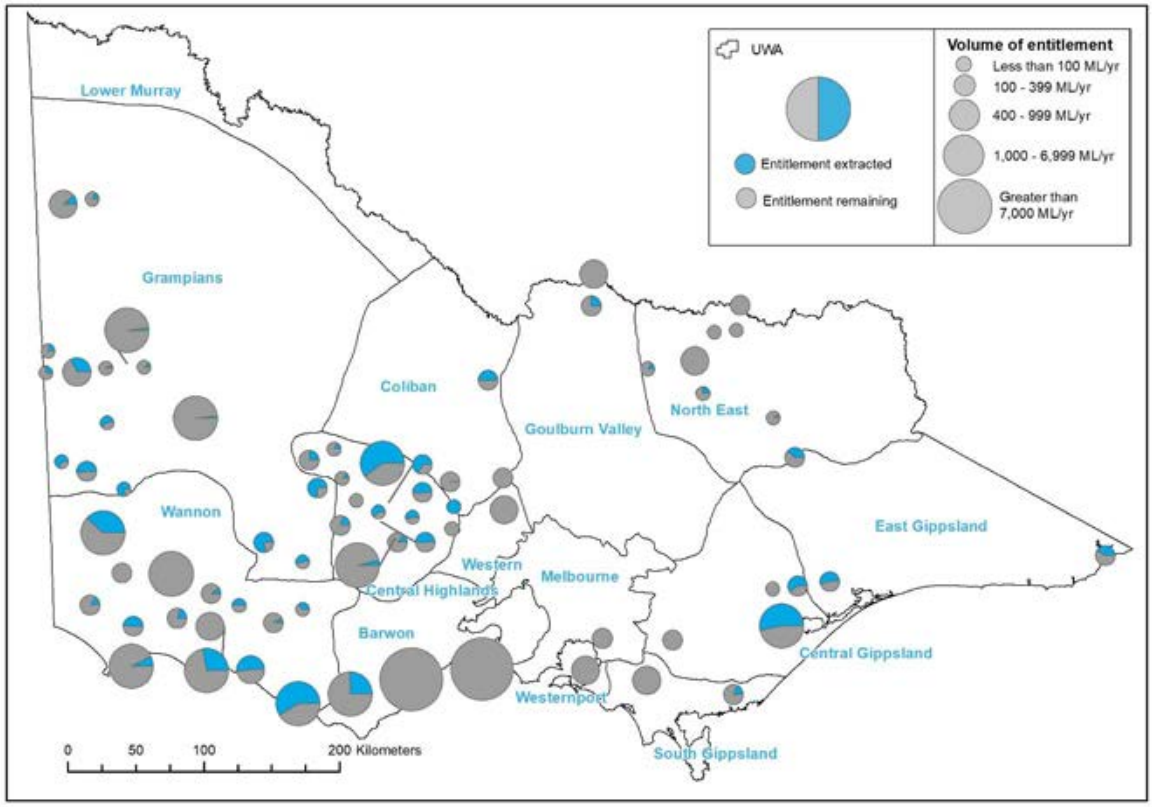
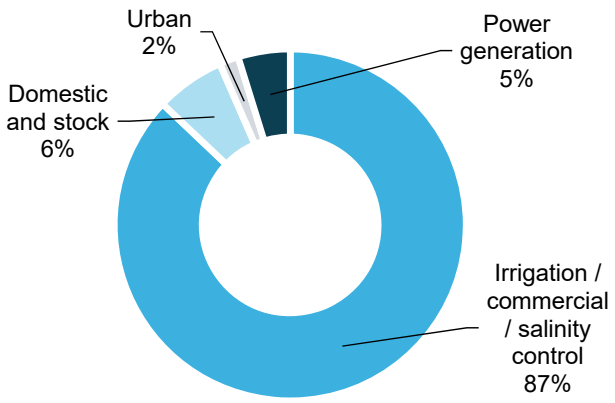


Table 3-5 and Figure 3-4 show the groundwater extraction by type of use in 2018–19.

Table 3-5 Groundwater extraction by type of end use, 2018–19

Consumptive end use	2018–19		2017–18	
	Volume diverted (ML)	Proportion of total consumptive diversions (%)	Volume diverted (ML)	Proportion of total consumptive diversions (%)
Irrigation / commercial / salinity control	433,109	87%	362,497	82%
Domestic and stock	31,716	6%	45,444	10%
Urban	9,576	2%	8,946	2%
Power generation	23,828	5%	22,958	5%
Total	**498,229**	**100%**	**439,845**	**100%**

Figure 3-4 Groundwater extraction by type of end use, 2018–19



3.3 Recycled water production

The total volume of 461,285 ML of wastewater produced in 2018–19 was less than the 474,881 ML produced in 2017–18 (Table 3-6). The volume of water recycled by Victoria's water corporations increased from the previous year and use internal to treatment plants (within process volumes) was slightly lower than in 2017–18. In 2018–19, use external to treatment plans was 83,852 ML, which was more than the 78,307 ML recycled for external uses in 2017–18. An additional 16,490 ML was recycled for use in wastewater treatment processes.

The volume of water recycled in Melbourne, which is defined as water treated in the Bunyip, Werribee and Yarra basins less the regional towns in those basins, was 46,142 ML, or 14%. 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 30% (or 37,710 ML) of the wastewater available for re-use.

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. The quantities of recycled water vary from year to year, partly depending on customer demand. During wet years, customer demand is typically lower. In 2018–19, the volume of water recycled by the Eastern Treatment Plant was 16,880 ML, which was a decrease on the 17,274 ML recycled the previous year.

The volume of water recycled by the Western Treatment Plant increased from 29,764 ML in 2017–18 to 31,744 ML in 2018–19.

Table 3-6 Volume of wastewater recycled, 2018–19

Basin	Wastewater produced (ML)	Volume of wastewater recycled (ML)	Percentage of wastewater recycled (%) [1]	End uses of recycled water				Volume discharged to the environment (ML)	Released to ocean/Other (ML)
				Urban and industrial	Agriculture	Beneficial allocation [2]	Within process [3]		
Avoca	260	151	58%	40	111	0	0	0	109
Barwon	33,842	4,919	8%	1,340	1,337	147	2,096	9,471	19,451
Broken	443	443	100%	0	443	0	0	0	0
Bunyip	150,745	21,746	7%	8,449	2,685	0	10,611	2,204	126,795
Campaspe	2,275	1,639	72%	225	1,412	0	3	635	0
Corangamite	2,533	529	17%	15	426	0	88	2,004	0
East Gippsland	91	91	100%	0	91	0	0	0	0
Glenelg	924	780	84%	33	747	0	0	143	0
Goulburn	7,627	7,372	97%	516	6,855	0	0	257	0
Hopkins	6,643	1,007	14%	151	790	0	65	0	5,637
Kiewa	309	127	41%	3	124	0	0	181	0
Latrobe	22,219	675	3%	57	72	546	0	3,496	18,048
Loddon	8,323	2,634	32%	1,343	1,290	0	0	5,167	521
Mallee	0	0	0%	0	0	0	0	0	0
Maribyrnong	4,259	1,846	27%	492	671	0	683	2,413	0
Millicent Coast	71	10	13%	10	0	0	0	0	61
Mitchell	1,349	1,349	100%	0	210	1,138	0	0	0
Moorabool	1,366	1,366	91%	1,201	39	0	126	0	0
Murray	10,384	4,593	43%	226	4,220	0	146	3,642	2,149
Otway Coast	1,425	372	23%	82	249	0	41	72	981
Ovens	2,611	1,291	49%	71	1,220	0	0	1,320	0
Portland Coast	2,634	125	5%	0	125	0	0	220	2,289
Snowy	174	174	100%	0	174	0	0	0	0
South Gippsland	5,247	462	8%	79	365	0	18	1,217	3,568
Tambo	801	801	100%	0	801	0	0	0	0
Thomson	1,327	1,300	98%	0	1,300	0	0	27	0

Werribee	179,884	38,970	21%	9,771	23,707	5,091	401	0	140,914
Wimmera	2,447	1,848	75%	541	1,306	0	0	0	599
Yarra	11,072	3,722	14%	538	971	0	2,212	6,185	1,166
Total 2018–19	**461,285**	**100,342**	**22%**	**25,182**	**51,740**	**6,922**	**16,490**	**38,655**	**322,288**
Total 2017–18	474,881	97,159	20%	25,951	44,325	8,032	18,850	41,548	336,177

Note

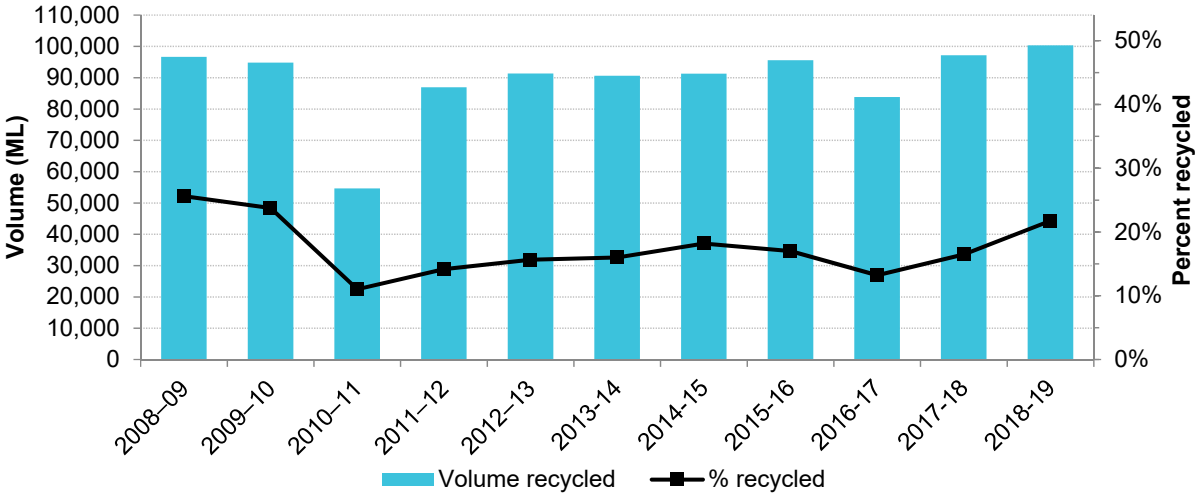
(1) Percentage of waste water recycled includes water recycled 'within plant process', which refers to water reused in treatment processes. This treatment is consistent with the Essential Service Commission's performance report.

(2) Volume used to deliver specific environmental flow benefits

(3) Water reused in wastewater treatment processes, for example backflushing of filters. This value is included in the total percentage recycled.

Figure 3-5 shows the trend in recycled water over the ten years to 2018–19.

Figure 3-5 Recycled water volume and percentage, 2008–09 to 2018–19



3.4 Desalination water production

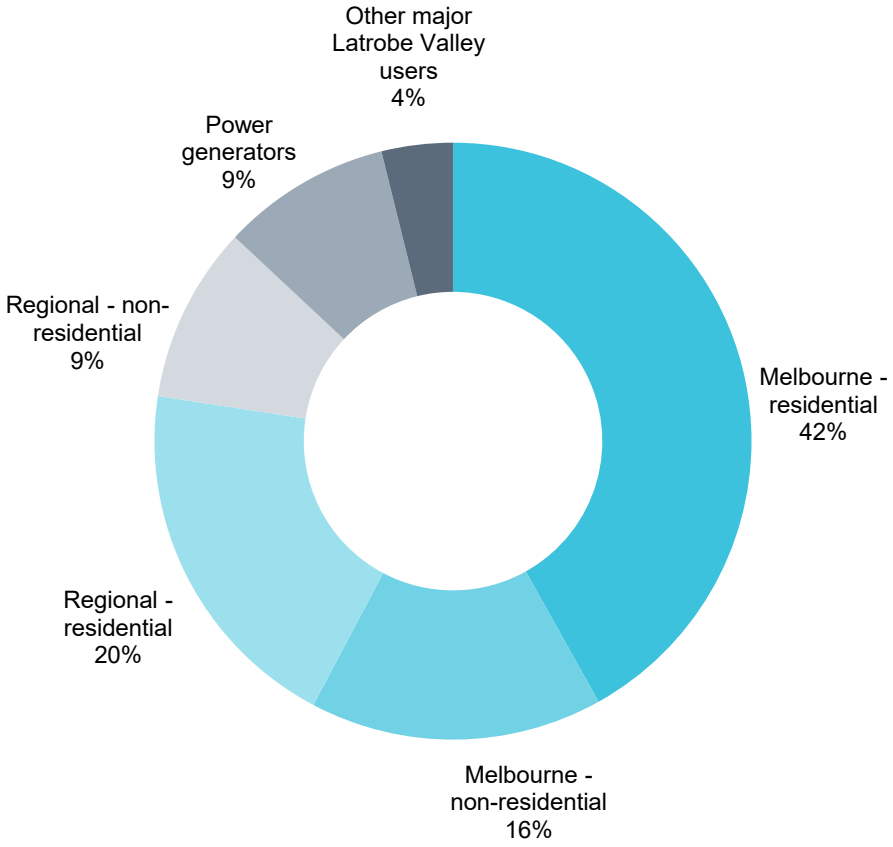
Water produced by the Victorian Desalination Project is transferred into Cardinia Reservoir and combined with the water available for consumptive uses. See chapter 1.1.4 for more information about the project.

The project began delivering water on 19 March 2017. The total volume delivered to 30 June 2019 was 21,966 ML, representing 1.21% of Melbourne's storage capacity. This is more than the 15,000 ML (or 0.83%) delivered in 2017–18. This includes a brought-forward water volume — water delivered during one year and paid for in the next — of 6,868 ML from the 2019–20 water order.

3.5 Metered urban and commercial consumptive use

Consumption in urban areas is typically measured by the metered volume of water delivered to customers: household (residential use) and business (commercial use) customers. 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.

Figure 3-6 Metered urban and commercial consumption of water, 2018–19



4. Water for the environment

Many of Victoria's rivers and wetlands have been modified as the population has grown to provide water for towns, industry and food production. In some rivers, up to half of the water that would have naturally flowed in them is removed each year for urban consumption, irrigation and industry. As a result, these waterways are not able to function as they would naturally, and it is necessary to manage flows in them and to wetlands. Water is specifically set aside for the environment in Victoria's water management framework in three ways:

- **water entitlements**: most of the water entitlements held for the environment are specified as a legal right to a share of the water available in storages that can be released to meet particular environmental needs in a given year. 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 made available in the right place at the right time: for example, 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**: these are volumes of water that 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**: this is water available above the total volume that can be allocated under entitlements for consumptive use. It includes water that is left over after limits on diversions have been reached and unregulated flows which cannot be kept in storage. This water also provides social, recreational and cultural benefits.

Environmental water entitlements are held by State and Commonwealth government agencies often referred to as environmental water holders. In Victoria, this includes the VEWH, the CEWH and the Murray–Darling Basin Authority (MDBA) as part of The Living Murray program.[2]

In most cases, water held by the CEWH or the MDBA that is required for delivery in Victoria is transferred to the VEWH to enable its delivery: the water is held by the VEWH until used or transferred back.

Environmental water holders can use allocation trade to move water between different environmental water accounts for delivery. On occasion, the environmental water holders will either sell or buy water from other water entitlement holders. Such trades are recorded as commercial water trades, with a price determined via the relevant water market. Also, other water entitlement holders can choose to donate water, either as water shares or seasonal allocation, to environmental water holders.

In some systems, carryover rules allow environmental water holders to retain unused water in storage at the end of the year. This can then be used to meet environmental watering priorities in future years. The environmental water holders use carryover and trade to achieve the best environmental outcomes.

Victorian Environmental Water Holder

The VEWH is an independent authority established by the Victorian Government in 2011, and it is responsible for managing Victoria's water for the environment. The VEWH works with local waterway managers — catchment management authorities and Melbourne Water — to ensure water for the environment achieves the best environmental outcomes. One of the VEWH's roles is to coordinate with other Murray–Darling basin environmental water holders — the CEWH, the MDBA and environmental water managers in New South Wales and South Australia — to optimise the benefits of delivery of all water for the environment in and from northern Victorian waterways.

Further information about the VEWH's planning processes for use of the environmental water holdings, the program's achievements and outcomes of environmental watering in 2018–19 is available in the VEWH's annual report and annual watering report (*Reflections*), available at www.vewh.vic.gov.au (search 'VEWH Reflections').

Commonwealth Environmental Water Holder

The CEWH manages the portfolio of water acquired by the Australian Government for the environment in the Murray–Darling basin. The CEWH holds Victorian water shares that were acquired through the Australian Government's investment in water-saving infrastructure and purchases. The CEWH receives annual allocations against its water shares and partners with the VEWH, the MDBA and Victorian waterway managers to deliver this water for the environment in Victoria.

More information about the CEWH is available at https://www.environment.gov.au/water/cewo.

[2] The Victorian water entitlements for the Living Murray program are held by the VEWH in trust for the MDBA. In 2018–19, the MDBA held water shares in Victoria.

Murray–Darling Basin Authority

The MDBA manages The Living Murray program on behalf of the basin states and the Commonwealth. This program is a partnership between the Commonwealth and the New South Wales, Victorian, South Australian and Australian Capital Territory governments. The Living Murray program focuses on achieving agreed ecological objectives at six icon sites, chosen for their high ecological and economic value and for their cultural and heritage significance to Aboriginal people. The sites encompass areas of high conservation value: the floodplains, wetlands and forests along the Murray, the Murray's estuary and the river itself. The VEWH holds some entitlements in trust for the MDBA, and decisions about the use of water under these entitlements are made by the Southern Connected Basin Environmental Watering Committee.

For more information about The Living Murray program, visit the MDBA's site (https://www.mdba.gov.au/) or search 'Living Murray Program'.

4.1 Managed environmental water

Managing and delivering water for the environment involves careful planning by many people and organisations. Each year, the VEWH develops a seasonal watering plan to collaboratively manage environmental flows to improve the health of river and wetland systems including their biodiversity, ecological function and water quality.

The seasonal watering plan is a statewide plan that guides environmental watering decisions in Victoria. It provides program partners, stakeholders and communities with a sense of what to expect during the water year. The plan for the upcoming water year is released by 30 June each year.

For more information about how water for the environment is managed in Victoria, visit the VEWH's website at http://vewh.vic.gov.au/watering-program/managing-water-for-the-environment.

4.1.1 Annual overview

Commonwealth Environmental Water Holder

In 2018–19, 294,406 ML of CEWH allocation was transferred into the VEWH's accounts for use in northern Victorian systems. This water was used for watering actions in the Murray, Goulburn, Broken, Campaspe and Loddon systems. Following the completion of environmental watering, 17,690 ML of unused CEWH water for the environment was returned to the CEWH.

Living Murray allocation

In 2018–19, 33,398 ML of Living Murray allocation was transferred to accounts held by the VEWH to contribute to watering actions in the Murray, Goulburn and Campaspe systems. Following the completion of environmental watering, 7,400 ML of unused Living Murray water for the environment was returned to The Living Murray program. An additional 41,933 ML of Living Murray allocation was transferred to the South Australian Murray system from accounts held by the VEWH to meet priority watering actions in the Lower Lakes, Coorong and Murray Mouth.

Victorian River Murray Increased Flows (RMIF)

In 2018–19, 13,930 ML of Victorian RMIF allocation was delivered within Victoria and another 50,000 ML was transferred to the South Australian Murray system to meet priority watering actions in Chowilla, Lower Lakes, Coorong and Murray Mouth.

Victorian Environmental Water Holder

This year was the VEWH's eighth year managing water for the environment in Victoria. In 2018–19, 92% of identified potential watering actions were fully or partially achieved through a combination of managed environmental flows, natural flows, unregulated passing flows and delivery of consumptive water en route. (Table 4-1). The number of potential watering actions has increased each year since the VEWH's inception. In 2018–19, the highest number of potential watering actions was identified (301, up from 283 in 2017–18). Since 2013–14, the number of sites watered each year has fluctuated due to climatic conditions, water availability and infrastructure improvements. The number of sites watered in 2018–19 was similar to 2017–18.

During 2018–19, several amendments and adjustments were made to seven of the VEWH's environmental and bulk entitlements to reflect inter-governmental agreements under the Murray–Darling Basin Plan, to implement water savings and policy projects and to improve the effective use of the Water Holdings. The VEWH also acquired water shares for the first time in the Broken system and increased its holdings of water shares in the Murray and Goulburn systems. Page 16 of the VEWH's *Annual Report 2018–19* has more information about changes to entitlements.

During 2018–19, the VEWH coordinated delivery of water for the environment to 90 priority river reaches and 78 wetlands, a total of 168 sites across Victoria.

Table 4-1 Watering actions achieved

Managed environmental watering sites	2018–19	2017–18
Number of river reaches delivered to	90	88
Number of wetlands delivered to	78	83
Number of required watering actions achieved	223	241
Percentage of required watering actions achieved	92%	92%
Percentage of required watering actions achieved using managed environmental water	75%	78%

The total volume of VEWH, CEWH and Living-Murray-managed environmental water available in 2018–19 was 2,082,763 ML, which was more than the year before. Of this total, 545,609 ML of environmental water was delivered during the year to priority river reaches and wetlands in Victoria. Table 4-2 summarises Victoria's managed environmental watering in 2018–19.

Table 4-2 Summary of managed environmental watering, 2018–19 (ML)

Managed environmental water	2018–19	2017–18
Availability		
Carryover	666,593	484,564
Seasonal allocations	1,042,647	929,072
Return flows (1)	373,620	665,589
Less carryover / allocation lost (2)	96	52,443
Total available (3)	**2,082,763**	**2,026,782**
Environmental deliveries		
Volume delivered to off-stream wetlands	71,028	154,107
Volume delivered in-stream	474,581	764,508
Total volume delivered	**545,609**	**918,615**

Notes

(1) '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.

(2) 'Carryover / volume lost' includes deductions to carryover or allocation to account for a spill, evaporation or change in storage event.

(3) '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 environmental water holders from another party.

Return flows

In some systems, water for the environment delivered through upstream sites can be used again downstream without impacting other entitlement holders. This helps to ensure it is used efficiently and effectively, to achieve optimal environmental benefits. Access to return flows for the environment is enabled through rules in the VEWH's bulk and environmental entitlements.

In 2018–19, a total of 373,620 ML was recredited to the VEWH's accounts for return flows delivered through upstream sites to the Murray River.

Environmental water holders use trade to manage their water portfolios. Trades include administrative transfers (moving water between environmental water holder accounts) and commercial trades (selling and purchasing allocation on the market). In 2018–19, allocation trades undertaken by environmental water holders included:

- selling and buying water allocation to non-environmental users commercially
- transferring water between Victorian systems to achieve outcomes and maximise water availability
- transferring all allocations made to the Snowy Water Initiative entitlements to the Snowy Scheme in accordance with conditions of those entitlements: see chapter 4.1.3 for details
- transferring allocation to South Australia for delivering environmental outcomes in the downstream Murray River.

Table 4-3 presents key trade activities undertaken by environmental water holders in 2018–19.

Table 4-3 Summary of key trade activities undertaken by environmental water holders, 2018–19 (ML)

Managed environmental water – other actions	2018–19	2017–18
Net volume sold to non-environmental users (ML)	31,916	15,000
Volume transferred to the Snowy Scheme (ML) (1)	81,165	83,813
Volume delivered via the Murray River to South Australia (ML)	526,776	691,151
Total other actions (ML)	**639,857**	**789,964**

Note

(1) The volume of allocation transferred from the Victorian Murray, Goulburn and Loddon systems to the Snowy Mountains 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 14 Victorian river basins. Table 4-4 presents for each river basin the volume of entitlements at 30 June 2019 and the volumes made available and used during 2018–19. A total of 2,082,763 ML was made available under these entitlements during the year (before trade), of which 545,609 ML was used for environmental benefits within Victoria.

The table includes entitlements held in Victorian river basins for environmental purposes by the VEWH, the CEWH and the MDBA (for The Living Murray program). Entitlements in each system can have different reliability (or security of supply), in Table 4-4, these are categorised as:

- high-reliability: legally recognised, secure entitlements to a defined share of water; full allocations are expected in most years
- low-reliability: legally recognised, secure entitlements to a defined share of water; full allocations are expected only in some years
- provisional: these entitlements provide access to water based on specific conditions in the related bulk or environmental entitlement
- unregulated: an entitlement linked to flow conditions in the river rather than volumes of water in a storage; these entitlements permit diversion of in-river flows above a certain height or rate, or flows that are in excess of what can be captured in storage
- share of inflows: specified as a share of inflows into water storages that can be released to meet particular environmental needs

Table 4-4 Environmental water availability and use, 2018–19 (ML)

Entitlement type / reliability	Entitlement volume at 1 July 2018	Net carryover at July 2018 (a)	Seasonal allocation / Share of inflows (b)	Carryover / Allocation lost to spill (c)	Return flows [1] (d)	Total available (pre trade) (e) = (a)+(b)+(c)+(d)	Net trade in [2] (f)	Volume used (g)	Unused water at 30 June 2019 [3] (h) = (e)+(f)+(g)
Northern systems									
Murray [4]									
High	500,925	467,321	513,685	0	363,713	1,344,719	-552,638	162,822	629,258
Low	152,210								
Provisional	75,024								
Unregulated	83,300								
Ovens									
High	123	0	123	0	0	123	39	162	0
Broken									
High	624	72	198	0	0	270	248	250	267
Low	23								
Goulburn									
High	464,389	95,994	402,952	0	9,665	508,612	-52,335	254,887	201,389
Low	231,247								
Campaspe									
High	27,372	9,148	27,402	0	0	36,550	0	23,356	13,194
Low	8,409								
Passing flows	30								
Loddon									
High	7,306	3,634	18,481	0	0	22,115	3,558	16,108	9,566
Low	2,551								
Provisional	7,590								
Passing flows	0								
Total northern systems		**576,170**	**962,840**	**0**	**373,378**	**1,912,389**	**-601,129**	**457,585**	**853,674**
Western systems									
Wimmera & Glenelg									
High	40,560	43,871	25,434	0	0	69,305	0	32,978	36,328
Provisional	1,000								

Passing flows	0								
Supply by agreement	28,000								
Total western systems		**43,871**	**25,434**	**0**	**0**	**69,305**	**0**	**32,978**	**36,328**
Central systems									
Tarago									
Share of inflows	10.3%	1,453	1,281	0	0	2,734	0	1,210	1,524
Yarra									
High	17,000	12,655	17,000	0	0	29,655	0	16,518	13,137
Werribee									
Share of inflows	10%	775	317	-96	242	1,237	281	793	725
Maribyrnong [6]									
n/a	n/a	0	0	0	0	0	300	180	120
Moorabool									
Share of inflows	11.9%	2,662	124	0	0	2,786	500	2,000	1,286
Barwon									
Share of inflows	3.8%	1,000	752	0	0	1,752	0	1,020	732
Unregulated	n/a								
Total central systems		**18,545**	**19,474**	**-96**	**242**	**38,164**	**1,081**	**21,721**	**17,524**
Gippsland systems									
Latrobe									
Unregulated	n/a	11,670	3,092	0	0	14,762	0	5,502	9,260
Share of inflows	9.45%								
Thomson									
High + share of inflows	22,461	16,337	31,806	0	0	48,143	0	27,823	20,320
Low	6,230								
Total Gippsland systems		**28,007**	**34,899**	**0**	**0**	**62,905**	**0**	**33,325**	**29,580**
Total		**666,593**	**1,042,647**	**-96**	**373,620**	**2,082,763**	**-600,048**	**545,609**	**937,106**

Notes

(1) '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.
(2) 'Net trade in' means the net trade to all environmental water holders into the river basin.
(3) 'Unused water' is all remaining volume at 30 June 2019. It includes water that will be carried over into 2019–20, water that was lost to evaporation or water written off where no carryover provisions exist.
(4) The Barmah-Millewa Forest Environmental Water Allocation is included in the Murray basin.
(5) Entitlement volume and allocation in the Goulburn basin was incorrectly reported in 2017–18: the volume reported did not include water shares held by the CEWH.
(6) There are no environmental entitlements in the Maribyrnong basin, but in partnership with Melbourne Water the VEWH purchased 300 ML from entitlement holders in the system.
n/a Not applicable.

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 Mountains 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, New South Wales 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 to recover water from the Murray, Goulburn and Loddon systems by 2012. This resulted in the creation of water 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 for environmental benefit. These transfers reduce the amount of water Snowy Hydro Limited is required to release from the Snowy Scheme to the Murray in the following year. In accordance with intergovernmental agreements, two-thirds of the withheld water is released to the Snowy River for environmental benefit, and the remaining third provides flows for the environment in the Murray River.

In January 2018, the VEWH transferred a total of 81,165 ML allocation to the Snowy Scheme. This is similar to the volume made available in the previous year (83,813 ML) reflecting similar Victorian allocations in both years. Including contributions from New South Wales, a total of 165,257 ML was transferred to the Snowy Scheme in

2018–19 (Table 4-5). Of this volume, 110,171 ML was assigned for release to the Snowy River and 55,086 ML to the Murray River.

Table 4-5 Water available under Snowy Water Initiative 2018–19 (ML) (1)

Entitlement source	Entitlement volume (ML)	Allocation in 2018–19 (ML)	Allocation in 2017–18 (ML)
Victoria (2)	115,939	81,165	83,813
New South Wales (3)	192,219	84,092	111,455
Total	**308,158**	**165,257**	**195,268**
Volume apportioned to Snowy River Increased Flows		*110,171*	*130,178*
Volume apportioned to Murray River Increased Flows		*55,086*	*65,089*

Notes
(1) The information about the Snowy River entitlements was sourced from the New South Wales Department of Industry.
(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.

In 2018–19, water allocation recovered under the Snowy Water Initiative was released for environmental benefit in both the Snowy and Murray rivers. A total 129,400 ML of Snowy River Increased Flows was released to the Snowy River from Jindabyne Dam, in addition to the 8,500 ML base passing flow and 500 ML riparian flow released from Mowamba Weir. No River Murray Increased Flows (RMIF) was released from the Snowy Scheme to the Murray system.

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 passing flows: these are flows that an irrigator or a water corporation must pass at its weir or reservoir before it can take water for other uses. Other obligations on entitlements are documented in statutory and local management plans.

4.2.1 Passing flows on bulk entitlements

Most consumptive bulk entitlements include obligations expressed as ‘passing flow requirements’. Passing flow requirements are specified as obligations in bulk entitlements and environmental entitlements, and the holders of these entitlements must report on their compliance with the requirements. Passing flows provide benefit to the environment and other purposes, including delivery entitlements and water for domestic and stock use.

No major breach of passing flows compliance was reported in 2018–19. However, four minor failures to meet passing flows requirements occurred, as reported below.

Goulburn-Murray Water was unable to meet passing flow requirements twice in 2018–19. First, due to maintenance works at Lake Eppalock, the flows were less than the minimum required flows for four days in August in the Campaspe system. Minimum passing flows not provided were credited to the passing flow account for later use. Second, in July and August 2018, downstream of Back Creek Junction, there were ten days of non-compliance due to maintenance works at Lake Nillahacootie in the Broken system. In August, due to a combination of fluctuating inflows and subsequent provision of hydrographic data, the provided flows were less than required for three days by less than 5 ML/d and for four days by less than 1 ML/d.

South Gippsland Water was unable to meet passing flow requirements once. For the *Devon North, Alberton, Yarram & Port Albert Bulk Entitlement*, there were difficulties meeting passing flow requirements due to changing operational functions required to meet the drought conditions experienced in the area. River flows in the Tarra River were very low during summer and autumn of 2018–19, and they continued to be lower than average in winter 2019. Remedial actions included reassessing and readjusting operational management of diversions from the offtake on the Tarra River at the diversion point, and additional water was also taken from groundwater licence BEE051808 and stored in the Devon North Raw Water Basin.

Western Water was not fully compliant with one bulk entitlement during 2018–19. Passing flow requirements on Willimigongon Creek require manual operation and are difficult to meet under most conditions, due to large variations in daily flows. As a result, shortfalls to the daily passing flows occurred during 2018–19 with an 0.8% shortfall in passing flow volumes. To supplement the manual process, telemetry was introduced in 2017–18 to further improve compliance with passing flow requirements.

4.2.2 Management plans

Obligations on consumptive entitlements are outlined in statutory and local management plans in unregulated river systems.

Statutory management plans follow a legislated process to determine how water in a waterway or groundwater system will be shared between consumptive uses and the environment in unregulated systems. These plans are developed with the community, water users and other stakeholders and include rules to meet management objectives in the area.

Local management plans are developed by water corporations for unregulated systems. These plans explain to licensees and the broader community the specific management arrangements for the water resource from which they extract water 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 plans typically apply in areas where there are no statutory management plans. For groundwater, local management plans are prepared through groundwater catchment statements.

In unregulated river systems, statutory management plans are documented as streamflow management plans. Streamflow management plans will include flow thresholds at which rosters, restrictions and bans are placed 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 they are allowed to take (for example, 75% of licensed volume). When water is particularly scarce, bans on diversions from waterways are imposed. March 2018 saw the highest number of streams — 162 — on restrictions and bans in 2018–19, compared to 130 the previous year. See chapter 2.5.3 for more information.

In 2018–19, there were eight streamflow management plans (SFMPs) in place in Victoria (Table 4-6). Seven SFMPs were in place in the Yarra basin. There was also a management plan for the upper Ovens River in the Ovens basin. The *Upper Ovens River WSPA Water Management Plan* provides for integrated management of surface water and groundwater. It is the only integrated management plan developed in Victoria so far.

Table 4-6 Status of streamflow management plans

Basin	Stream(s)	Status	Responsible authority
Ovens	Upper Ovens River (above Myrtleford)	Integrated surface water and groundwater management plan approved and operational. A review was completed in 2017–18.	Goulburn-Murray Water
Yarra	Hoddles Creek, Plenty River, Pauls / Steels / Dixons creeks, Stringybark Creek, Woori Yallock Creek and Little Yarra and Don rivers	Streamflow management plans approved and operational	Melbourne Water
	Olinda Creek	The Olinda Creek streamflow management plan was amended in May 2018.	

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 in the Yarra basin, 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 WSPA Water Management Plan*, and information about compliance is reported in the Upper Ovens River WSPA annual report available on the Goulburn-Murray Water website.

Water for the environment is not restricted to surface water and can include groundwater. An amendment in 2005 to the *Water Act 1989* established the environmental water reserve, to sustain the long-term health of our rivers and groundwater systems. Water for the environment can include water above the permissible consumptive volume and rules that restrict groundwater extraction when aquifer levels reach specified triggers, to protect the environment.

Groundwater is managed through a range of actions to ensure sustainable and equitable sharing of the resource. Statutory and local management plans outline the obligations for consumptive groundwater users including restrictions and rosters. In 2018–19, three GMUs were subject to restrictions. See chapter 2.5.4 for more information.

In 2018–19, statutory management plans were in place in seven groundwater WSPAs (Table 4-7).

Table 4-7 Status of statutory management plans in groundwater catchments in 2018–19

Groundwater catchment	Water supply protection area	Status	Responsible authority
Goulburn–Broken	Katunga	Amended in June 2017	Goulburn-Murray Water
Loddon	Loddon Highlands	Approved in November 2012	Goulburn-Murray Water
Campaspe	Lower Campaspe Valley	Approved in October 2012	Goulburn-Murray Water
Ovens	Upper Ovens	Approved in January 2012	Goulburn-Murray Water
Westernport	Koo Wee Rup	Approved August 2010	Southern Rural Water
Hopkins-Corangamite	Warrion	Approved August 2010	Southern Rural Water
Seaspray	Yarram	Approved October 2010	Southern Rural Water

Compliance with each approved statutory management plan is reported annually by the relevant water corporation to the Minister for Water. The relevant water corporation also publishes local and statutory management plans on their websites. Authorities with plans currently in place are:

- Goulburn-Murray Water:
  - https://www.g-mwater.com.au/water-resources/surface-water/unregulated-local-management-rules
  - https://www.g-mwater.com.au/water-resources/ground-water/management/upperovenswspa
- Southern Rural Water:
  - http://www.srw.com.au/ via > Publications > Rivers and Creeks Management Rules and Plans
  - http://www.srw.com.au/ via > Publications > Groundwater management rules and plans
- Grampians Wimmera Mallee Water: https://www.gwmwater.org.au/about-us/annual-reports
- Melbourne Water: https://www.melbournewater.com.au/water/waterway-diversions/stream-flow-management.

4.3 Above cap water

Above cap water is the volume of water available above the volume allocated to water entitlements and provided as passing flows. 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 to the volume flowing out of Victoria for the last 16 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, 2003–04 to 2018–19

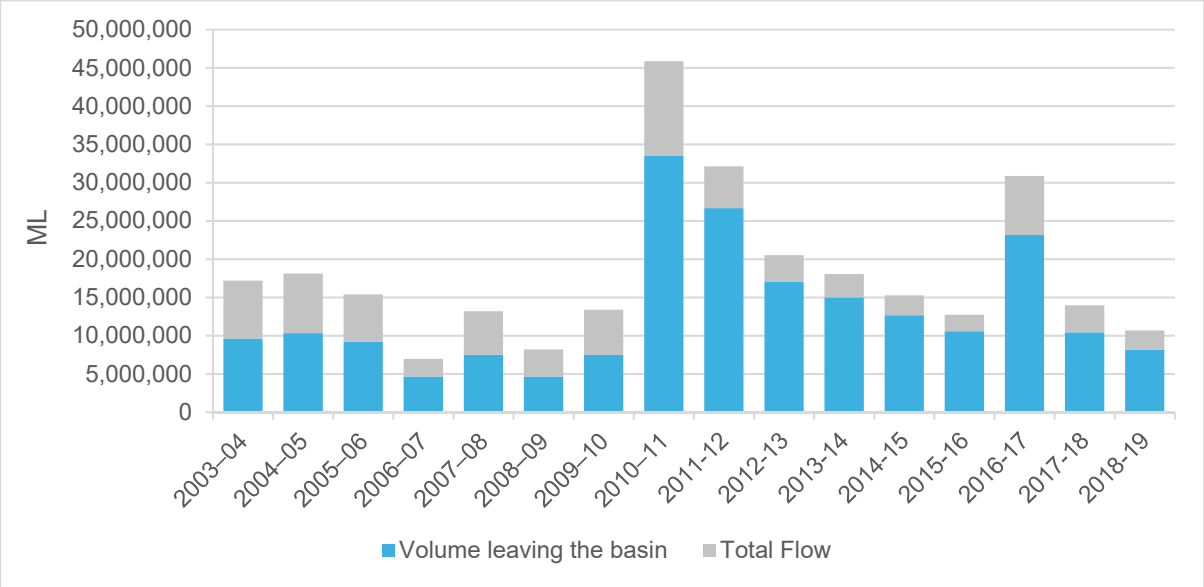


Table 4-8 shows the above cap water for each basin by reporting the total amount of water in each basin together with the amount of water that leaves the basin after water is extracted for consumptive use. The above cap water is expressed as a proportion of the annual flows of water that could have left the basin if there were no diversions. The reduced rainfall and streamflows experienced across much of the state in 2018–19 meant that the above cap water as a total volume of water leaving Victoria's river basins was lower than the previous year (8,150,558 ML, compared to 10,431,511 ML in 2017–18). As a percentage of total inflow volume, the water reaching the basin outlets was slightly higher than the previous year, with 78% reaching the basin outlets in 2018–19 (Table 4-8).

In 2018–19, the proportion of total flows leaving the basin increased in seven of the basins and decreased in 21, compared to 2017–18 (Table 4-8). The basins that experienced the lowest proportions of water leaving the basin as a percentage of total flows in 2018–19 were the Avoca (0%), Thomson (28%), Wimmera (35%), Moorabool (42%), Loddon (46%) and Werribee (50%) basins. The proportion of annual flows leaving the basin was 90% or above in 14 basins, predominantly in the south of the state: this was one more than in 2017–18. Although the Yarra and Snowy basins recorded the highest proportion of total flows leaving the basin in 2018–19, the volumes for both basins were lower than in the previous year.

Table 4-8 Volume leaving Victorian river basins, 2018–19

Basin	Outflow to	2018–19			2017–18		
		Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)	Total flow if no diversions (ML)	Volume leaving the basin (ML)	Proportion of total flow leaving the basin (%)
Murray [1]	South Australia	2,737,418	1,687,357	62%	3,807,603	2,065,155	54%
Kiewa [2]	Murray River	457,330	416,230	91%	555,611	511,744	92%
Ovens	Murray River	702,562	647,260	92%	1,004,509	954,533	95%
Broken	Murray River	32,924	21,287	65%	100,463	78,736	78%
Goulburn	Murray River	1,444,085	819,017	57%	1,842,064	930,014	50%
Campaspe	Murray River	51,918	48,886	94%	39,477	94,395	239%
Loddon	Murray River	58,090	26,988	46%	71,767	34,107	48%
East Gippsland	Bass Strait	182,905	182,294	100%	152,362	151,596	99%
Snowy (Vic. only) [3]	Bass Strait	388,996	548,373	141%	509,899	754,931	148%
Tambo	Gippsland Lakes	43,687	41,048	94%	52,882	50,229	95%
Mitchell	Gippsland Lakes	385,870	366,060	95%	417,895	396,799	95%
Thomson	Gippsland Lakes	451,419	128,377	28%	546,194	193,893	35%
Latrobe	Gippsland Lakes	387,496	308,503	80%	487,699	401,559	82%
South Gippsland	Bass Strait, Western Port	528,478	502,238	95%	693,510	662,949	96%
Bunyip	Bass Strait, Western Port, Port Phillip Bay	489,980	454,534	93%	478,488	435,726	91%
Yarra [4]	Port Phillip Bay	490,538	298,736	61%	599,427	346,945	58%
Maribyrnong	Port Phillip Bay	26,319	18,847	72%	23,944	19,455	81%
Werribee	Port Phillip Bay	46,148	23,101	50%	16,847	9,263	55%
Moorabool	Port Phillip Bay	37,362	15,623	42%	48,573	8,279	17%
Barwon	Port Phillip Bay, Bass Strait	97,286	67,833	70%	145,446	108,953	75%
Corangamite [4]	Corangamite Lakes	111,426	110,132	99%	282,555	281,102	99%
Otway Coast	Bass Strait	816,710	790,420	97%	843,521	816,839	97%
Hopkins	Bass Strait	135,766	127,219	94%	239,748	230,430	96%
Portland Coast	Bass Strait	202,080	200,063	99%	344,469	341,673	99%
Glenelg	Bass Strait	347,250	291,592	84%	617,198	526,162	85%
Millicent Coast [5]	South Australia	-	-	-	-	-	-
Wimmera [4]	Lakes Hindmarsh and Albacutya	24,306	8,538	35%	32,478	26,044	80%
Mallee [5]	Murray River	-	-	-	-	-	-
Avoca [6]	Lake Bael Bael and the Marshes	3,397	2	0%	3,366	0	0%
Total		**10,681,744**	**8,150,558**	**76%**	**13,957,993**	**10,431,511**	**75%**

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 New South Wales 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 New South Wales 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 is used as a tool 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 2018–19 water year, the volume of water traded and the movement of the water traded.

Further information about water-trading in Victoria is provided in the *Victorian Water Trading 2018–19 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 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 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 2.5.2 for information about allocations in 2018–19.

The allocation made against a water entitlement may be traded separately from the water entitlement and from the land title. Allocation trade can occur either 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 within, 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 there is a change in the named holder of the water share; this could occur for the new owner to have the right to be issued allocation)
- an association or variation of the water share (when an existing owner wishes to vary the allocation account that the water share is linked or the works that are associated with the water share).

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 to 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. Such transfers usually 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 2018–19

5.2.1 Allocation trade

A total of 2,845,523 ML of allocation was traded in Victoria in 2018–19, a decrease on 2017–18 when 3,335,696 ML was traded. Most of this occurred in northern Victoria (2,813,414 ML), with small volumes in southern Victoria (30,454 ML) and western Victoria (1,655 ML).

The volume of and long-term growth in allocation trade in northern Victoria shows an increasing reliance on the trade to meet water requirements and to manage accounts for commercial purposes and the environment. Generally, there has been an increasing trend in trade since 2007–08 (Figure 5-1). The volume of trade decreased this year, likely due to the reduced availability of allocation from New South Wales and the reduction in available water in Victoria over the past four years.

During 2018–19, temperatures were hotter than average throughout the year and during the peak irrigation period from November 2018 to April 2019. There were also significant rainfall deficits for the year and during the peak irrigation period in the GMW and Lower Murray Water irrigation areas.

As in previous years, environmental trades made up a significant portion of the volume traded in 2018–19: there was 1,059,161 ML of within-environment allocation trade in northern Victoria (Table 5-1), which equates to 37% of the total volume traded. For information about the assumptions made to distinguish between environmental and consumptive trading, see the *Victorian Water Trading 2018–19 Annual Report* (search 'Trade reports Victorian water register').

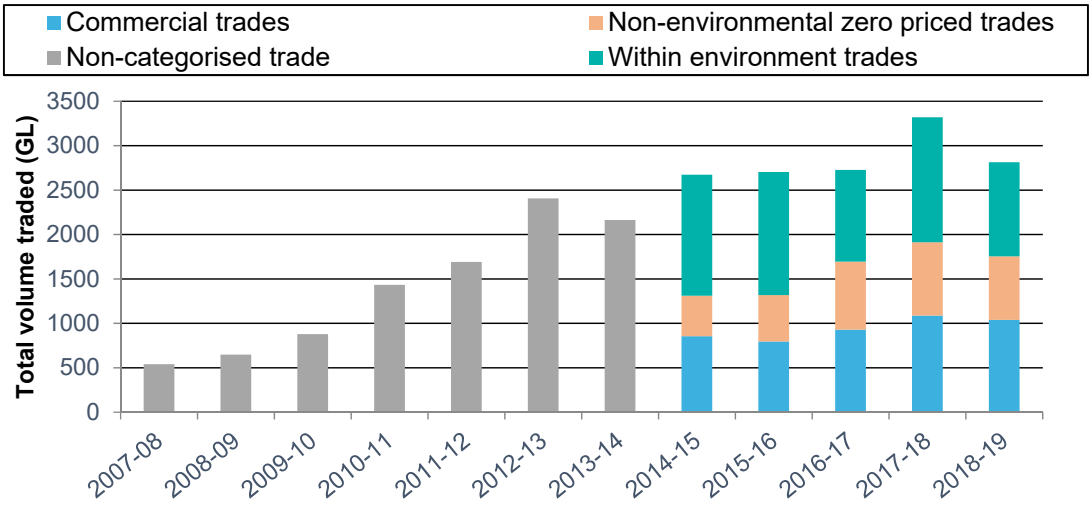
Table 5-1 Summary of trade of seasonal allocation trade in Victoria

Trade type	2018–19			
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
Northern Victoria				
Commercial trades	14,571	1,038,229	10,454	1,087,683
Zero-priced allocation trades	5,198	716,024	5,059	823,469
Within-environment trades	93	1,059,161	83	1,405,860
Northern Victoria subtotal	***19,862***	***2,813,414***	***15,596***	***3,317,012***
Southern Victoria				
Commercial trades	331	12,102	123	5,961
Non-commercial trades	401	18,352	235	12,275
Southern Victoria subtotal	***732***	***30,454***	***358***	***18,236***
Western Victoria				
Commercial trades	8	1,655	3	448
Western Victoria subtotal	***8***	***1,655***	***3***	***448***
Total	**20,602**	**2,845,523**	**15,957**	**3,335,696**

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.

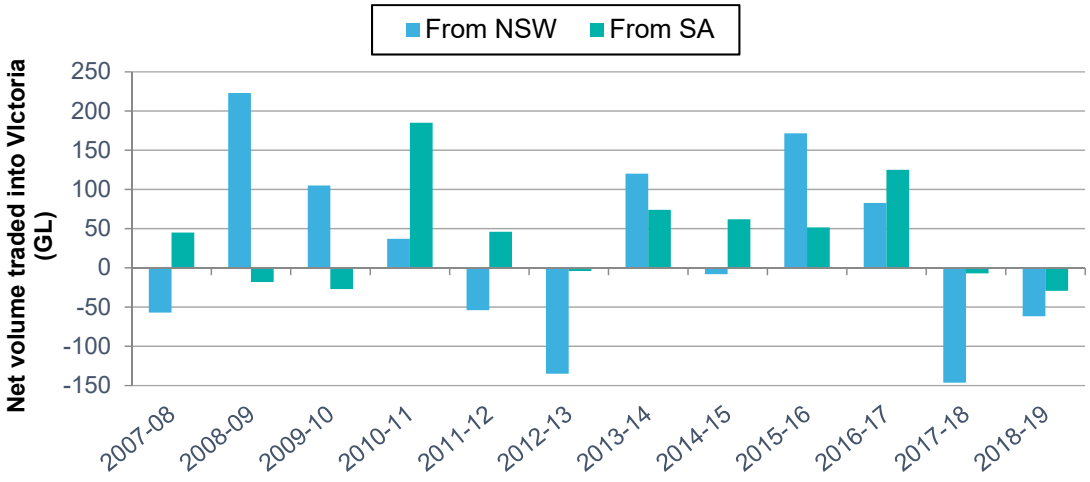
Commercial trades, where allocation is sold for a specified price, represented 1,038,229 ML of the total volume of allocation water traded in northern Victoria. Zero-priced trades, where water is traded from one account to another without payment, represented about 25% of the total volume traded (Figure 5-1). These trades may include trades between accounts owned by the same person, between related parties as part of an entitlement transfer, a contractual lease or carryover parking.

Figure 5-1 Volume of allocation trade in northern Victoria, 2018–17



Water trade between Victoria, New South Wales and South Australia is permitted, subject to trading rules. Excluding trade within environmental accounts, there was a total of 123,490 ML traded into Victoria (67,571 ML commercially) in 2018–19 and 214,487 ML traded out of Victoria (114,33 ML commercially), resulting in an overall net trade out of Victoria of 90,996 ML (Figure 5-2).

Figure 5-2 Net volume of allocation trade into Victoria from New South Wales and South Australia (excluding within-environment trade), 2018–19



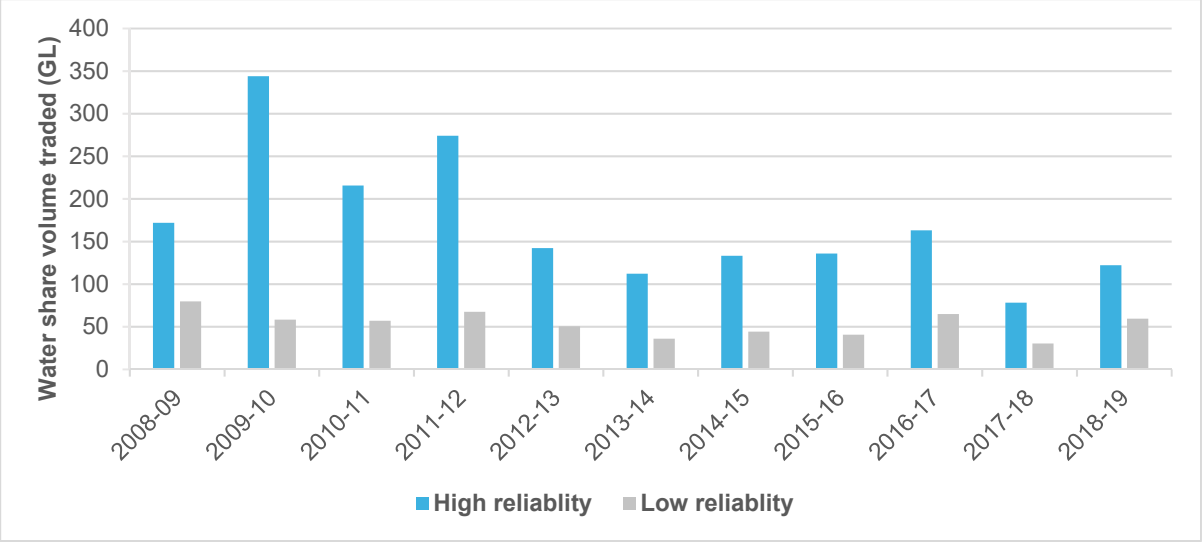
5.2.2 Water share transfers

Water share trade across Victoria in 2018–19 included 122,131 ML of high-reliability and 59,497 ML 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	2018–19		2017–18	
	Number of trades	Volume (ML)	Number of trades	Volume (ML)
High-reliability				
Northern Victoria	2,349	112,381	1,882	69,469
Southern Victoria	174	9,750	119	8,800
High-reliability total	**2,523**	**122,131**	**2,001**	**78,269**
Low-reliability				
Northern Victoria	748	54,737	530	26,103
Southern Victoria	134	4,764	92	4,290
Low-reliability total	**882**	**59,501**	**622**	**30,393**

Figure 5-3 Transfer of ownership of water shares in Victoria, 2018–19



5.2.3 Unregulated surface water

Surface water take and use licence trading during 2018–19 resulted in 2,920 ML of water permanently traded and 10,077 ML 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 2,575 ML of permanent trade and 7,851 ML of temporary trade. Significantly 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.

Table 5-3 shows trade of surface water take and use licences, which was much lower than trade in groundwater take and use licences. Although trade as part of land transfer (take and use licence change of ownership) is the most-common type of trade, the volume of temporary trades increased significantly from the year before.

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

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	73	2,226	71	345	208	3,982
South	174	7,851	47	2,575	221	6,377
West	-	-	-	-	5	259
Total 2018–19	**247**	**10,077**	**118**	**2,920**	**434**	**10,618**
Total 2017–18	168	5,472	117	1,737	411	11,858

5.2.4 Groundwater

Table 5-4 shows that the volume of temporary and permanent groundwater take and use licence trading was higher in 2018–19 than in the previous year, with 36,907 ML of temporary trade (compared to 18,206 ML in 2016–17) and 7,825 ML of permanent trade (compared to 5,278 ML in 2017–18). The volume of trades as part of a land transfer also increased markedly, from 39,837 ML in 2017–18 to 64,450 ML in 2018–19.

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

Region	Temporary trade		Permanent trade		Trade as part of land transfer	
	Number	Volume (ML)	Number	Volume (ML)	Number	Volume (ML)
North	154	20,180	36	4,250	180	46,701
South	193	13,708	47	2,887	184	12,257
West	27	3,019	6	688	7	5,492
Total 2018–19	**374**	**36,907**	**89**	**7,825**	**371**	**64,450**
Total 2017–18	187	18,206	91	5,278	304	39,837

Part 2: Water accounts 2018–19

Part 2 of the *Victorian Water Accounts 2018–19* presents an account of surface water, groundwater and distribution systems in Victoria for 2018–19.

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.

In previous accounts, chapter 8 has provided the accounts for all of Victoria's rural and urban distribution systems, tracking 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. While chapters 6 and 7 describe the entitlements and use of water taken from river basins and groundwater catchments, chapter 8 described the movement of this water through the constructed distribution systems that deliver water to users.

Chapter 8 has been removed from the accounts, from this year onwards. The online Water Accounts will replace this chapter in a more user-friendly way, providing users with detailed information about the town or water corporation of interest to them via an interactive map. Visit the online Water Accounts and search for your town by going to https://accounts.water.vic.gov.au.

6. River basin accounts

6.1 Methodology

6.1.1 Introduction

This chapter outlines the basis for the information presented in the river basin 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 river basin accounts are compiled from information obtained from:

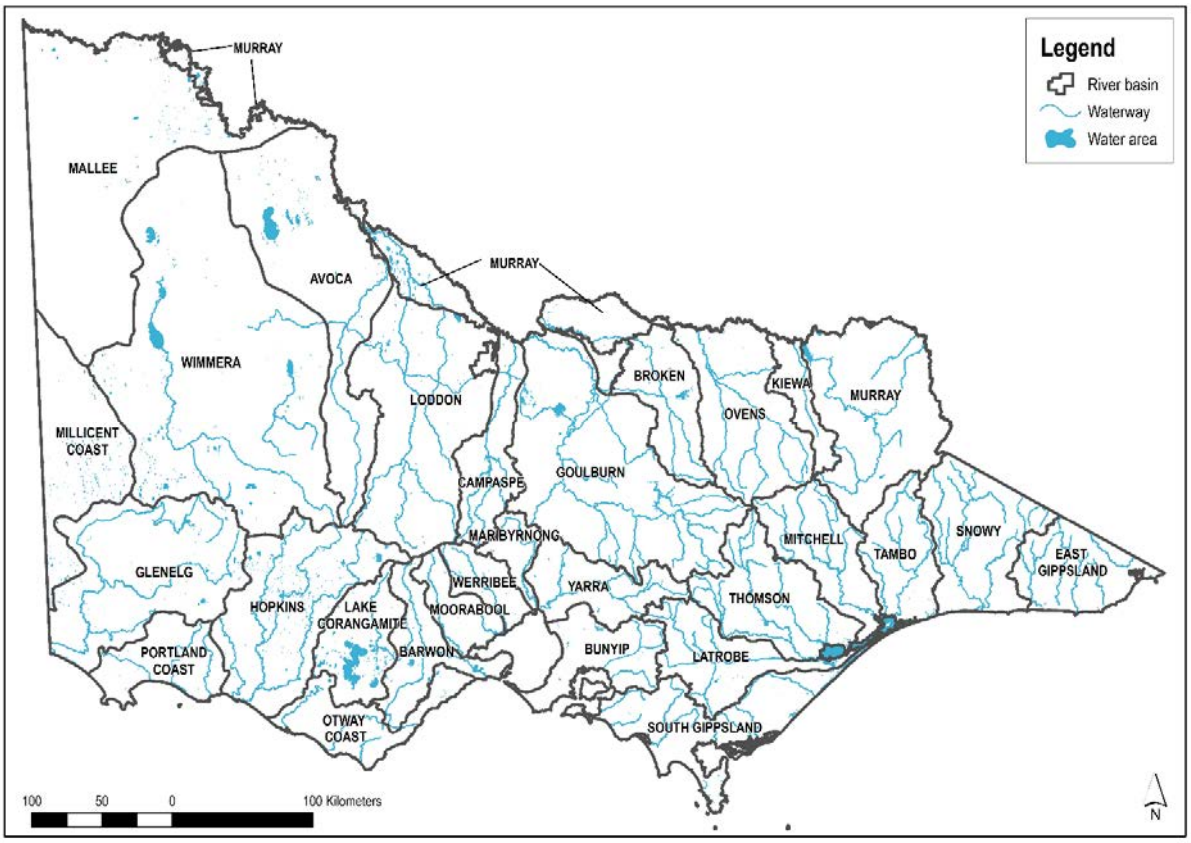
- responses to requests for data from water corporations, the VEWH, DELWP, major users of water and the MDBA
- water consumption and recycled water data collected from water corporations by the Essential Services Commission
- hydrologic information from selected streamflow monitoring sites
- climate information from selected rainfall and evaporation monitoring sites provided by the 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 river basins is provided for the period 1 July 2018 to 30 June 2019. River basin boundaries are shown in Figure 6-1. Responsibilities for water management are reported in the accounts as they were in 2018–19. Any changes to responsibilities since the end of June 2019 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.

Figure 6-1 River basin boundaries



6.1.2 Continuous improvement of the Victorian Water Accounts

The basin-scale water availability and use reported in this chapter is based on a water balance of inflows, changes to volumes held in storage, consumptive use, losses and outflows. Outflows from each basin are calculated using streamflow gauges near catchment outlets, or they are estimated using streamflow records from higher in the catchment or in neighbouring catchments. For all basins except the Murray, inflows are back-calculated as the balancing term in the accounts (see chapter 6.1.6.2). These inflows are then compared to long-term average (LTA) estimates of inflow.

Two reviews have been completed to ensure the most accurate outflow data and LTA estimates were used for the 2018–19 accounts, reviews of:

- the data and method used to calculate the volume of water leaving the basin
- estimates of long-term water availability (see chapter 2.2).

6.1.2.1 Review of data and method used to calculate basin outlet outflows

'Water passed at outlet of basin' represents the total volume of flows that leaves the end of the basin (see chapter 6.1.6.3). The volume is estimated by using gauged streamflow data at a point as close to the basin outlet as possible, and by then extrapolating the gauged data to the ungauged basin area. The calculation methods and streamflow data were reviewed by consultants in late 2019, to ensure the best-available data and methods were being used to calculate outflows.

Changes to the gauged streamflow data and calculation method were recommended and implemented in 14 basins, providing a higher level of certainty in the outflow calculation. As a result:

- the Corangamite basin had the largest percentage decrease in outflow volume, because two unsuitable gauges were being used, overestimating the volume
- the Werribee basin had the largest percentage increase in outflow volume
- outflows increased in the Ovens, East Gippsland, Bunyip, Yarra and Maribyrnong basins when new, more-suitable gauge/s were either introduced or substituted for previous ones and included in the calculation
- the volume of outflows also increased in the East Gippsland, Snowy, Tambo and Mitchell basins because estimates of outflows from small coastal streams were also included in the calculation method
- outflows decreased in the Moorabool, Barwon, Otway and Glenelg basins because existing calculations were either corrected to better reflect ungauged flows (for example, in the Moorabool basin) or new, more-suitable gauge/s were either introduced or substituted for previous ones and included in the calculation.

The Water Balance part — part 3 — of each basin's accounts details the changes for 2018–19 for each of the 14 basins where outflow calculation methods and/or data have been altered.

6.1.2.2 Review of estimates of long-term water availability

As part of the *Long-term Water Resource Assessment for Southern Victoria* (explained in chapter 2.2), a technical assessment was undertaken in 2019 to identify changes in surface water availability. The technical assessment refined the original estimates of long-term water availability — also known as long-term average inflows — using improved data and methods and a period that better represents the current climate (based on data from 1975 to the present).

In the 2017–18 accounts, the LTWRA's estimates of LTA inflows could not be applied to all basins. The gauges used in the Bunyip, Corangamite, Glenelg, Otway Coast and South Gippsland basins to determine the new LTA inflows were different to those used to calculate the total inflows. Further work has been completed for the 2018–19 accounts to update the LTA inflow estimates, so they come from one consistent data source.

Changes were made to all LTA inflow estimates except those for the Mallee and Millicent Coast basins. The changes can be attributed to a combination of:

- adopting the LTWRA estimates of LTA inflows as a common baseline
- using estimates of inflows for post-1975 conditions, rather than inflow estimates for the full historical record
- adjusting the LTWRA estimate to allow for impacts of small catchment dams accounted for in the accounts but not in the LTWRA
- adding additional ungauged areas to the accounts' estimates of outflow, and hence water balance, for the East Gippsland, Mitchell, Moorabool, Snowy and Tambo basins.

The Water Balance part — part 3 — of each basin's accounts detail adjustments to the LTA inflow estimates, and more information is available in Appendix E.

6.1.3 Surface water resources

Chapter 6 provides information about surface water in 2018–19, with a subchapter for each of the 29 river basins. Each subchapter has a brief description and map of the basin then four parts: management arrangements, 2018–19 water resources overview, water balance and compliance against entitlements.

6.1.4 Management arrangements

This part details the relevant organisations in each basin and their management responsibilities.

6.1.5 2018–19 water resources overview

This part provides a snapshot of the water resource for 2018–19. It summarises:

- **rainfall received**: the percentage of rainfall received in each basin is estimated from the Bureau of Meteorology's rainfall map (Figure 2-3 in chapter 2.1), which determines the percentage of long-term average rainfall received in Victoria for 2018–19
- **catchment inflows and storage levels**: catchment inflows from the water balance are compared to the long-term average inflow (chapter 2.2) for each basin, along with the starting and ending storage volumes for the year. A chart is also presented that plots catchment inflows, long-term average inflows 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 ten years
- **seasonal allocations, restrictions and water use**: any seasonal allocation determinations (chapter 2.5.2), urban restrictions (chapter 2.5.1) or licensed diversion restrictions (chapter 2.5.3) that applied during 2018–19 are detailed here, along with a summary of consumptive uses from the water balance and water for the environment.

6.1.6 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). The water balance table is presented first with a notes column. Any notes are then described in detail below the water balance.

A surface water balance is presented for all 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 and outflows — are explained below.

6.1.6.1 Major on-stream storage

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 at the end of the year. In general, only on-stream storages with a total capacity of more than 1,000 ML are included in this component of the water balance. Storages of less than 1,000 ML are important locally, but they are generally not material to the total volume of water 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.

6.1.6.2 Inflows

Inflows are the volume of water flowing into waterways within a basin. The inflow components included in the water balance — catchment inflow, rainfall on major storages, transfers from other basins, return flow from irrigation and treated wastewater discharged back to river — are explained below.

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 the Ovens, Goulburn, Broken, Campaspe and Loddon basins into the Murray River. It also includes estimated inflows to small catchment dams in the Murray basin.

In addition to the above, the estimated volume harvested by small catchment dams in each basin makes up part of the catchment inflow volume in the water balance. It is determined by calculating the water balance around each individual dam, based on the annual climate including inflows, extractions, rainfall and evaporation. The total volume harvested is the difference between dam inflows and outflows. Aggregating volumes harvested by dams across each basin, this estimates how much water is harvested by small catchments over the course of a year.

Rainfall on major storages: this item represents inflows from rain falling directly on major on-stream storages. Estimates are based on rainfall data and the surface area of storages. Information about storages in each basin with storages is presented in the notes below the balance 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 into or out of the storage that are not shown as rainfall or evaporation, and it includes major and minor components influencing the change in storage during the year.

Transfers from other basins: transfers from other basins are included in a basin's water balance only if 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 flow from irrigation: return flow 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 item represents the volume of water discharged from wastewater treatment plants back into waterways as part of the water recycling process. 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 volume of wastewater produced (excluding evaporation)
- the total volume recycled
- the percent recycled: this includes 'within plant process', which refers to water reused in sewage treatment processes (for example, to back-flush filters). This value is included in the total percentage recycled, consistent with its treatment in the Essential Services Commission's performance report
- a breakdown into the following end-use categories:
    - the volume recycled for urban and industrial uses
    - the volume recycled for agricultural uses
    - the volume recycled for beneficial allocations, which refers to the volume used to deliver specific environmental flows benefits
    - the volume recycled within plant process, which refers to water reused in wastewater treatment processes (for example, to maintain biological processes or back-flush filters). This value is included in the total 'Percent recycled', consistent with its treatment in the Essential Services Commission's performance report
    - the volume discharged to the environment: that is, the volume returned back into the river system
    - the volume of other discharges, which could either refer to an ocean outfall, 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.

6.1.6.3 Outflows

This term represents water that has left a waterway, whether by natural processes (such as evaporation and seepage), by being diverted by water corporations and individuals or by being passed at the outlet of the basin. The outflow components included in the water balance — diversions, losses and water passed at outlet of basin— are explained below.

Diversions include water that is deliberately diverted from a waterway to meet a specific use and includes the following.

- **Urban diversions:** this item represents the total volume of water diverted from waterways by water corporations to supply urban customers.
- **Irrigation district diversions:** this item 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:** this item represents the volume of water diverted directly from waterways by licence holders. 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:** this item represents the transfer of water to another basin where it is either used or contributes to the in-stream flows 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. The volume extracted — the volume used in each basin — is calculated by multiplying the estimated capacity of each dam by an extraction factor and reducing this number as necessary if the dam had insufficient inflows to actually supply the volume required. In previous years, all volumes presented for small catchment dams were annual average figures. From this year onwards, the volumes presented are estimated based on the observed annual climate.
- **Losses:** this item represents 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. They include:

- **evaporation losses from major storages:** this item 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. This volume is determined directly from a water balance calculated for each individual dam
- **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-stream losses include infiltration to groundwater, overbank spills and evaporation. However, the natural processes giving rise to in-stream losses are difficult to measure directly. Consequently, in-stream losses are typically estimated as a proportion or function of gauged streamflow.

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.

There are ten basins that do not have water resource models suitable for calculating in-stream losses for use in the accounts: the East Gippsland, Snowy, Tambo, Latrobe, South Gippsland, Yarra, Corangamite, Otway Coast, Hopkins and Portland Coast basins. In the absence of water resource models, in-stream losses could be calculated using water balances. However, this would require streamflow data at the source and outlet of each major river. Although there are a reasonable number of gauged locations across the basins, their distribution means that deriving comprehensive estimates of in-stream losses is not possible. This does not mean there are no in-stream losses in these basins, rather that they cannot be estimated using currently available models, or as the balancing item in the water balances.

Table 6-1 Models used to derive in-stream losses for 2018–19

Basin(s)	Model(s)
Kiewa	Kiewa River REALM (1)
Ovens	Ovens River REALM
Broken, Goulburn, Campaspe, Loddon	Goulburn Simulation Model (covering the Goulburn, Broken, Campaspe and Loddon systems) Wandella Creek REALM (Loddon system only, downstream of Loddon Weir)
Avoca	Kerang Lakes REALM
Wimmera	Wimmera–Glenelg REALM (also referred to as Wimmera Mallee 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

Note
(1) REALM = REsource ALlocation Model.

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.

6.1.7 Compliance against entitlements

Compliance against water entitlements is reported in these accounts in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

One table in this part shows the entitlement volumes in the basin; the other shows the volume of available water in 2018–19 and the volume taken.

In accordance with the section 43 of the *Water Act 1989*, bulk entitlements may specify rules and obligations on its holder, including:

- rules about when, where and how much water can be taken
- rules about how the water can be used
- rules about the right to a share of storage capacity and a share of inflows
- obligations to release flows for environmental uses
- obligations to supply primary entitlement holders
- obligations to contribute to the payment of operation and maintenance costs
- obligations to meter water, maintain accounts and report.

Bulk entitlement holders report on compliance each year. Specific instances of non-compliance are reported in these accounts in the key compliance points box in each basin subchapter.

6.1.7.1 Entitlement issued

A table in each basin subchapter shows the volume of entitlements as at 30 June of each water year.

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 entitlement volume as at the end of the water year and represents 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.

Entitlements to water also include rights granted to individuals (for example, water shares and take and use licences). These are reported as a group of each entitlement types and show the total volume of licences issued per basin.

Unregulated take and use licence volumes have been reported differently in 2018–19. In previous years, the entitlement tables showed the volume of unregulated take and use licences for water taken from a waterway: this included licences for small catchment dams, where they on the waterway. This year, the different types of licences have been reported separately and include:

- take and use licences – unregulated surface water: this includes all licence volume that is considered to be for water taken from the waterway. It includes licences to take from a waterway to fill an off-water dam (dams for which no harvesting from the catchment is possible)
- licensed small catchment dams – on-waterway: this includes licensed small catchment dams that are on-waterway; they are considered to harvest water from the catchment as well as the waterway
- licensed small catchment dams – off-waterway: this includes licensed small catchment dams that are off-waterway; they harvest all water from the catchment and do not take any water from the catchment.

Note that the volume of usage, loss and water harvested for small catchment dams is an estimate based on a small catchment dam interception model. There is no real increase to entitlement volume in unregulated systems, only a change in which entitlements we report on.

6.1.7.2 Water taken

This part presents the available water and the water taken in the basin for 2018–19. The components – opening carryover, allocation issued, net trade in/out, total water available and water taken – are described below.

Opening carryover: this item represents any water carried over from 2017–18 that could be taken in 2018–19.

Allocation issued: this item represents the water allocation made available under the entitlement that was available for use and trade in the 2018–19 water year. Individuals or authorities that hold water entitlements in Victoria are allocated water according to the size of their entitlement and the available resource. For example, in 2018–19 entitlement holders with low-reliability water shares in the Thomson–Macalister system were allocated 35% of their entitlement. That is, for every 100 ML of low-reliability entitlement they owned, they were allocated 35 ML of water they could use or trade.

Water issued and used under take and use licences is also represented as allocation in the allocation account balance tables. This allocation issued represents the volume that was available under licences throughout the water year, and it can be different to the entitlement volume at the end of the water year. Where licences have been cancelled during the year, the allocation volume presented may be greater than the entitlement volume as at the end of the water year. The volumes may also be different as a result of temporary trading between systems. For example, temporary trade of licences can occur between unregulated and groundwater systems in the Ovens basin: this would affect the allocation volume issued to licences in the Ovens basin.

Net trade in/out: this item represents the volume of water that may have been traded in for use within the basin or traded out of the basin.

Total water available: This represents the volume of water that was available to be taken in 2018–19. This item is the sum of the first three components: opening carryover, allocation issued and the net of the in/out trade of water.

Water taken: this item represents the volume of water used during the year under the entitlement. 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 specified in the bulk entitlement.

6.1.8 Small catchment dams

Small catchment dams 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 (that is, 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 the Victorian Water Accounts before 2016–17, the total volume of water harvested by small catchment dams was estimated from computer-based simulation modelling of the impact of small catchment dams on mean annual streamflows, based on estimates of the total volume of small catchment dams in a basin.

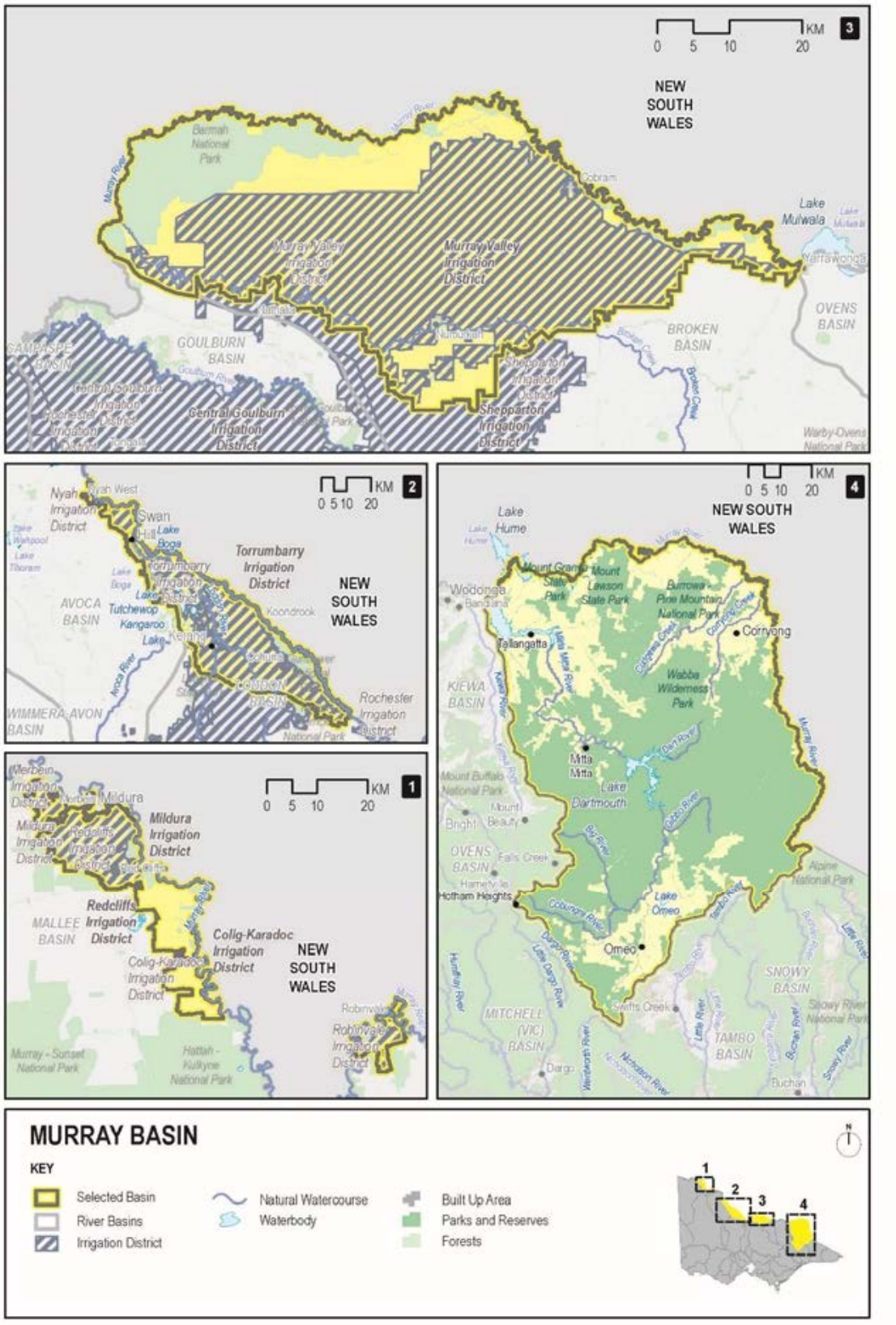
From 2017–18, the method used to estimate the usage, evaporation and harvested volumes from small catchment dams was improved. The key difference is that each dam identified in the GIS data has been individually modelled, to better reflect the water balance around the dam based on the climate for that year. Estimated small catchment dam impacts are represented in the basin water balances as three separate components. They are:

- the estimated volume harvested by small catchment dams in each basin, which appears as catchment inflow in the water balance
- the estimated volume that owners extract from dams to supply their needs, which is accounted for as a diversion in the surface water balance
- the estimated volume of evaporation (less rainfall) from the surface of small catchment dams, which is accounted for as a loss in the surface water balance.

6.2 Murray basin

The Murray River forms the border with New South Wales. Victoria shares the volume of water held in the major 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 6-2).

Figure 6-2 Map of the Murray basin (Victoria)



6.2.1 Management arrangements

Management of water in the Murray basin is undertaken by various parties as shown in Table 6-2.

The MDBA operates the Murray River on behalf of the Victorian, New South Wales and South Australian governments in accordance with the water-sharing arrangements set out in the Murray–Darling Basin Agreement. Under the 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 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 from Victoria's share of the water supply storages in the Murray basin to entitlement holders in the regulated Victorian Murray system.

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

Authority	Management responsibilities
Murray–Darling Basin Authority	• Operates the River Murray system and efficiently delivers water to users on behalf of all Murray River governments; coordinates waterway management along the Murray River and operates the Murray supply system • Oversees water resource management in accordance with the 2012 Murray–Darling Basin Plan
Department of Environment, Land, Water and Planning (Victoria)	• Coordinates Victoria's input to Murray River system operational and resource management decisions
WaterNSW	• Operates Lake Hume, Euston Weir and the Menindee Lakes system on behalf of the MDBA
South Australian Water Corporation	• Operates Lake Victoria and several locks on behalf of the MDBA
Goulburn-Murray Water	• Operates Lake Dartmouth, Yarrawonga Weir (Lake Mulwala), Torrumbarry Weir and Mildura Weir on behalf of the MDBA • Supplies Murray Valley, Torrumbarry, Woorinen, Tresco and Nyah irrigation areas • Manages private diversions on the Victorian side of the Murray upstream of Nyah
Lower Murray Water	• Supplies Red Cliffs, Robinvale, Merbein and the First Mildura irrigation districts • Manages private diversions on the Victorian side of the Murray downstream of Nyah • Supplies towns along the Murray River from Swan Hill to the South Australian border
North East Water	• Supplies towns upstream of Lake Mulwala
Goulburn Valley Water	• Supplies towns in the Murray Valley Irrigation Area
Coliban Water	• Supplies towns in the Torrumbarry Irrigation Area
East Gippsland Water	• Supplies Omeo and Dinner Plain
Grampians Wimmera Mallee Water	• Supplies domestic and stock water to towns and farms in the northern Mallee area
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west
Mallee Catchment Management Authority	• Responsible for waterway and catchment management 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	• Responsible for waterway and catchment management in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley
North Central Catchment Management Authority	• Responsible for waterway and catchment management 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.

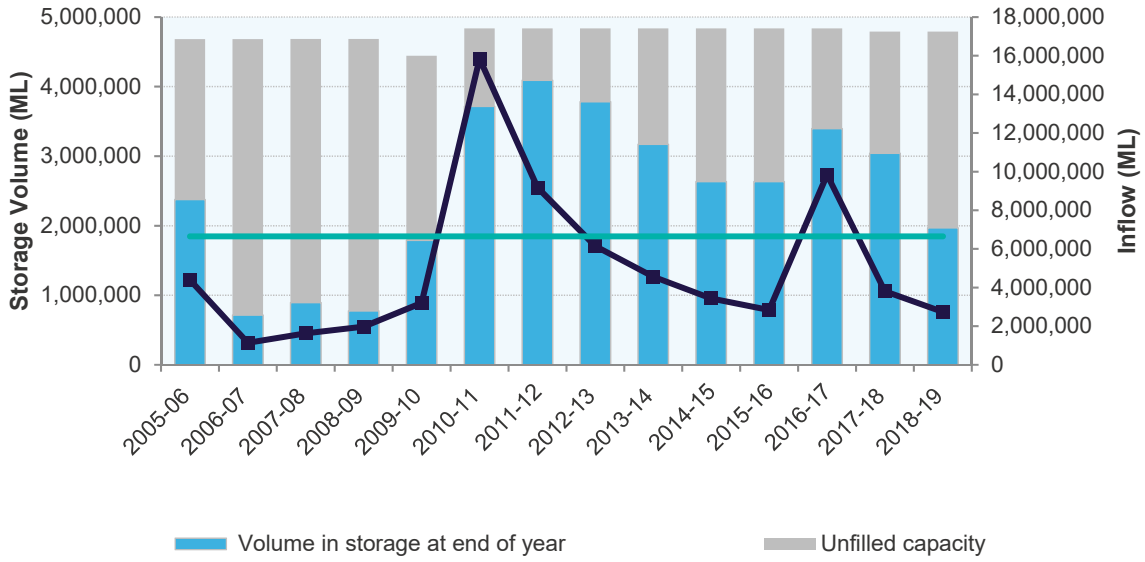
6.2.2 2018–19 water resources overview

In the Murray basin in 2018–19, rainfall was between 80% and 100% of the long-term average in most of the area upstream of Hume Dam, between 60 and 80% of the long-term average along the Hume Dam to Echuca reach and between 40% and 60% of the long-term average downstream of Echuca.

Catchment inflows to the Murray basin in 2018–19 were 41% of the long-term average (6,649,300 ML), lower than in 2017–18 when inflows were 57% of the long-term average. The long-term average presented has been revised from the previous Victorian Water Accounts, as chapter 6.1.2 explains.

The volume held in Victoria's share of the major Murray system storages started at 62% of capacity at the beginning of July and was at 40% of capacity at the end of June 2019. Victoria had no access to a share of Menindee Lakes during 2018–19 as storage levels did not get above the 480,000 ML trigger level specified in the Murray–Darling Basin Agreement. When storages levels are low, available water is reserved for New South Wales, to supply local needs.

Figure 6-3 Storage volumes and catchment inflows in the Murray basin (Victoria)



Seasonal allocations in the regulated Murray system began the year at 41% (on 2 July 2018), and they reached 100% by December 2018. There was no seasonal allocation for low-reliability water shares in 2018–19.

Two of the Murray basin's unregulated streams had total bans on licensed diversions in place in July 2018: Black Dog Creek (upper) and Indigo Creek. Total bans were in place on Black Dog Creek (upper) for the whole of 2018–19, and Indigo Creek was unrestricted from August to October 2018. As summer approached, bans were being placed on more streams, from three in November 2018 to a peak of 11 in March 2019. Most bans were lifted by May with only the Black Dog Creek (upper) and Indigo Creek still on restrictions at the end of June 2019.

There were no restrictions on urban water use in the Murray basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 1,619,928 ML of water was diverted for consumptive uses — town, domestic and stock, irrigation, commercial supply — and for diversions to wetlands for environmental purposes. This was less than the 1,794,381 ML diverted the previous year.

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. Except for the Kerang Wetlands, these are also The Living Murray Icon sites.

The Lindsay, Wallpolla and Mulcra islands (also The 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 2018–19, the Murray basin (Victoria) water for the environment comprised:

- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – Flora and Fauna component, comprising 45,267 ML of high-reliability, 8,523 ML of low-reliability and 49,000 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 Forest 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
- *Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999* – River Murray Increased Flows – comprising Victoria's share of water recovered under the Snowy Water Initiative released from the Snowy Scheme to the River Murray, held by the VEWH
- *Environmental Entitlement (River Murray – NVIRP Stage 1) 2012*, comprising 27,031 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, held by the VEWH
- 389,245 ML of high-reliability water shares and 41,837 ML low-reliability water shares held for the environment
- water set aside for minimum 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.

In addition, other water in the basin not allocated for consumptive use can provide environmental as well as social, recreational and cultural benefits.

A total of 660,316 ML of environmental water was used in the Murray basin in 2018–19: 62,499 ML of this was diverted off-stream, 100,321 ML was delivered and used on floodplains and in-stream and 497,496 ML was delivered to the South Australia border for further environmental outcomes downstream.

6.2.3 Water balance

The total volumes of water available and supplied from water resources in the Murray basin in 2018–19 are shown in Table 6-3.

Table 6-3 Water balance – Murray basin

Water account component	Notes	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	2,875,800	3,420,200
Volume in storage at end of year	1	1,842,700	2,875,800
Change in storage		**(1,033,100)**	**(544,400)**
Inflows			
Catchment inflow	2	2,737,418	3,807,603
Rainfall on major storages	1	71,000	112,000
Spills from New South Wales	3	0	2,700
Net trade from New South Wales	3	0	0
Water returned to the Murray River	4	283,976	306,439
Treated wastewater discharged back to river	5	3,642	3,711
Total inflows		**3,096,036**	**4,232,452**
Outflows			
Diversions			
Urban diversions		42,194	39,949
Irrigation district diversions		1,002,970	1,119,267
Licensed diversions from regulated streams		504,026	478,343
Licensed diversions from unregulated streams		3,461	1,290
Environmental water diversions		62,499	149,269
Small catchment dams	6	4,779	6,264
Total diversions		**1,619,928**	**1,794,381**
Losses			
Evaporation losses from major storages	1	179,100	319,800
Evaporation from small catchment dams	6	3,492	3,674
In-stream infiltration to groundwater, flows to floodplain and evaporation	7	639,259	593,842
Total losses		***821,851***	***917,316***
Water passed to other systems			
Murray River flows to South Australia from Victoria's allocation	8	1,567,850	1,615,000
Ceded to New South Wales	3	66,800	89,300
Spills to New South Wales	3	0	245,400
Net trade to New South Wales	3	52,707	115,455
Total water passed at outlet of basin		***1,687,357***	***2,065,155***
Total outflows		**4,129,136**	**4,776,852**

6.2.3.1 Notes to the water balance

This water balance for the Murray river system includes only the Victorian portion of the Murray resource.

The volumes presented in the water balance may not be consistent with the MDBA's cap compliance reporting, due to different accounting methods.

Some volumes presented in the 2017–18 comparison column have changed from the *Victorian Water Accounts 2017–18*. Details of these changes are noted in the notes below.

1. Storage

Major on-stream storages in the Murray basin are included in the water balance. Table 6-4 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

The volume reported as a closing balance for 2017-18 has been revised from the volume reported in the *Victorian Water Accounts 2017–18.* The adjusted volume is based on new information available from data providers.

Table 6-4 Storage volumes in the Murray 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 Dartmouth (Vic. share)	1,928,116	1,928,000	34,500	40,100	(520,200)	1,402,200
Lake Hume (Vic. share)	1,502,579	749,600	26,400	75,300	(409,200)	291,500
Lake Victoria (Vic. share)	338,500	198,200	10,100	63,700	4,400	149,000
Menindee Lakes (Vic. share) (1)	865,500	0	0	0	0	0
Sub-total	**4,634,695**	**2,875,800**	**71,000**	**179,100**	**(925,000)**	**1,842,700**
Off-stream storages						
Kangaroo Lake	39,200	31,280	2,097	11,251	11,114	33,240
Kow Swamp	51,710	36,485	5,333	29,142	27,542	40,218
Lake Boga	37,000	28,086	2,005	10,789	7,734	27,036
Lake Charm	22,000	20,223	1,081	5,839	4,801	20,266
Lake Cullulleraine	5,270	4,442	309	5,017	4,710	4,444
Sub-total	**155,180**	**120,516**	**10,826**	**62,039**	**55,901**	**125,204**
Total 2018–19	**4,789,875**	**2,996,316**	**81,826**	**241,139**	**(869,099)**	**1,967,904**
Total 2017–18	4,836,375	1,952,676	159,291	484,129	1,890,876	3,518,715

Notes

(1) Victoria's share of Menindee Lakes is reported as 865,500 ML to reflect the volume available when the lakes are at full supply level. However, when the volume in the lakes falls below 480,000 ML, Victoria loses all access to the lakes, and it does not regain access until the storage next reaches 640,000 ML.

2. Catchment inflow

Inflows are calculated based on estimates of inflows to major on-stream storages plus inflows from tributaries.

Catchment inflow is defined as:

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

3. Movements between Victoria and New South Wales

In accordance with the Murray–Darling Basin Agreement and state trading rules, water can move between Victoria and New South Wales shares of the River Murray system through ceding, internal spills and trade.

In 2018–19 Victoria ceded a total of 66,800 ML to New South Wales. This volume was all ceded in Hume Dam. There was no water ceded in Menindee Lakes in 2018–19.

Internal spills between Victoria and New South Wales occur when only one state's share of a storage is full and inflows are internally spilled, becoming resources for the state which has capacity to store them. There were no spills recorded in 2018–19.

In 2018–19, there was net trade from Victoria to New South Wales of 52,707 ML. This included trade between environmental water holders, as well as non-environment trade.

4. Return flows

Previously reported as return flow from irrigation, this item now includes water returned to the Murray River after environmental diversions. 18,902 ML was returned to the Murray River via Gunbower Creek, following environmental diversions to Gunbower Forest. 265,074 ML was returned to the Murray River from Torrumbarry and Murray Valley Irrigation districts at points specified in the River Murray – Goulburn-Murray Water bulk entitlement.

5. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-5 lists the wastewater treatment plants in the Murray basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-5 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bellbridge	11	11	100%	0	11	0	0	0	0
Bundalong	0	0	0%	0	0	0	0	0	0
Cobram	260	260	100%	0	260	0	0	0	0
Cohuna	0	0	0%	0	0	0	0	0	0
Corryong	98	98	100%	0	98	0	0	0	0
Dartmouth	10	0	0%	0	0	0	0	10	0
Gunbower / Leitchville	0	0	0%	0	0	0	0	0	0
Koondrook	71	0	0%	0	0	0	0	0	71
Koorlong	2,327	2,251	97%	0	2,251	0	0	0	76
Lake Boga	47	0	0%	0	0	0	0	0	47
Merbein	149	0	0%	0	0	0	0	0	149
Mildura	1,348	692	51%	0	692	0	0	0	656
Murrabit	6	0	0%	0	0	0	0	0	6
Nathalia	73	73	100%	0	73	0	0	0	0
Numurkah	108	108	100%	0	108	0	0	0	0
Nyah / Nyah West	76	0	0%	0	0	0	0	0	76
Omeo	23	23	100%	0	23	0	0	0	0
Robinvale	252	168	67%	0	168	0	0	0	84
Strathmerton	10	10	100%	0	10	0	0	0	0
Swan Hill	984	0	0%	0	0	0	0	0	984
Tallangatta	83	83	100%	0	83	0	0	0	0
Walwa	4	4	100%	0	4	0	0	0	0
Wodonga	4,005	373	6%	226	0	0	146	3,632	0
Yarrawonga	439	439	100%	0	439	0	0	0	0
Total 2018–19	**10,384**	**4,593**	**43%**	**226**	**4,220**	**0**	**146**	**3,642**	**2,149**
Total 2017–18	10,675	4,742	43%	155	4,483	0	105	3,711	2,222

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-6 provides information about small catchment dams in the basin.

Table 6-6 Estimated small catchment dam information for the Murray basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	12,142	3,242	3,019	6,261
Registered / licensed commercial and irrigation	4,123	1,537	473	2,010
Total 2018–19	**16,265**	**4,779**	**3,492**	**8,271**
Total 2017–18	16,265	6,264	3,674	9,938

7. In-stream losses

In-stream losses are the balancing item in this water balance. It is the difference between of the total inflows, the known outflows and the net change in storage volume. This volume may not be consistent with the MDBA's accounts due to different accounting methods and due to the MDBA's data only covering the regulated part of the River Murray.

The volume of in-stream loss reported for 2017–18 has been adjusted in line with the corrections to water passed at outlet of basin and the closing storage volumes for that year.

8. Water passed at outlet of basin

This includes the volume of water delivered to South Australia via the Murray River and Lindsay River, including 497,496 ML of water delivered under Victorian entitlements held for the environment.

This volume was incorrectly reported as 2,032,170 ML in 2017–18: the volume included prior versions of the New South Wales transfer volumes in error. The amount has been corrected in this account.

6.2.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Murray – Key compliance points

- ✓ **There was a net increase in the total entitlement volume from the previous year. This increase was allowed under the situations below.**
  - **An increase was made to the volume of high-reliability water shares (36,887 ML), low-reliability water shares (9,924 ML), high-reliability environmental entitlement (15,485 ML), low-reliability environmental entitlement (4,629 ML) and unregulated environmental entitlement (9,000); and a decrease was made in loss allowances. The issue of new entitlements was a result of water recovery achieved under stage 1 and stage 2 of the Goulburn-Murray Water Connections Project. In issuing the water recovery as new entitlements, Murray loss allowances were also reduced; however, as the entitlements were issued after the final seasonal determination and the close of the irrigation season (in April and June 2019), the revised loss allowances only apply for compliance purposes from 2019–20.**
  - **An increase was also made to *Bulk Entitlement (River Murray – North East Water) Conversion Order 1999* to reflect the conversion of water shares held by North East Water to bulk entitlement.**
  - **There were also changes to unregulated take and use licence volume (increased by 973 ML), largely due to data errors being corrected in the Victorian Water Register.**
- ✓ **The total volume diverted (1,433,033 ML) was within the volume available for the year (2,172,359 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **under the *Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999*, losses incurred for Nyah were 505 ML above the longer-term volume and 5 ML above the annual loss volume. Torrumbarry losses (including Tresco) were 11,800 ML above the annual allowed loss volume, but within the permitted tolerance once the dry season loss volume and additional annual loss allowance were included.**
  - ✗ **under the *Bulk Entitlement (River Murray – Grampians Wimmera Mallee Water) Order 1999*, no approved metering plan has been implemented for that order.**

Entitlements in the Murray basin provide the basis for how water is shared in the basin. Rights to water in the Murray basin are shown in Table 6-7.

Most entitlements to water in the regulated Murray provide 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. 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 2018–19.

Diversions under 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 to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.*

Table 6-7 Entitlement volumes in the Murray basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	
High-reliability water shares	984,149
Low-reliability water shares	316,055
High-reliability supply by agreements	1,084
Low-reliability supply by agreements	456
Bulk Entitlement (River Murray – South East Water) Order 2012 [1]	n/a
Bulk Entitlement (River Murray – City West Water) Order 2012 [1]	n/a
Bulk Entitlement (River Murray – Yarra Valley Water) Order 2012 [1]	n/a
Environmental Entitlement (River Murray – NVIRP Stage 1) 2012 [2]	n/a
Loss provision – irrigation district [3]	231,443
Loss provision – Victorian Mid-Murray Storages [4]	n/a

Subtotal: Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999	**1,533,187**
Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	
High-reliability water shares	297,535
Low-reliability water shares	5,475
Millewa Waterworks districts	700
Yelta Wargan Waterworks districts	14
Provision for statutory domestic and stock rights	532
Loss provisions (5)	15,981
Subtotal: Bulk Entitlement (River Murray – Lower Murray Urban and Rural Water – Irrigation) Conversion Order 1999	**320,237**
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	3,486
Bulk Entitlement (River Murray – North East Water) Conversion Order 1999	14,540
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 (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	54,856
Low-reliability entitlement	110,373
Unregulated entitlement	83,300
Barmah-Millewa Forest Environmental Water Allocation (BMF-EWA) (6)	
Barmah-Millewa Forest Environmental Water Allocation – high-reliability	50,000
Barmah-Millewa Forest Environmental Water Allocation – low-reliability	25,000
River Murray Increased Flows (RMIF) (7)	n/a
Subtotal: Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	**323,528**
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	29,794
Take and use licences – unregulated surface water	13,787
Licensed small catchment dams – on-waterway (8)	2,460
Licensed small catchment dams – off-waterway (8)	13,725
Total (30 June 2019)	**2,298,499**
Total (30 June 2018) (8)	2,220,298

Notes

(1) Together, 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 Goulburn-Murray Water Connections Project stage 1.

(2) This entitlement provides the 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 Goulburn-Murray Water Connections Project stage 1.

(3) These loss allowances represent the total loss allowances as outlined in the bulk entitlement. The actual loss allowed may vary year to year based on the rules in the bulk entitlement, actual delivery volumes, carryover or headroom allowance. This loss allowance applied until after the last seasonal determination in April 2019 when it was revised (26 April 2019 and 28 June 2019) as a result of the issue of water recovered as part of stage 1 and stage 2 of the Goulburn-Murray Water Connections Project. For compliance purposes, the loss allowance that applied for 2018–19 (that is, the loss allowance before 26 April 2019) has been included here.

(4) The allowance for loss in the Victorian Mid-Murray Storages includes a portion of fixed distribution loss and is adjusted for the net evaporation from the storages (Kow Swamp, Kangaroo Lake, Lake Charm and Lake Boga).

(5) The loss allowance volume includes 4,800 ML loss allowance for the Millewa waterworks district.

(6) The Barmah-Millewa Forest Environmental Water Allocation includes 50 GL of high-reliability entitlement and 25 GL of low-reliability entitlement and is matched by equivalent entitlements in New South Wales. Conditions of the entitlement provide for the allocation to be borrowed to support Victorian Murray allocations and specifies certain conditions when the allocation must be released.

(7) The River Murray Increased flows entitlement reflects the water available recovered under the Snowy Water Initiative for the health of the Murray River. It provides for up to 70 GL of water being made available in the Snowy Scheme each year, however the volume available in the Murray in a given year depends on the volume of this water released from the Snowy Scheme to the Murray River.

(8) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change. Chapter 6.1 explains the change.

Table 6-8 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-8 Available water and take for the Murray basin

Water entitlement	Available water					Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Spillable write-off	Total available water	
River Murray – Goulburn-Murray Water						
Water shares	263,429	934,066	(311,287)	0	**886,208**	**458,071**
Supply by agreements	498	1,084	70	0	**1,652**	**1,033**
River Murray – Melbourne retailers (1)	13,056	17,695	(14,100)	0	**16,651**	**0**
River Murray – NVIRP stage 1 (2)	24,873	18,463	(15,966)	0	**27,370**	**5,190**
Loss allowance – irrigation districts (3)	-	-	-	-	**-**	**125,422**
Operating provisions (whole of system) (3)	-	-	-	-	**-**	**43,485**
Net diversion: River Murray – Goulburn-Murray Water (4)					**931,881**	**633,201**
River Murray – Lower Murray Urban and Rural Water – Irrigation						
Water shares	45,607	310,066	267,523	0	**623,196**	**577,153**
Millewa Waterworks district	9	700	434	0	**1,143**	**1,091**
Yelta Wargan Waterworks districts	13	14	(27)	0	**0**	**0**
Loss allowance – irrigation districts (5)	-	15,981	-		**15,981**	**11,792**
Diversion: River Murray – Lower Murray Water (6)					**640,320**	**590,035**
River Murray – Lower Murray Water (Urban)	389	30,971	(1,976)	0	**29,384**	**22,258**
River Murray – Wimmera Mallee Water	1,094	3,486	2,143	0	**6,723**	**4,973**
River Murray – North East Water (7)	487	16,620	(1,600)	0	**22,509**	**10,267**
River Murray – Goulburn Valley Water	1,410	5,593	0	0	**7,003**	**4,571**
River Murray – Coliban Water	1,849	6,285	1,055	0	**9,189**	**4,781**
Corryong	-	680	0	-	**680**	**243**
Cudgewa	-	29	0	-	**29**	**0**
Dartmouth	-	60	0	-	**60**	**0**
Omeo	-	77	0	-	**77**	**54**
Walwa	-	61	0	-	**61**	**22**
River Murray – Flora and Fauna						
High- and low-reliability components (8)	7,869	403,084	(244,893)	0	**166,061**	**143,700**
Unregulated entitlement	-	0	0	-	**0**	**0**
BMF-EWA	185,340	75,000	0	-	**260,340**	**0**
RMIF (9)	122,780	0	(47,781)	-	**74,999**	**13,930**
Subtotal: River Murray – Flora and Fauna (10)					**501,400**	**157,630**
River Murray – Snowy Environmental Reserve (11)	-	29,794	(29,794)	-	**0**	**0**
Take and use licences – unregulated surface water	-	13,861	0	-	**13,861**	**3,461**
Licensed small catchment dams (12)	-	16,187	(2)	-	**16,185**	**1,537**
Total 2018–19	**668,704**	**1,899,856**	**(396,201)**	**0**	**2,172,359**	**1,433,033**
Total 2017–18 (12)	645,813	2,328,682	(608,129)	(93,733)	2,272,633	1,711,647

Notes

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

(2) This entitlement is held by the VEWH, and water use reported represents both in-stream use and actual diversions from the waterway. Of the 5,190 ML reported, 4,148 ML represents diversions from the waterway.

(3) Loss in districts includes loss incurred in Torrumbarry, Murray Valley, Nyah, Tresco and Woorinen irrigation districts, 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).

(4) 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 flow from irrigation).

(5) The loss recorded under the Lower Murray Water irrigation bulk entitlement includes loss in the Millewa waterworks district.

(6) 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.

(7) Allocation includes return flows of 2,080 ML credited to North East Water from Wodonga recycled water treatment.

(8) Allocation includes return flows of 363,713 ML credited to the VEWH from deliveries of environmental water. Most of the allocation traded out of this entitlement was traded to South Australia, where it was used to deliver environmental outcomes in the lower Murray River, Lower Lakes and Coorong.

(9) No new allocation to RMIF was made available in 2018–19. Allocated traded under this entitlement in 2018–19 was traded to South Australia, where it was used to deliver environmental outcomes in the lower Murray River, Lower Lakes and Coorong.

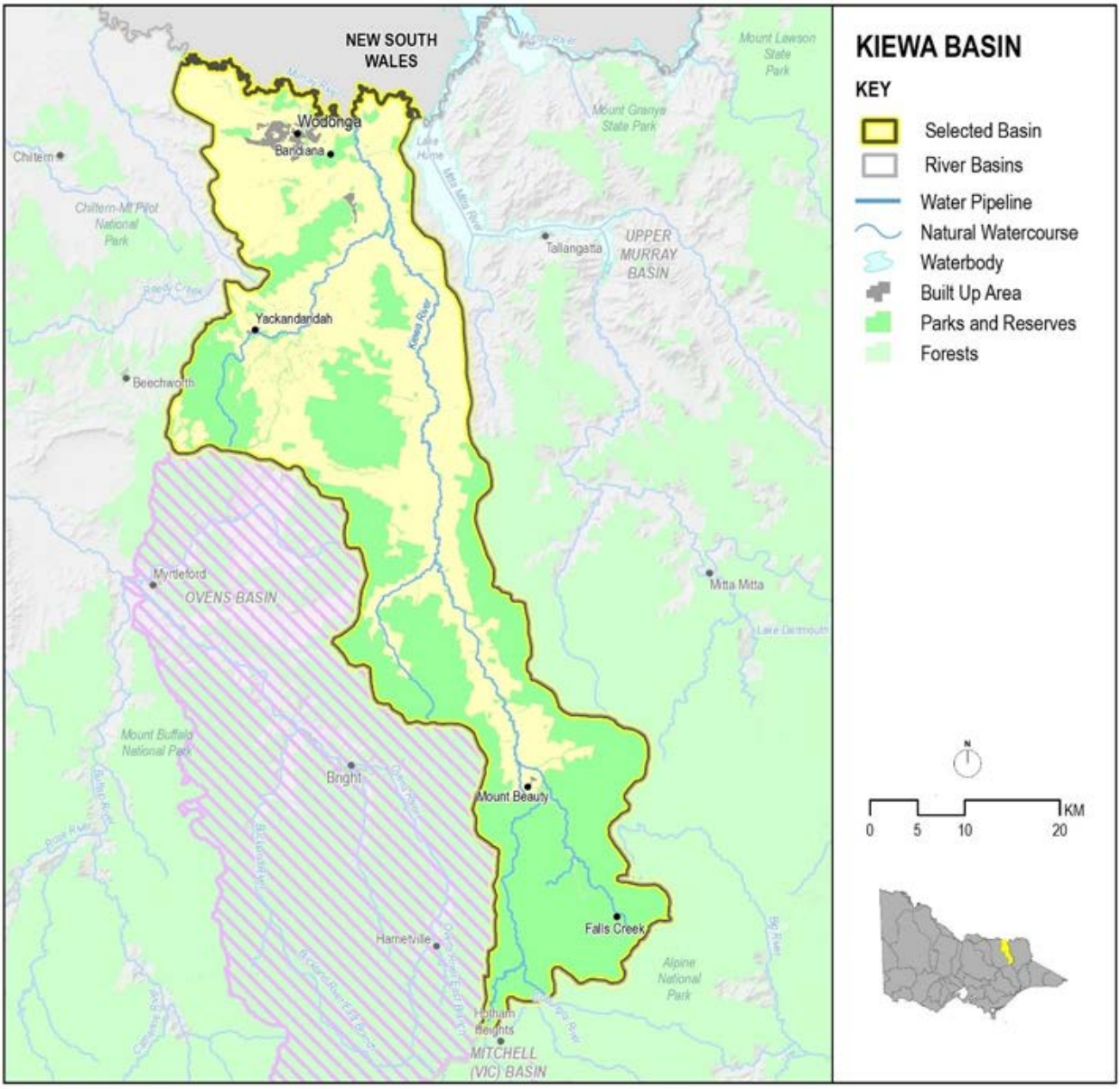
(10) Water use reported under this entitlement represents both in-stream use and actual diversions from the waterway. Of the 157,630 ML reported, 58,351 ML represents diversions from the waterway.

(11) Water allocated to this entitlement between 1 February 2018 and 31 January 2019 was traded to the Snowy inter-valley transfer account to offset reductions in releases from the Snowy Scheme as part of the Snowy Water Initiative and to allow equivalent volumes to be released from the Scheme as Snowy River Increased Flows and RMIF to support the environmental health of those rivers.

6.3 Kiewa basin

The Kiewa basin (Figure 6-4) 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 and draining northward to the Murray River.

Figure 6-4 Map of the Kiewa basin



6.3.1 Management arrangements

Management of water in the Kiewa basin is undertaken by various parties as shown in Table 6-9.

Outflows from the Kiewa basin are shared on a 50-50 basis between Victoria and New South Wales within the Murray system.

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

Authority	Management responsibilities
Goulburn-Murray Water	• Manages private diversions
North East Water	• Supplies towns across the basin including Wodonga and Mount Beauty
AGL Hydro	• Operates reservoirs in the Kiewa basin for hydropower generation
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west

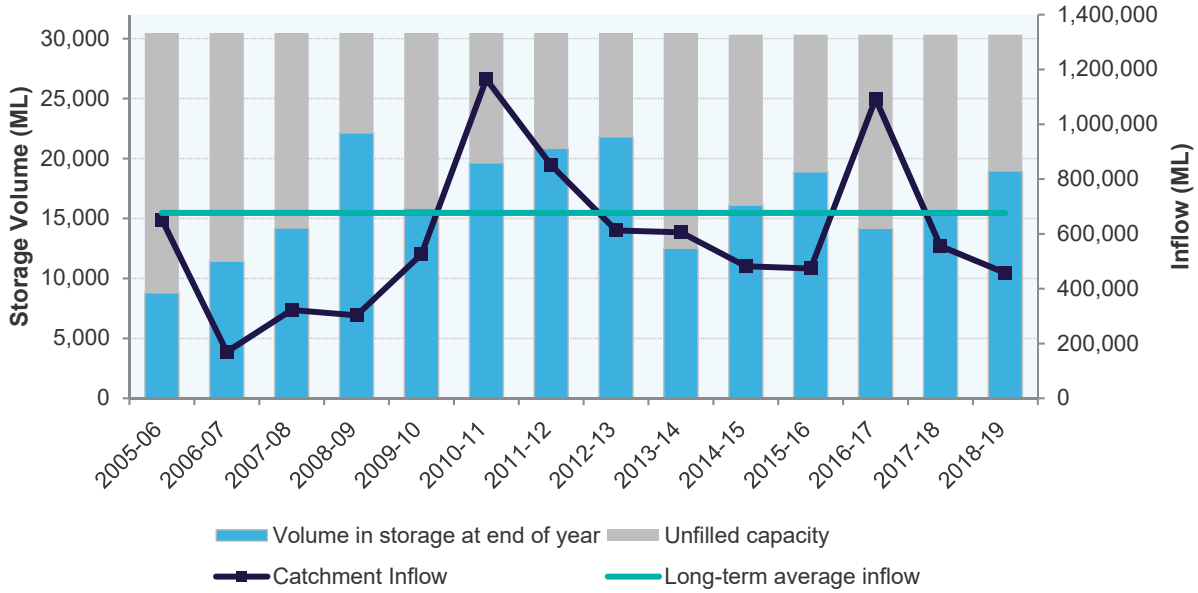
6.3.2 2018–19 water resources overview

In 2018–19, the Kiewa basin received between 80% and 100% of the long-term average rainfall in the majority of the basin, with the northern half and south-west corner of the basin receiving between 60% and 80%.

Catchment inflows were 68% of the long-term average annual volume of 676,700 ML: less than the inflows recorded in 2017–18, which were 82% of the long-term average. The long-term average presented has been revised from the previous Victorian Water Accounts, as chapter 6.1.2 explains. The volume of water flowing out of the Kiewa River into the Murray basin represented 91% of the Kiewa basin's total inflows.

Major storages in the Kiewa basin started the year at 50% of capacity and ended the year higher, at 63% of capacity.

Figure 6-5 Storage volumes and catchment inflows in the Kiewa basin



In July 2018, there were bans on licensed diversions on 11 streams in the Kiewa basin, and they were all lifted by September 2018. Licensed diversions were banned on most streams by November 2018, and by January licensed diversions from all streams were banned and remained so until May 2019. All bans were lifted by the end of the year except for Bight Creek, which remained restricted until the end of June 2019.

There were no restrictions on urban water use in the Kiewa basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 8,420 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 8,498 ML diverted in the previous year.

6.3.2.1 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. The nationally significant Alpine wetlands, known as the Alpine sphagnum bogs and associated fens, also rely on this water. Water from the Kiewa basin also flows into the Murray River, helping to protect environmental assets in the Murray basin.

In 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.3.3 Water balance

The total volumes of water available and supplied from water resources in the Kiewa basin in 2018–19 are shown in Table 6-10.

Table 6-10 Water balance – Kiewa

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	14,864	13,704
Volume in storage at end of year	1	18,570	14,864
Change in storage		**3,706**	**1,160**
Inflows			
Catchment inflow	2	457,330	555,611
Rainfall on major storages	1	n/a	n/a
Treated wastewater discharged back to river	3	327	351
Total inflows		**457,656**	**555,962**
Outflows			
Diversions			
Urban diversions		513	432
Licensed diversions from unregulated streams	4	5,023	4,264
Transfers to Ovens basin	5	573	577
Small catchment dams	6	2,311	3,225
Total diversions		***8,420***	***8,498***
Losses			
Evaporation losses from major storages	1	n/a	n/a
Evaporation from small catchment dams	6	1,594	1,694
In-stream infiltration to groundwater, flows to floodplain and evaporation		27,707	32,866
Total losses		***29,300***	***34,560***
Water passed at outlet of basin			
Kiewa basin outflow to Murray River – Victorian share		208,115	255,872
Kiewa basin outflow to Murray River – NSW share		208,115	255,872
Total water passed at outlet of basin		***416,230***	***511,744***
Total outflows		**453,950**	**554,802**

6.3.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Kiewa basin are included in the water balance. Table 6-11 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

An estimate of rainfall and evaporation for storages in the Kiewa basin has not been made, as data for these sites is not available.

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	457	n/a	n/a	385	842
Rocky Valley Lake	28,294	14,407	n/a	n/a	3,321	17,728
Sub-total	**29,710**	**14,864**	**n/a**	**n/a**	**3,706**	**18,570**
Off-stream storages						
Clover Pondage	255	134	n/a	n/a	(85)	50
Pretty Valley basin	355	355	n/a	n/a	0	355
Sub-total	**610**	**489**	**n/a**	**n/a**	**(85)**	**405**
Total 2018–19	**30,320**	**15,353**	**n/a**	**n/a**	**3,622**	**18,974**
Total 2017–18	30,320	14,175	n/a	n/a	1,178	15,353

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-12 lists the wastewater treatment plants in the Kiewa basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

The treated wastewater volume of 327 ML returned to the river includes the amount discharged to the environment from wastewater treatment plants as well as an amount of 145 ML returned from the Falls Creek Alpine Resort to Rocky Valley Creek.

Table 6-12 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Baranduda	0	0	0%	0	0	0	0	0	0
Dinner Plain	58	58	100%	0	58	0	0	0	0
Mount Beauty	185	3	2%	3	0	0	0	181	0
Yackandandah	66	66	100%	0	66	0	0	0	0
Total 2018–19	**309**	**127**	**41%**	**3**	**124**	**0**	**0**	**181**	**0**
Total 2017–18	350	140	40%	5	135	0	0	210	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences. The change is explained in chapter 6.1.

5. Transfer to Ovens basin

The 573 ML transfer represents water that is transferred to the Ovens basin to be supplied to urban customers in Beechworth.

6. Small catchment dams

Water harvested, used and lost by small catchment dams (farm dams) is included in the water balance. Table 6-13 provides information about small catchment dams in the basin.

Table 6-13 Estimated small catchment dam information for the Kiewa basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,406	1,380	1,278	2,658
Registered / licensed commercial and irrigation	4,519	931	316	1,246
Total 2018–19	**10,925**	**2,311**	**1,594**	**3,904**
Total 2017–18	10,925	3,225	1,694	4,919

6.3.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Kiewa – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (7,040 ML) was within the volume available for the year (20,453 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Kiewa basin provide the basis for how water is shared in the basin. Rights to water in the Kiewa basin are outlined in Table 6-14.

Diversions under 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 to the MDBA through the *Transition Period Water Take Report* (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's *Water Audit Monitoring Report.* Carryover provisions are not available for entitlement holders in the Kiewa basin.

Table 6-14 Entitlement volumes in the Kiewa basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Beechworth) Conversion Order 2001 (1)	1,100
Bulk Entitlement (Kiewa – Hydro) Conversion Order 1997 (2)	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 (3)	13,664
Licensed small catchment dams – on-waterway (4)	1,841
Licensed small catchment dams – off-waterway (4)	2,679
Total (30 June 2019)	**20,389**
Total (30 June 2018) (4)	20,439

Notes

(1) The Beechworth bulk entitlement was previously reported in the Ovens basin. This entitlement can source water from both the Kiewa and the Ovens basins, however the majority of the water is sourced from the Kiewa. The town of Beechworth is physically in the Ovens basin, so any water sourced from the Ovens under this entitlement is transferred to the Ovens basin for use.

(2) 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. A specified volume is not applicable.

(3) The volume of unregulated surface water entitlements now includes licences for in-stream diversions. In the Kiewa basin, there are 11 ML of in-stream licence.

(4) Reporting for unregulated entitlement volume changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change. Chapter 6.1 explains the change.

Table 6-15 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-15 Available water and take for the Kiewa basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Beechworth	-	1,100	0	**1,100**	**573**
Kiewa – Hydro (1)	-	-	-	**-**	**-**
Kiewa – Tangambalanga	-	179	0	**179**	**0**
Mount Beauty – Tawonga	-	718	0	**718**	**311**
Yackandandah	-	209	0	**209**	**202**
Take and use licences – unregulated surface water	-	13,716	8	**13,724**	**5,023**
Licensed small catchment dams (2)	-	4,531	(8)	**4,523**	**931**
Total 2018–19	**0**	**20,453**	**0**	**20,453**	**7,040**
Total 2017–18 (2)	-	19,339	(1)	19,338	6,934

Notes

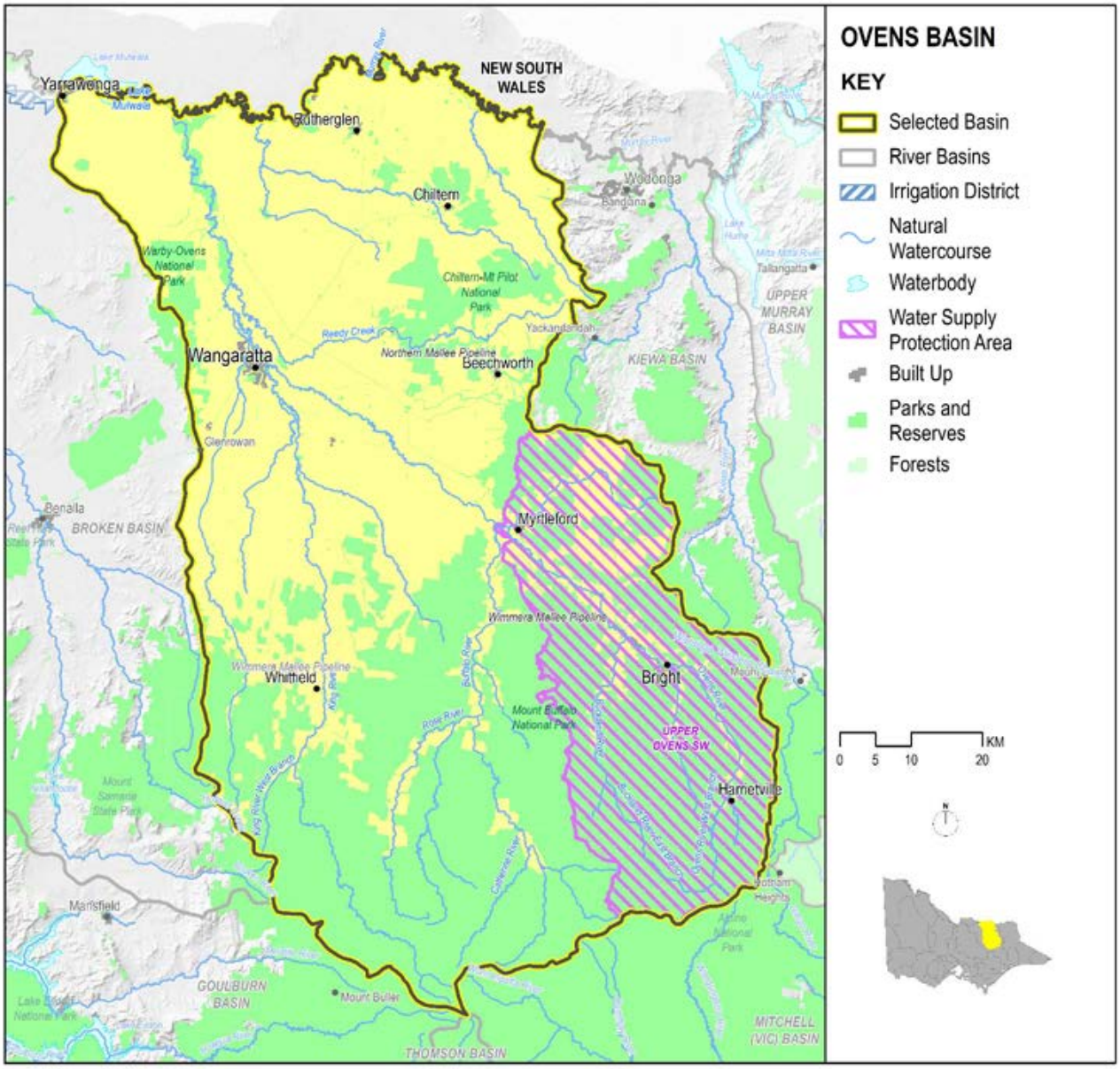
(1) This bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes. All water diverted under this entitlement must be returned to the waterway, therefore no volumes are reported as diversions for the purposes of this table.

(2) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19, the prior-year totals have been adjusted from the 2017–18 published accounts to reflect this change.

6.4 Ovens basin

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

Figure 6-6 Map of the Ovens basin



6.4.1 Management arrangements

Management of water in the Ovens basin is undertaken by various parties as shown in Table 6-16.

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

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies primary entitlements in the regulated Ovens and King systems • Manages licensed diversions • Operates Lake Buffalo and Lake William Hovell
North East Water	• Supplies towns including Wangaratta, Bright, Myrtleford, Beechworth and Chiltern
North East Catchment Management Authority	• Responsible for waterway and catchment management in the region bounded by the Murray River in the north, the Victorian Alps in the south, the New South Wales border in the east and the Warby Ranges in the west

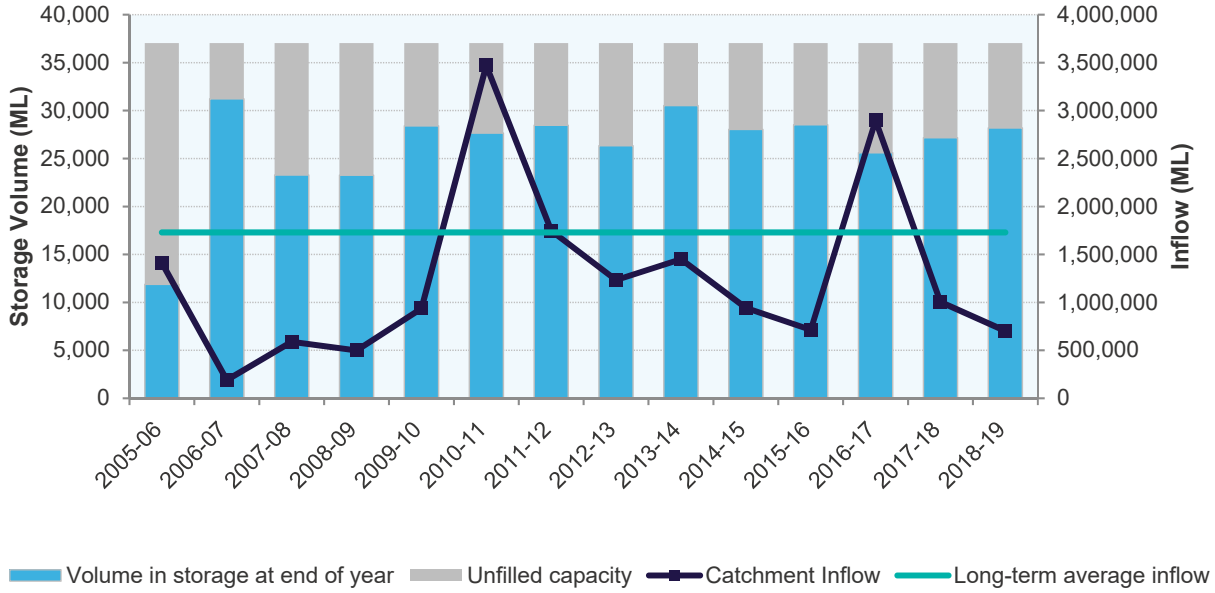
6.4.2 2018–19 water resources overview

In 2018–19, rainfall across the Ovens basin was between 60% and 80% of the long-term average in most of the basin, except for the south-west corner and eastern half which received between 80% and 100%.

Catchment inflows in 2018–19 were 41% of the long-term average annual volume of 1,729,300 ML: less than the inflows recorded in 2017–18, which were 58% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. The volume of water flowing out of the Ovens basin into the Murray River represented 92% of the Ovens basin's total inflows.

Major storages in the Ovens basin started the year at 73% of capacity and ended the year higher, at 76% of capacity.

Figure 6-7 Storage volumes and catchment inflows in the Ovens basin



In July 2018, restrictions on diversions remained on four streams, but they were lifted in early August. All unregulated streams were then unrestricted until November 2018, when total bans were placed on six streams. By February 2019, licensed diversions were restricted on a peak of 22 streams. These were lifted on all but four in May and only two remained in place by the end of June 2019. Deep Creek was unrestricted for the whole of 2018–19.

There were no restrictions on urban water use in the Ovens basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 26,706 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 25,619 ML diverted in the previous year.

6.4.2.1 Water for the environment

Several important environmental assets in the Ovens basin depend on water for the environment, including:

- the lower Ovens River (which contains heritage and iconic reaches), which is an important environmental asset that depends on water in the Ovens basin
- the lower Ovens wetlands, which support egrets, herons, cormorants, bitterns and treecreepers
- the Buffalo River, which is an important site for large fish species during their breeding cycle: trout cod are found as far up the King River as Whitfield
- water from the Ovens basin, which feeds into the Murray basin, helping to maintain the Murray basin's environmental assets.

In 2018–19, water for the environment in the Ovens basin comprised:

- water set aside for the environment and other downstream uses through the operation of passing flows released as a condition of consumptive bulk entitlements held by Goulburn-Murray Water in 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 WSPA Water Management Plan*
- 123 ML of high-reliability water shares held for the environment
- 39 ML of water allocation transferred to the VEWH for delivery in the Ovens system for environmental and Aboriginal outcomes
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2018–19, 162 ML of environmental water was delivered in-stream in the Ovens basin.

6.4.3 Water balance

The total volumes of water available and supplied from water resources in the Ovens basin in 2018–19 are shown in Table 6-17.

Table 6-17 Water balance – Ovens basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	27,165	25,602
Volume in storage at end of year	1	28,183	27,165
Change in storage		**1,018**	**1,563**
Inflows			
Catchment inflow	2	702,562	1,004,509
Rainfall on major storages		3,287	3,759
Transfers from Kiewa basin	3	573	577
Treated wastewater discharged back to river	4	1,320	1,585
Total inflows		**707,742**	**1,010,430**
Outflows			
Diversions			
Urban diversions		5,887	5,531
Licensed diversions from regulated streams		11,135	8,636
Licensed diversions from unregulated streams	5	4,545	3,787
Small catchment dams	6	5,138	7,666
Total diversions		***26,706***	***25,619***
Losses			
Evaporation losses from major storages		3,534	3,806
Evaporation from small catchment dams	6	3,746	4,263
In-stream infiltration to groundwater, flows to floodplain and evaporation		25,478	20,646
Total losses		***32,758***	28,715
Water passed at outlet of basin			
Ovens basin outflow to Murray River	7	647,260	954,533
Total water passed at outlet of basin		***647,260***	***954,533***
Total outflows		**706,724**	**1,008,867**

6.4.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Ovens basin are included in the water balance. Table 6-18 shows how storage volumes changed 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	13,753	2,333	2,717	959	14,328
Lake William Hovell	13,690	13,412	954	817	306	13,855
Total 2018–19	**37,030**	**27,165**	**3,287**	**3,534**	**1,265**	**28,183**
Total 2017–18	37,030	25,602	3,759	3,806	1,610	27,165

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Transfer to Ovens

The 573 ML transfer represents water that is transferred from the Kiewa basin before being supplied to urban customers in Beechworth.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-19 lists the wastewater treatment plants in the Ovens basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-19 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Beechworth	256	58	23%	0	58	0	0	198	0
Bright / Porepunkah	331	13	4%	13	0	0	0	318	0
Chiltern	10	10	100%	0	10	0	0	0	0
Glenrowan	28	28	100%	0	28	0	0	0	0
Moyhu	2	2	100%	0	2	0	0	0	0
Myrtleford	363	0	0%	0	0	0	0	363	0
Rutherglen / Wahgunyah	96	96	100%	41	55	0	0	0	0
Wangaratta	1,462	1,084	74%	17	1,067	0	0	378	0
Wangaratta Trade Waste	64	0	0%	0	0	0	0	64	0
Total 2018–19	**2,611**	**1,291**	**49%**	**71**	**1,220**	**0**	**0**	**1,320**	**0**
Total 2017–18	2,868	1,283	45%	82	1,201	0	0	1,585	0

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences. Chapter 6.1 explains the change.

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-20 provides information about small catchment dams in the basin.

Table 6-20 Estimated small catchment dam information for the Ovens basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	26,401	3,526	3,195	6,721
Registered / licensed commercial and irrigation	10,935	1,612	551	2,163
Total 2018–19	**37,336**	**5,138**	**3,746**	**8,884**
Total 2017–18	37,336	7,666	4,263	11,928

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Ovens basin in the 2018–19 accounts has been revised from previous accounts: see chapter 6.1.2 for details. The new method estimates outflows using data from a second gauge, in addition to the data from the previous site. This provides a higher level of certainty in the outflow calculation. This has increased the reported outflows to the Murray River by 1% for 2018–19: the previous estimate would have resulted in outflows of 637,959 ML.

6.4.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Ovens – Key compliance points

- ✓ **There was a net increase of 8 ML to the total entitlement volume from the previous year.**
  - **A 30 ML water share was cancelled during the year.**
  - **38 ML of unregulated licence volume was issued during the year.**
- ✓ **The total volume diverted (23,342 ML) was within the volume available for the year (65,162 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Ovens basin provide the basis for how water is shared in the basin. Rights to water in the Ovens basin are outlined in Table 6-21.

Diversions under 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 to the MDBA through the Transition Period Water Take Report (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's Water Audit Monitoring Report.

Table 6-21 Entitlement volumes in the Ovens basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Ovens System – Goulburn-Murray Water) Conversion Order 2004 (1)	
High-reliability water shares	26,164
Spill-reliability water shares	12,525
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	**46,521**
Bulk Entitlement (Bright) Conversion Order 2000	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 (2)	1,470
Bulk Entitlement (Springhurst) Conversion Order 1999	36
Bulk Entitlement (Whitfield) Conversion Order 1999	34
Take and use licences – unregulated surface water (3)	13,820
Licensed small catchment dams – on-waterway (4)	3,442
Licensed small catchment dams – off-waterway (4)	7,493
Total (30 June 2019)	**74,047**
Total (30 June 2018) (4)	74,039

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 Moyhu, Oxley and Wangaratta.

(2) 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).

(3) The volume of unregulated surface water entitlements now includes licences for in-stream diversions. In the Ovens basin, there are 19 ML of in-stream licence.

(4) Reporting for unregulated entitlement volume changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 published accounts to reflect this change. Chapter 6.1 explains the change.

Table 6-22 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-22 Available water and take for the Ovens basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Ovens system – Goulburn-Murray Water					
Water shares [1]	-	28,533	()	**28,533**	**11,297**
Ovens system – Moyhu, Oxley and Wangaratta	-	7,832	0	**7,832**	**3,316**
Diversion: Ovens system – Goulburn-Murray Water [2]					**14,613**
Bright [3]	-	870	600	**1,470**	**1,339**
Chiltern [4]	-	180	0	**180**	**0**
Glenrowan [5]	-	90	0	**90**	**9**
Harrietville	-	91	0	**91**	**64**
Myrtleford [3]	-	1,212	(600)	**612**	**586**
Springhurst	-	36	0	**36**	**0**
Whitfield	-	34	0	**34**	**0**
Take and use licences – unregulated surface water [6]	-	13,820	291	**14,111**	**4,545**
Licensed small catchment dams [7]	-	11,074	0	**11,074**	**1,612**
Total 2018–19	**-**	**64,872**	**291**	**65,162**	**23,342**
Total 2017–18 [7]	-	64,885	169	65,054	20,066

Notes

(1) Water use reported includes 162 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 includes water delivered in-stream for environmental purposes.

(3) North East Water reported that a temporary trade of 600 ML was made from the Myrtleford bulk entitlement to the Bright bulk entitlement to prepare for a dry climate scenario and increased demand.

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

(5) Glenrowan receives urban supply from the Wangaratta system. North East Water diverted 9 ML under the Glenrowan bulk entitlement in 2018–19 to supply water to an irrigation customer via a supply by agreement.

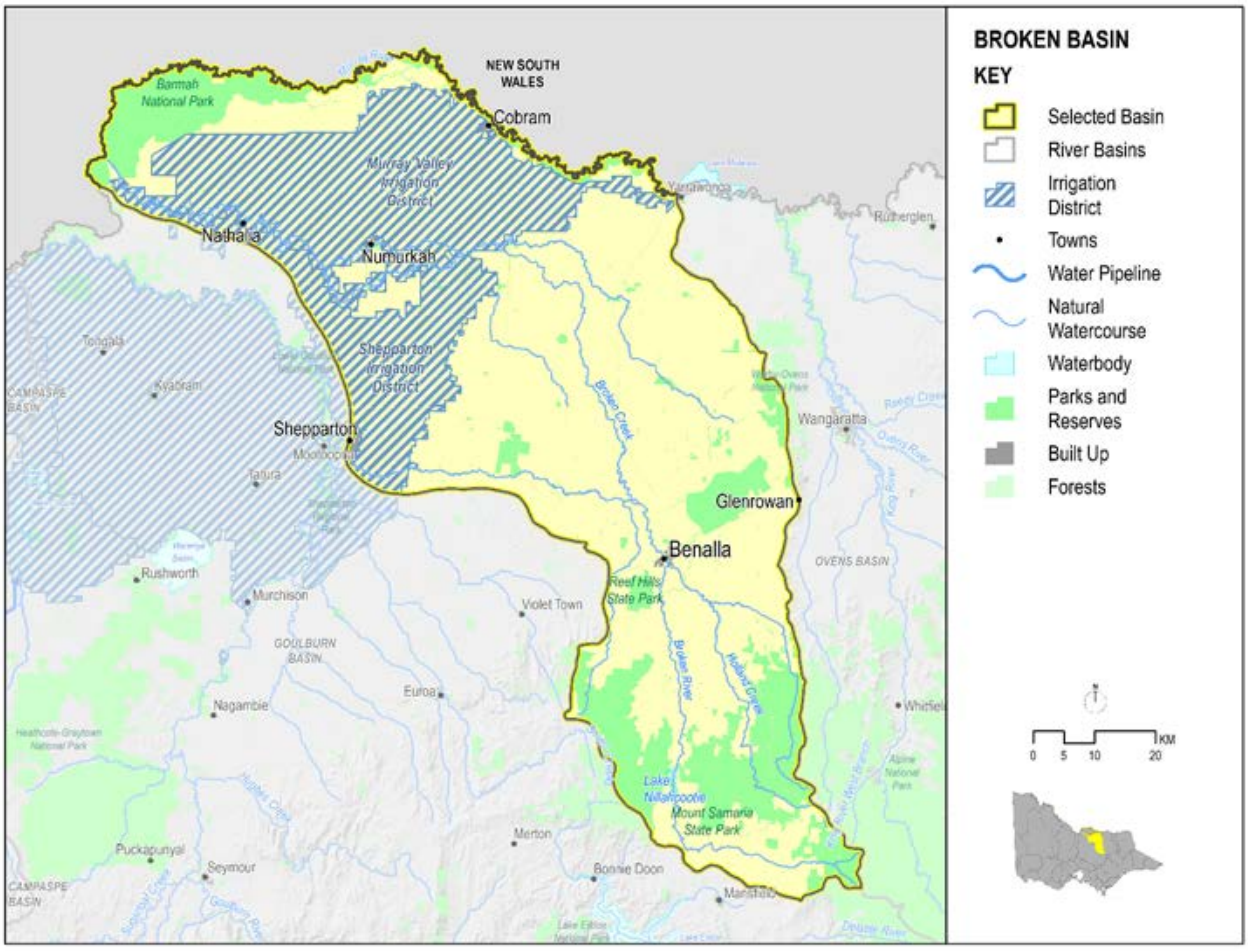
(6) Net trade encompasses temporary and permanent trades in and out of the Ovens basin. The net value of 291 ML represents water traded in from the Upper Ovens GMU.

(7) Water taken from licensed small catchment dams was reported in this table for the first time in 2018–19, and the prior-year totals have been adjusted from the 2017–18 published accounts to reflect this change.

6.5 Broken basin

The Broken basin (Figure 6-8) 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 6-8 Map of the Broken basin



6.5.1 Management arrangements

Management of water in the Broken basin is undertaken by various parties as shown in Table 6-23.

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

Authority	Management responsibilities
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 and North East Water • Operates Lake Nillahcootie and weirs on Broken River
North East Water	• Supplies towns across most of the Broken basin including Benalla • Operates the Loombah and McCall-Say reservoirs
Goulburn Valley Water	• Supplies towns in the west of the basin including Shepparton, Nathalia and Dookie (sourced from Goulburn and Murray basins)
Goulburn Broken Catchment Management Authority	• Responsible for waterway and catchment management in the region comprising the catchments of the Goulburn and Broken rivers and part of the Murray River valley

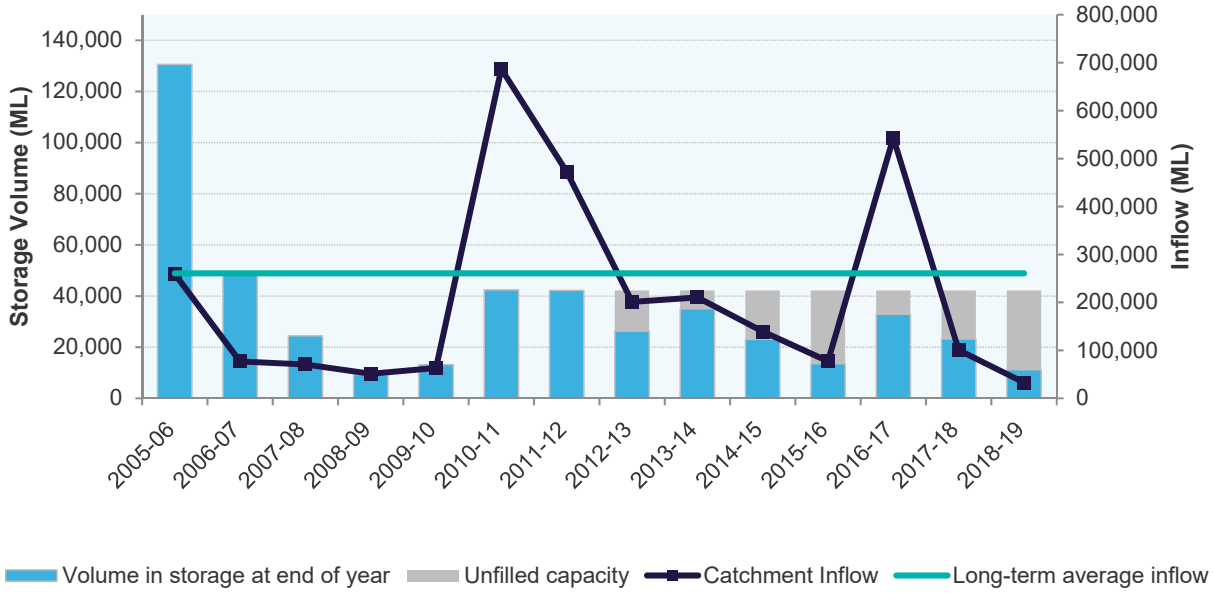
6.5.2 2018–19 water resources overview

In 2018–19, rainfall across the Broken basin was 60% to 80% of the long-term average.

Catchment inflows in 2018–19 were 13% of the long-term average annual volume of 260,800 ML, below the inflows recorded in 2017–18, which were 39% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Major storages in the Broken basin started the year at 55% of capacity and ended the year lower at 27% of capacity.

Figure 6-9 Storage volumes and catchment inflows in the Broken basin



Note

(1) Unfilled capacity is not shown on the graph before 2010–11: before then, Lake Mokoan was included as a storage in the Broken basin. Lake Mokoan was decommissioned in 2010 and water supply from this storage ceased, so it is no longer included in the total storage capacity for Broken basin.

The opening seasonal allocation for high-reliability water shares was announced on 2 July 2018 at 0% and reached 37% by April 2019. There was no seasonal determination allocation for low-reliability water shares in 2018–19.

In 2018–19, all licensed diversions from Boosey, Hollands and Ryans creeks were banned for the entire year, while licensed diversions on the Lima and Lima East creeks remained unrestricted.

There were no restrictions on urban water use in the Broken basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 11,949 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 15,570 ML diverted in the previous year.

6.5.2.1 Water for the environment

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

In 2018–19, 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: this water also provides social, recreational and cultural benefits
- 624 ML of high-reliability water shares and 23 ML low-reliability water shares held for the environment.

A total of 250 ML of environmental water was delivered in-stream in the Broken basin in 2018–19.

6.5.3 Water balance

The total volumes of water available and supplied from water resources in the Broken basin in 2018–19 are shown in Table 6-24.

Table 6-24 Water balance – Broken basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	23,200	32,877
Volume in storage at end of year	1	11,206	23,200
Change in storage		**(11,994)**	**(9,677)**
Inflows			
Catchment inflow	2	32,924	100,463
Rainfall on major storages	1	2,328	4,553
Treated wastewater discharged back to river	3	0	0
Total inflows		**35,252**	**105,016**
Outflows			
Diversions			
Urban diversions		1,658	1,517
Licensed diversions from regulated streams		7,760	9,595
Licensed diversions from unregulated streams		722	580
Environmental water diversions		0	500
Small catchment dams	4	1,809	3,379
Total diversions		***11,949***	***15,570***
Losses			
Evaporation losses from major storages	1	3,808	4,697
Evaporation from small catchment dams	4	1,872	2,800
In-stream infiltration to groundwater, flows to floodplain and evaporation		8,330	12,889
Total losses		***14,010***	***20,386***
Water passed at outlet of basin			
Broken River at Gowangardie to Goulburn basin		20,709	75,011
Boosey Creek at Tungamah to Murray basin		0	2,168
Broken Creek at Katamatite to Murray basin		578	1,557
Total water passed at outlet of basin		***21,287***	***78,736***
Total outflows		**47,247**	**114,693**

6.5.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Broken basin are included in the water balance. Table 6-25 shows how storage volumes changed 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	22,246	2,090	3,050	(10,898)	10,389
Loombah-McCall Say	1,747	954	238	758	383	817
Total 2018–19	**42,147**	**23,200**	**2,328**	**3,808**	**(10,514)**	**11,206**
Total 2017–18	42,147	32,877	4,553	4,697	(9,532)	23,200

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin.

Table 6-26 lists the wastewater treatment plants in the Broken basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-26 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Benalla	431	431	100%	0	431	0	0	0	0
Tungamah	12	12	100%	0	12	0	0	0	0
Total 2018–19	**443**	**443**	**100%**	**0**	**443**	**0**	**0**	**0**	**0**
Total 2017–18	522	522	100%	0	522	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-27 provides information about small catchment dams in the basin.

Table 6-27 Estimated small catchment dam information for the Broken basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	16,857	1,156	1,556	2,712
Registered / licensed commercial and irrigation	8,796	652	316	969
Total 2018–19	**25,654**	**1,809**	**1,872**	**3,681**
Total 2017–18	25,654	3,379	2,800	6,179

6.5.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Broken – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (11,043 ML) was within the volume available for the year (24,041 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **during regulated conditions, the losses for Upper Broken Creek were 1,128 ML above the annual allowance of 1,850 ML under the bulk entitlement. GMW are working with DELWP and have identified actions to attempt to rectify the ongoing issues with the Upper Broken Creek loss allowance; the accuracy of the offtake measurement is being improved**
  - ✗ **for the Broken system, in July and August 2018 downstream of Back Creek Junction, there were ten days of non-compliance during an outage for maintenance works at Lake Nillahcootie. In August, fluctuating inflows and disparities between hydrographic data and operational flows resulted in a period of three days where recorded inflows were below the volume required by less than 5 ML/d and four days where the flows were below the volume required by less than 1 ML/d. Passing flows were amended in June 2019 in agreement with the Goulburn Broken Catchment Management Authority.**

Entitlements in the Broken basin provide the basis for how water is shared in the basin. Rights to water in the Broken basin are outlined in Table 6-28.

Entitlements to water in the regulated part of the Broken basin provide for the right to carry over unused allocation to the next season. These entitlement holders can carry over unused water up to 50% of their entitlement volume.

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 to the MDBA through the Transition Period Water Take Report (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's Water Audit Monitoring Report.

Table 6-28 Entitlement volumes in the Broken basin

Water entitlement	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
Broken supplement to Lower Goulburn and Murray [2]	n/a
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 [3]	1,411
Licensed small catchment dams – on-waterway [4]	1,308
Licensed small catchment dams – off-waterway [4]	7,489
Total (30 June 2019)	**35,486**
Total (30 June 2018) [4]	35,492

Notes

(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 Tungamah, Devenish and St James.

(2) Supplementary supply to the lower Goulburn and Murray systems is provided when low-reliability allocations have reached 100% and surplus water remains in the Broken system. A specified volume is not applicable.

(3) The volume of unregulated surface water entitlements now includes licences for in-stream diversions, in the Ovens basin there is 2 ML of in-stream licence.

(4) Reporting for unregulated entitlement volume has changed in 2018–19, the definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 published accounts to reflect this change, which chapter 6.1 explains.

Table 6-29 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-29 Available water and take for the Broken basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Broken system – Goulburn-Murray Water					
Water shares [1]	4,865	6,521	(1,839)	**9,548**	**5,032**
Tungamah, Devenish and St. James [2]	64	68	0	**132**	**0**
Broken supplement to Lower Goulburn and Murray				**-**	**0**
Loss allowance [3]	-	1,850	-	**1,850**	**2,978**
Diversion: Broken system – Goulburn-Murray Water [4]				**11,530**	**8,010**
Loombah-McCall Say (Benalla)	0	2,324	0	**2,324**	**1,658**
Take and use licences – unregulated surface water	0	1,488	0	**1,488**	**722**
Licensed small catchment dams [5]	0	8,700	0	**8,700**	**652**
Total 2018–19	**4,929**	**20,950**	**(1,839)**	**24,041**	**11,043**
Total 2017–18 [5]	7,229	26,389	(5,505)	28,113	14,583

Notes

(1) Water use reported includes 250 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) 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 2018–19, these towns continued to be supplied with water via a pipeline from Yarrawonga in the Murray system.

(3) Goulburn-Murray Water has an annual average loss allowance of 1,850 ML. In 2018–19, Goulburn-Murray Water reported that during regulated conditions, the losses from Broken Creek were 1,128 ML over the loss allowance.

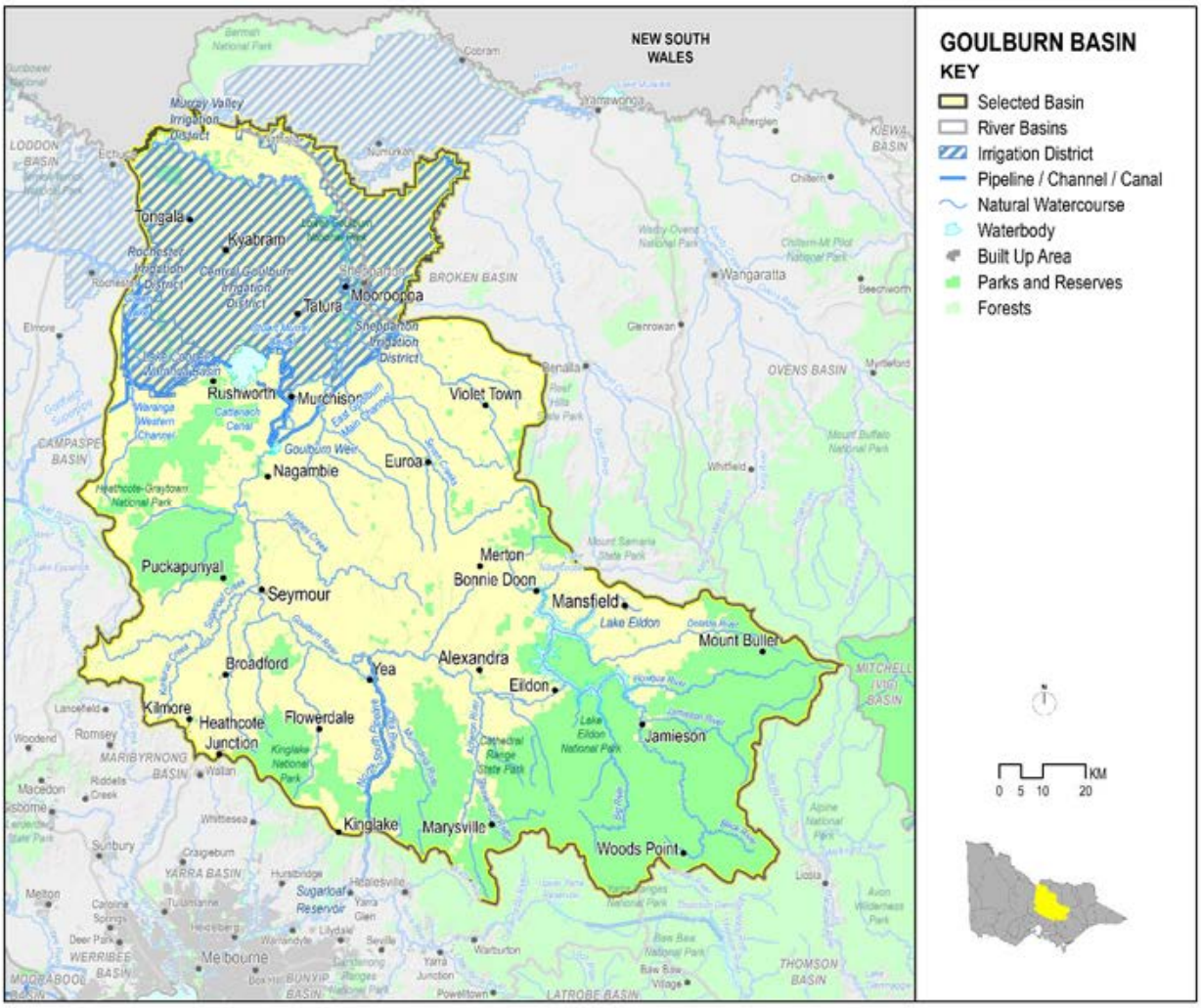
(4) The water use reported in this line item represents the bulk diversion during regulated conditions to supply primary entitlements under the Broken system source bulk entitlement. It includes environment deliveries in-stream (250 ML).

(5) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 published accounts to reflect this change.

6.6 Goulburn basin

The Goulburn basin (Figure 6-10) 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 6-10 Map of the Goulburn basin



6.6.1 Management arrangements

Management of water in the Goulburn basin is undertaken by various parties as shown in Table 6-30.

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

Authority	Management responsibilities
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
Goulburn Valley Water	• Supplies towns located in the Goulburn basin including Shepparton, Alexandra and Seymour
Coliban Water	• Can supply towns located in the Loddon and Campaspe basins from the Goulburn basin including Bendigo
Melbourne Water	• Operates the Silver–Wallaby diversion system to Melbourne
Grampians Wimmera Mallee Water	• Supplies Quambatook
Goulburn Broken Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Goulburn basin

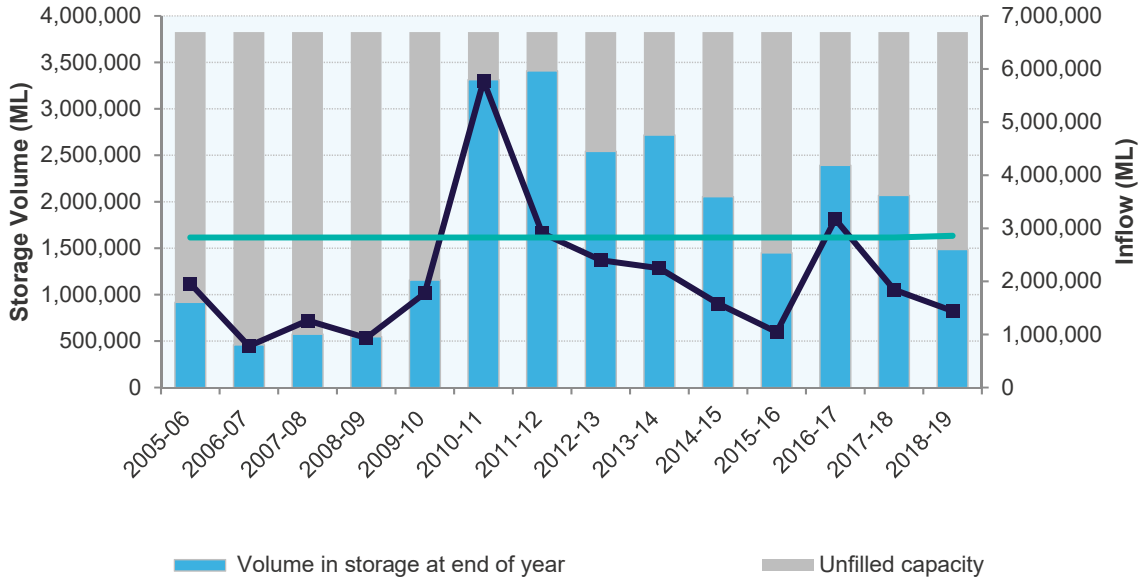
6.6.2 2018–19 water resources overview

In 2018–19, rainfall across most of the Goulburn basin was between 60% and 80% of the long-term average. The south-east of the basin received between 80% and 100% of the long-term average rainfall.

Catchment inflows in 2018–19 were 51% of the long-term average annual volume of 2,859,000 ML, below the inflows recorded in 2017–18, which were 64% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

The volume of water in major storages in the Goulburn basin was 55% of capacity at 1 July 2018 and 38% at 30 June 2019.

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



The first seasonal determination for high-reliability water shares of 32% for the Goulburn basin was announced on 2 July 2018 and increased to 100% by March 2019. There was no seasonal determination allocation for low-reliability water shares in 2018–19.

Like the previous year, licensed diversions from Sunday Creek were banned again for the whole of 2018–19. All other streams remained unrestricted until December 2018, when bans on licensed diversions from Sevens Creeks were applied. Total bans were also placed on Hughes and King Parrot creeks, and restrictions were placed on the Yea River and its tributaries in January 2019. The Acheron River had restrictions put in place in March, and by the end of May 2019 all restrictions were lifted except for Sunday Creek.

In 2018–19, water restrictions were applied to six towns in the Goulburn basin. Low storages in the Euroa and Sunday Creek systems in Goulburn Valley Water's (GVW's) area triggered GVW's drought response plan in April 2019. Stage 2 restrictions were implemented in Kilmore, Kilmore East, Wandong, Heathcote Junction, Euroa and Violet Town and remained in place until the end of June 2019. All other towns were on permanent water-saving rules throughout the year.

In 2018–19, 1,026,454 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was about the same as the 1,079,196 ML diverted in the previous year.

6.6.2.1 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 flows into the Murray, Campaspe and Loddon basins, 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 2018–19, water sourced from the Goulburn basin for the environment 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 26,555 ML of high-reliability and 5,792 ML of low-reliability entitlements held by the VEWH

- the *Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012* comprising 36,624 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
- 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
- up to 7,490 ML of water each year, as part of the Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005
- 331,333 ML of high-reliability water shares and 60,319 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: this water also provides social, recreational and cultural benefits.

A total of 261,258 ML of environmental water was sourced from the Goulburn basin in 2018–19: 1,181 ML of this was diverted off-stream while the remaining 260,077 ML was delivered in-stream in the Goulburn River. An additional volume of 6,372 ML was delivered under the *Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005*, via the Loddon Valley Irrigation District.

6.6.3 Water balance

The total volumes of water available and supplied from water resources in the Goulburn basin in 2018–19 are shown in Table 6-31.

Table 6-31 Water balance – Goulburn basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	1,849,267	2,141,867
Volume in storage at end of year	1	1,285,943	1,849,267
Change in storage		**(563,324)**	**(292,600)**
Inflows			
Catchment inflow	2	1,444,085	1,842,064
Rainfall on major storages	1	63,946	91,551
Inflow from Broken River at Gowangardie		20,709	75,011
Inflow from Loddon via the Loddon supplement		0	8,554
Return flow from irrigation		0	0
Transfer from Campaspe via Waranga Western Channel		0	15,643
Treated wastewater discharged back to river	3	391	1,584
Total inflows		**1,529,131**	**2,034,407**
Outflows			
Diversions			
Urban diversions		28,237	26,751
Irrigation district diversions	4	953,489	1,003,876
Licensed diversions from regulated streams		19,350	18,527
Licensed diversions from unregulated streams	5	5,887	5,478
Transfer from Silver and Wallaby creeks to Yarra basin		356	757
Transfers to Melbourne via North-South Pipeline	6	0	7
Environmental water diversions	7	7,553	6,541
Small catchment dams	8	11,581	17,258
Total diversions		***1,026,454***	***1,079,196***
Losses			
Evaporation losses from major storages	1	86,215	176,787
Evaporation from small catchment dams	8	10,618	11,463
In-stream infiltration to groundwater, flows to floodplain and evaporation		150,151	129,548
Total losses		***246,984***	***317,797***
Water passed at outlet of basin			
Goulburn River to Campaspe River via Waranga Western Channel		0	0
Goulburn River outflow to Murray River		791,425	912,754
Goulburn River outflow to Murray River via Broken Creek		27,592	17,260

Total water passed at outlet of basin	**819,017**	**930,014**
Total outflows	**2,092,455**	**2,327,007**

6.6.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Broken basin are included in the water balance. Table 6-32 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

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	23,821	4,625	12,079	5,492	21,860
Lake Eildon	3,334,158	1,824,465	59,233	73,972	(546,026)	1,263,700
Sunday Creek Reservoir	1,650	981	87	164	(521)	383
Sub-total	**3,361,308**	**1,849,267**	**63,946**	**86,215**	**(541,055)**	**1,285,943**
Off-stream storages						
Greens Lake	32,500	20,806	1,584	5,895	(837)	15,658
Waranga Basin	432,360	197,619	15,581	61,836	33,012	184,376
Sub-total	**464,860**	**218,425**	**17,165**	**67,731**	**32,175**	**200,034**
Total 2018–19	**3,826,168**	**2,067,692**	**81,111**	**153,946**	**(508,880)**	**1,485,977**
Total 2017–18	3,826,168	2,391,636	116,758	263,394	(177,308)	2,067,692

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-33 lists the wastewater treatment plants in the Goulburn basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

In addition to the recycled water reported below, 134 ML was returned from the Mount Buller Resort to Black Dog Creek and other waterways during the water year.

Table 6-33 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Alexandra	150	124	82%	89	35	0	0	26	0
Avenel	14	14	100%	0	14	0	0	0	0
Bonnie Doon	21	21	100%	0	21	0	0	0	0
Broadford	80	80	100%	0	80	0	0	0	0
Eildon	118	37	31%	37	0	0	0	81	0
Euroa	213	213	100%	77	136	0	0	0	0
Girgarre	0	0	0%	0	0	0	0	0	0
Kilmore	434	284	65%	0	284	0	0	150	0
Kyabram / Merrigum	450	450	100%	0	450	0	0	0	0
Mansfield	239	239	100%	80	159	0	0	0	0
Marysville	55	55	100%	55	0	0	0	0	0
Mooroopna	915	915	100%	0	915	0	0	0	0
Murchison	0	0	0%	0	0	0	0	0	0
Nagambie	103	103	100%	0	103	0	0	0	0
Seymour	497	497	100%	117	380	0	0	0	0
Shepparton	2,509	2,509	100%	0	2,509	0	0	0	0

Stanhope / Rushworth	50	50	100%	0	50	0	0	0	0
Tatura	1,409	1,409	100%	0	1,409	0	0	0	0
Tongala	230	230	100%	0	230	0	0	0	0
Upper Delatite	31	31	100%	0	31	0	0	0	0
Violet Town	11	11	100%	0	11	0	0	0	0
Yea	100	100	100%	61	39	0	0	0	0
Total 2018–19	**7,627**	**7,372**	**97%**	**516**	**6,855**	**0**	**0**	**257**	**0**
Total 2017–18	8,694	7,232	83%	579	6,652	0	0	1,464	0

4. Irrigation district diversions

The volume of irrigation district diversions reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a portion of the amount being reclassified as environmental diversion.

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences. Chapter 6.1 explains the change.

6. Inter-basin transfers

There were no transfers to the Yarra basin via the North-South Pipeline in the 2018–19 water year.

7. Environmental diversions

The volume of environmental diversion reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to the addition of water sourced from the Goulburn basin under the Loddon River Environmental Reserve bulk entitlement being included as an environmental diversion from the Goulburn basin.

8. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-34 provides information about small catchment dams in the basin.

Table 6-34 Estimated small catchment dam information for the Goulburn basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	51,197	7,709	8,972	16,680
Registered / licensed commercial and irrigation	22,645	3,873	1,647	5,519
Total 2018–19	**73,842**	**11,581**	**10,618**	**22,199**
Total 2017–18	73,842	17,258	11,463	28,721

6.6.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Goulburn – Key compliance points

- ✓ **There was a net increase in the total entitlement volume from the previous year. This increase was allowed under the situations below.**
  - **An increase was made to the volume of high-reliability water shares (32,248 ML), high-reliability environmental entitlement (17,704 ML) and low-reliability environmental entitlement (2,652 ML) with a decrease in loss allowances during 2018–19. The issue of new water shares was a result of water recovery achieved under stage 1 and stage 2 of the Goulburn-Murray Water Connections Project. In issuing the water savings, Goulburn loss allowances were reduced, but as the shares were issued after the final seasonal determination and the close of the irrigation season (in April), the revised loss allowances only apply for compliance purposes from 2019–20. Other minor changes to the water share volume resulted from the conversion of two supply by agreements to water shares (16 ML high-reliability and 3.8 ML low-reliability) and the surrender of three high-reliability water shares (6.4 ML).**
- ✓ **The total volume diverted (1,266,080 ML) was within the volume available for the year (1,481,766 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**

✖	**no approved metering plan has been implemented for the *Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006*.**

Entitlements in the Goulburn basin provide the basis for how water is shared in the basin. Rights to water in the Goulburn basin are outlined in Table 6-35.

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 (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. Water held above entitlement volume is also subject to a risk of spill; there were no spill events in 2018–19 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 from the VEWH's account to the Snowy Scheme so it can be subsequently released from the Snowy Scheme to support the health of the Snowy and Murray rivers.

Table 4-5 has information about this entitlement.

Diversions under 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 to the MDBA through the Transition Period Water Take Report (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's Water Audit Monitoring Report.

Table 6-35 Entitlement volumes in the Goulburn basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995 [1]	
High-reliability water shares	1,083,821
Low-reliability water shares	469,087
High-reliability supply by agreements	4,456
Low-reliability supply by agreements	1,841
Waterworks districts [2]	2,289
Bulk Entitlement (Quambatook – Grampians Wimmera Mallee Water) Order 2006	100
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
Goulburn system – Melbourne metropolitan retailers	
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
Subtotal: Goulburn system – Melbourne metropolitan retailers	**n/a**
Environmental Entitlement (Goulburn System – Living Murray) 2007	
Living Murray – high-reliability entitlement	39,625
Living Murray – low-reliability entitlement	156,980
Subtotal: 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	
Snowy high-reliability entitlement	30,252
Snowy low-reliability entitlement	8,156
Subtotal: Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	**38,408**
Goulburn River Environmental Entitlement 2010	
Goulburn River high-reliability environmental entitlement	26,555
Goulburn River low-reliability environmental entitlement	5,792
Subtotal: Goulburn River Environmental Entitlement 2010	**32,347**
Goulburn supplement to Broken Creek [5]	40,000
Goulburn supplement to Little Lake Boort [5]	300
Goulburn supplement for Loddon environmental [5]	7,490
Goulburn water quality reserve [5]	30,000
Goulburn exchange rate trade commitment	99,649
Loss provision – irrigation district [6]	298,129

Subtotal: Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995	**2,340,432**
Bulk Entitlement (Broadford, Kilmore and Wallan) Conversion and Augmentation Order 2003 [7]	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 [8]	n/a
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014 [9]	22,000
Silver and Wallaby Creeks Environmental Entitlement 2006 [10]	n/a
Take and use licences – unregulated surface water	15,791
Licensed small catchment dams – on-waterway [11]	8,426
Licensed small catchment dams – off-waterway [11]	14,219
Total (30 June 2019)	**2,408,666**
Total (30 June 2018) [11]	2,380,388

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 includes the volume of water to supply water allowance holders in the Normanville, Tungamah, East Loddon and West Loddon waterworks districts. It excludes the specified volume of water of loss allowance in these districts as well as the volume of water required to supply Grampians Wimmera Mallee Water and Coliban Water's bulk entitlements via these districts.

(3) Together, 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 Goulburn water savings achieved in the previous year under the Goulburn-Murray Water Connections Project stage 1; a specified volume has not been included.

(4) This entitlement provides the VEWH with a total annual allocation of water equal to one-third of the phase 3 Goulburn water savings achieved in the previous year under the Goulburn-Murray Water Connections Project stage 1; a specified volume has not been included.

(5) These are additional supplies (or supplements) the Goulburn system is required to provide to the Broken Creek and Loddon systems and for water quality in the Goulburn system. Schedule 3 of Goulburn-Murray Water's Eildon – Goulburn Weir bulk entitlement sets out the conditions for these supplies to be provided. The Goulburn supplement for Loddon environmental is supplied to the VEWH under VEWH's *Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005* where it is labelled the 'Wimmera-Mallee Pipeline savings entitlement'.

(6) This represents the maximum loss allowance as outlined in the bulk entitlement including loss allowances in the Normanville, East Loddon and Tungamah waterworks districts. The actual loss allowed will vary year to year, based on the rules in the bulk entitlement, actual delivery volumes, carryover or headroom allowance. This loss allowance applied until after the last seasonal determination in April 2019 when it was revised (26 April 2019 and 28 June 2019) as a result of the issue of water recovered as part of stage 1 and stage 2 of the Goulburn-Murray Water Connections Project. For compliance purposes, the loss allowance that applied for 2018–19 (that is, the loss allowance before 26 April 2019) has been included here.

(7) 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).

(8) The Rubicon–Hydro bulk entitlement held by AGL Hydro Ltd is for non-consumptive purposes and therefore a specified volume has not been included. Water diverted under this entitlement is returned to the watercourse.

(9) 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.

(10) The *Silver and Wallaby Creeks Environmental Entitlement 2006* specifies the volume of environmental (passing) flows required to be released for Silver Creek and Wallaby Creek, so a specified volume has not been included.

Table 6-36 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-36 Available water and take for the Goulburn basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Eildon – Goulburn Weir					
Water shares	381,743	1,051,565	(401,628)	**1,031,680**	**682,188**
Supply by agreements	2,217	4,469	(794)	**5,892**	**3,867**
Waterworks districts [1]	-	2,289	(2)	**2,287**	**1,633**
Quambatook – GWMWater	87	100	0	**187**	**103**
Goulburn channel system – CW	361	2,420	(300)	**2,481**	**1,076**
Goulburn River and Eildon – GVW [2]	5,118	26,446	(7,014)	**24,549**	**17,773**
Goulburn channel system – GVW	988	7,191	(1,900)	**6,279**	**5,431**
Goulburn system – Melbourne retailers	19,794	24,126	(22,867)	**21,052**	**0**
Environmental Entitlement Goulburn system – Living Murray [3]	1,792	39,625	14,241	**55,658**	**26,468**
Goulburn system – NVIRP Stage 1 [3]	19,181	25,139	1,358	**45,677**	**15,601**
Goulburn system – Snowy Environmental Reserve	0	30,252	(28,437)	**1,815**	**0**
Goulburn River environmental entitlement [3]	1,108	18,516	196,965	**216,589**	**212,818**
Loss allowance – irrigation district	-	-	-	-	**143,478**
Downstream commitments and waterway losses [4]	-	-	-	-	**141,714**
Diversion: Eildon – Goulburn Weir [5]					**1,252,149**
Broadford, Kilmore and Wallan	-	2,238	0	**2,238**	**1,487**
Buxton	-	110	0	**110**	**0**
Euroa system	-	1,990	0	**1,990**	**821**
Longwood	-	120	0	**120**	**61**
Mansfield	-	1,300	0	**1,300**	**788**
Marysville	-	462	0	**462**	**241**
Pyalong	-	75	0	**75**	**58**
Strathbogie	-	23	0	**23**	**17**
Thornton	-	120	0	**120**	**0**
Upper Delatite	-	235	0	**235**	**96**
Violet Town	-	20	0	**20**	**0**
Woods Point	-	30	0	**30**	**9**
Yea	-	438	0	**438**	**238**
Rubicon – Hydro Ltd	-	0	0	**0**	**0**
Silver and Wallaby creeks – Melbourne Water	-	22,000	0	**22,000**	**356**
Silver and Wallaby Creeks Environmental Entitlement	-	-	-	**-**	**-**
Take and use licences – unregulated surface water	-	15,816	(13)	**15,802**	**5,887**
Licensed small catchment dams [6]	-	22,642	13	**22,655**	**3,873**
Total 2018–19	**432,389**	**1,299,756**	**(250,379)**	**1,481,766**	**1,266,080**
Total 2017–18 [6]	722,380	1,273,358	(255,625)	1,740,113	1,444,116

Notes

(1) Reported volumes relate to water allowance holders 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 147 ML, credited to Goulburn Valley Water for return flows from Goulburn-Murray Water customers.

(3) Water use reported under these entitlements represents both in-stream use and actual diversions from the waterway. Of the 261,258 ML reported, 1,181 ML represents diversions from the waterway.

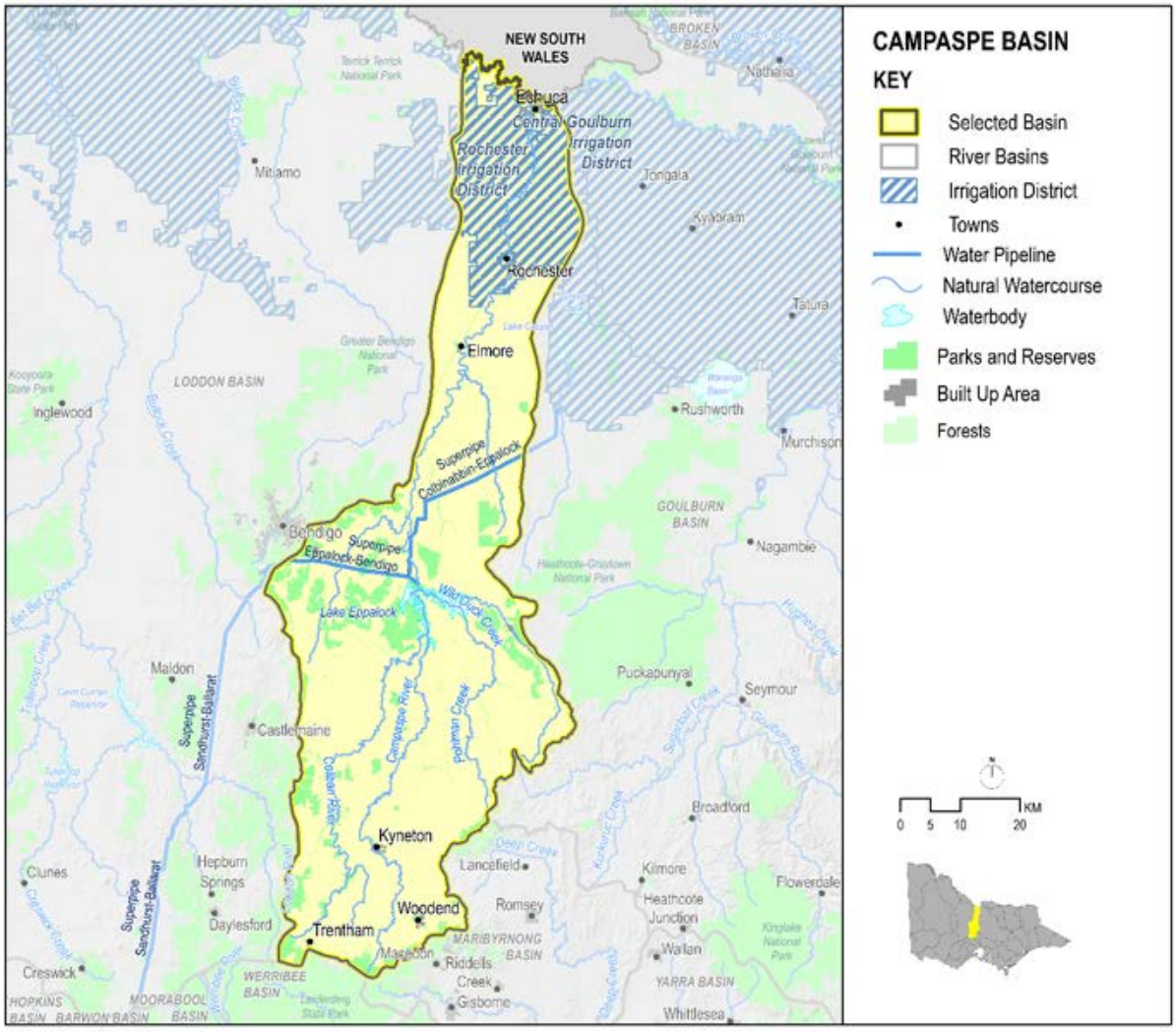
(4) This reflects use of water to manage the system including the net transfer of water to off-stream storages — Waranga basin and Greens Lake — as well as water supplied to the Campaspe, Loddon and Murray rivers during the water year.

(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. It includes environment deliveries in-stream (261,258 ML) as well as environmental diversions off-stream (7,553 ML).

6.7 Campaspe basin

The Campaspe basin (Figure 6-11) is located in 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 Management arrangements

Management of water in the Campaspe basin is undertaken by various parties as shown in Table 6-37.

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

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies Rochester Irrigation District and Campaspe area • Manages licensed diversions • Provides bulk water supply to Coliban Water • Operates Lake Eppalock
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
Western Water	• Supplies urban water for Woodend at the southern end of the basin
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Campaspe basin

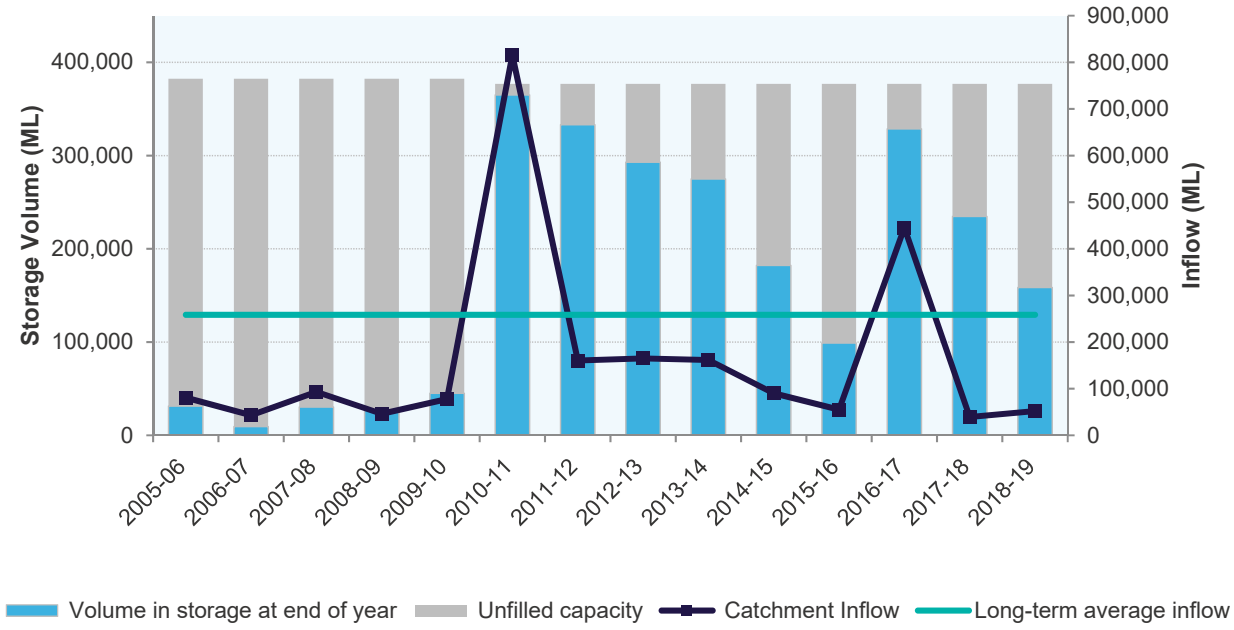
6.7.2 2018–19 water resources overview

In 2018–19, rainfall in most of the Campaspe basin was between 60% and 80% of the long-term average. The southern half of the basin (from Redesdale to the southern edge of the basin) received between 80% and 100% of the long-term average.

Catchment inflows were 20% of the revised long-term average (258,600 ML): more than the inflows recorded in 2017–18, which were 15% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

The volume of water in major storages in the Campaspe basin was 67% of capacity at 1 July 2018 and 42% at 30 June 2019.

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



In 2018–19, the first seasonal allocation for high-reliability water shares was announced on 2 July 2018 at 100%. There was no seasonal determination allocation for low-reliability water shares in 2018–19.

In the Campaspe basin, 17 unregulated streams began 2018–19 with bans on licensed diversions in place. These were lifted at the end of July 2018 for all but six streams, which remained under ban for the entirety of 2018–19. The number of streams restricted increased to 15 in November 2018 and by January 2018 total bans were in place for 18 streams. These remained in place for the rest of the year. Meadow Valley, Mia Mia and Native Gully creeks were unrestricted for the whole of 2018–19.

There were no restrictions on urban water use in the Campaspe basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 47,375 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 45,618 ML diverted in the previous year.

6.7.2.1 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 2018–19, 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
- 6,594 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: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 23,356 ML of environmental water was delivered in-stream in the Campaspe basin.

6.7.3 Water balance

The total volumes of water available and supplied from water resources in the Campaspe basin in 2018–19 are shown in Table 6-38.

Table 6-38 Water balance – Campaspe basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	234,792	328,640
Volume in storage at end of year	1	158,491	234,792
Change in storage		**(76,301)**	**(93,848)**
Inflows			
Catchment inflow	2	51,918	39,477
Rainfall on major storages	1	11,861	36,060
Transfer from Waranga Western Channel to Lake Eppalock		0	0
Transfer to Campaspe basin from Waranga Western Channel		0	82
Treated wastewater discharged back to river	3	635	720
Total inflows		**64,414**	**76,339**
Outflows			
Diversions			
Urban diversions		20,063	19,577
Diversion for Coliban Water rural entitlements		8,648	8,595
Licensed diversions from regulated streams		10,669	9,576
Licensed diversions from unregulated streams		546	661
Small catchment dams	4	6,519	7,210
Transfer from Campaspe basin to Western Waranga Channel		0	0
Transfer from Campaspe basin to White Swan Reservoir		931	0
Total diversions		***47,375***	***45,618***
Losses			
Evaporation losses from major storages		31,284	18,506
Evaporation from small catchment dams	4	5,339	5,796
In-stream infiltration to groundwater, flows to floodplain and evaporation		7,831	5,872
Total losses		***44,454***	***30,174***
Water passed at outlet of basin			
Campaspe River outflows to Murray River	5	48,886	94,395
Total water passed at outlet of basin		***48,886***	***94,395***
Total outflows		**140,715**	**170,187**

6.7.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Campaspe basin are included in the water balance. Table 6-39 shows how storage volumes changed during the year. Rainfall and evaporation estimates cannot be made for Campaspe Weir.

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						
Campaspe Weir	2,624	2,439	n/a	n/a	134	2,573
Lake Eppalock	304,651	185,476	7,455	24,181	(57,764)	110,986
Lauriston Reservoir	19,790	15,700	1,282	2,078	1,136	16,040
Malmsbury Reservoir	12,034	2,735	668	1,015	(142)	2,246
Upper Coliban Reservoir	37,770	28,442	2,456	4,010	(242)	26,646
Total 2018–19	**376,869**	**234,792**	**11,861**	**31,284**	**(56,878)**	**158,491**
Total 2017–18	376,869	328,640	36,060	18,506	(111,402)	234,792

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-40 lists the wastewater treatment plants in the Campaspe basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-40 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Axedale	7	7	100%	7	0	0	0	0	0
Echuca	1,101	1,101	100%	0	1,101	0	0	0	0
Elmore	0	0	0%	0	0	0	0	0	0
Heathcote	110	110	100%	110	0	0	0	0	0
Kyneton	758	327	43%	56	271	0	0	431	0
Lockington	0	0	0%	0	0	0	0	0	0
Rochester	0	0	0%	0	0	0	0	0	0
Woodend	298	94	31%	52	39	0	3	204	0
Total 2018–19	**2,275**	**1,639**	**72%**	**225**	**1,412**	**0**	**3**	**635**	**0**
Total 2017–18	2,977	2,258	76%	252	2,004	0	1	720	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-41 provides information about small catchment dams in the basin.

Table 6-41 Estimated small catchment dam information for the Campaspe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,715	5,207	4,866	10,074
Registered / licensed commercial and irrigation	6,522	1,311	473	1,784
Total 2018–19	**36,237**	**6,519**	**5,339**	**11,858**
Total 2017–18	36,237	7,210	5,796	13,006

5. Water passed at outlet of basin

This volume is the gauged flow from the Campaspe River to the Murray River, measured at Rochester downstream of Waranga Western Channel.

6.7.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Campaspe – Key compliance points

- ✓ **There was a net increase of 15 ML in the total entitlement volume from the previous year.**
  - **Unregulated take and use licence volume increased by 15 ML during the year.**
- ✓ **The total volume diverted (64,593 ML) was within the volume available for the year (114,726 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **under Goulburn-Murray Water's Campaspe system bulk entitlement, four days of minimum-flow non-compliance occurred during the year, due to fluctuations in calculated inflows.**

Entitlements in the Campaspe basin provide the basis for how water is shared in the basin. Rights to water in the Campaspe basin are outlined in Table 6-42.

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.

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 to the MDBA through the Transition Period Water Take Report (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's Water Audit Monitoring Report.

Table 6-42 Entitlement volumes in the Campaspe basin

Water entitlement	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	
Campaspe River TLM high-reliability entitlement	126
Campaspe River TLM low-reliability entitlement	5,048
Subtotal: Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	**5,174**
Campaspe River Environmental Entitlement 2013	
High-reliability entitlement	18,996
Fixed-reliability entitlement	1,656
Low-reliability water shares	2,966
Subtotal: Campaspe River Environmental Entitlement 2013	**23,618**
Campaspe exchange rate trade commitment (3)	368
Provision for system operation (4)	11,441
Subtotal: Bulk Entitlement (Campaspe System – Goulburn-Murray Water) Conversion Order 2000	**83,590**
Bulk Entitlement (Campaspe System – Coliban Water) Conversion Order 1999 (5)	
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 (6)	120
Bulk Entitlement (Woodend) Conversion Order 2004	470
Take and use licences – unregulated surface water (7)	970
Licensed small catchment dams – on-waterway (7)	1,918
Licensed small catchment dams – off-waterway (7)	4,604
Total (30 June 2019)	**141,932**
Total (30 June 2018) (7)	141,917

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) 2018–19 is the first year this component of the entitlement has been reported in the accounts. This detail has been included to provide greater clarity about the entitlement, and it does not represent a change in the entitlement nor its volume.

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

(5) Under this bulk entitlement, Coliban Water releases water from Lake Eppalock, Lauriston Reservoir, Malmsbury Reservoir and Upper Coliban Reservoir 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.

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

(7) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-43 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-43 Permitted and actual take for the Campaspe basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Campaspe system – Goulburn-Murray Water					
Water shares	11,121	23,465	(11,994)	**22,593**	**10,669**
Axedale, Goornong and Rochester	78	349	(200)	**227**	**85**
Campaspe River – Living Murray Initiative [1]	2,978	126	0	**3,104**	**3,104**
Campaspe River Environmental Entitlement [1]	5,983	20,652	3,730	**30,365**	**20,252**
Operating provisions (whole of system) [2]	-	-	-	**-**	**0**
Diversion: Campaspe system – Goulburn-Murray Water [3]				**56,289**	**34,109**
Campaspe system – Coliban Water					
Rural entitlements	-	15,742	0	**15,742**	**8,648**
Urban commitments	-	34,518	0	**34,518**	**19,546**
Operating provisions (whole of system)	-	50,260	-	**50,260**	**28,194**
Diversion: Campaspe system – Coliban Water	-	120	0	**120**	**137**
Trentham	-	470	0	**470**	**295**
Woodend	-	981	10	**991**	**546**
Take and use licences – unregulated surface water	-	6,606	(10)	**6,596**	**1,311**
Licensed small catchment dams [4]	**20,161**	**103,029**	**(8,464)**	**114,726**	**64,593**
Total 2018–19	24,903	126,272	(24,728)	126,447	84,951
Total 2017–18 [5]					

Notes

(1) The water use reported under these two entitlements is in-stream use. It is not included as a diversion for the purposes of the Campaspe basin water balance in Table 6-38.

(2) The water taken under the operating provision 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 2018–19, the supplement was provided to the Goulburn system was 0 ML.

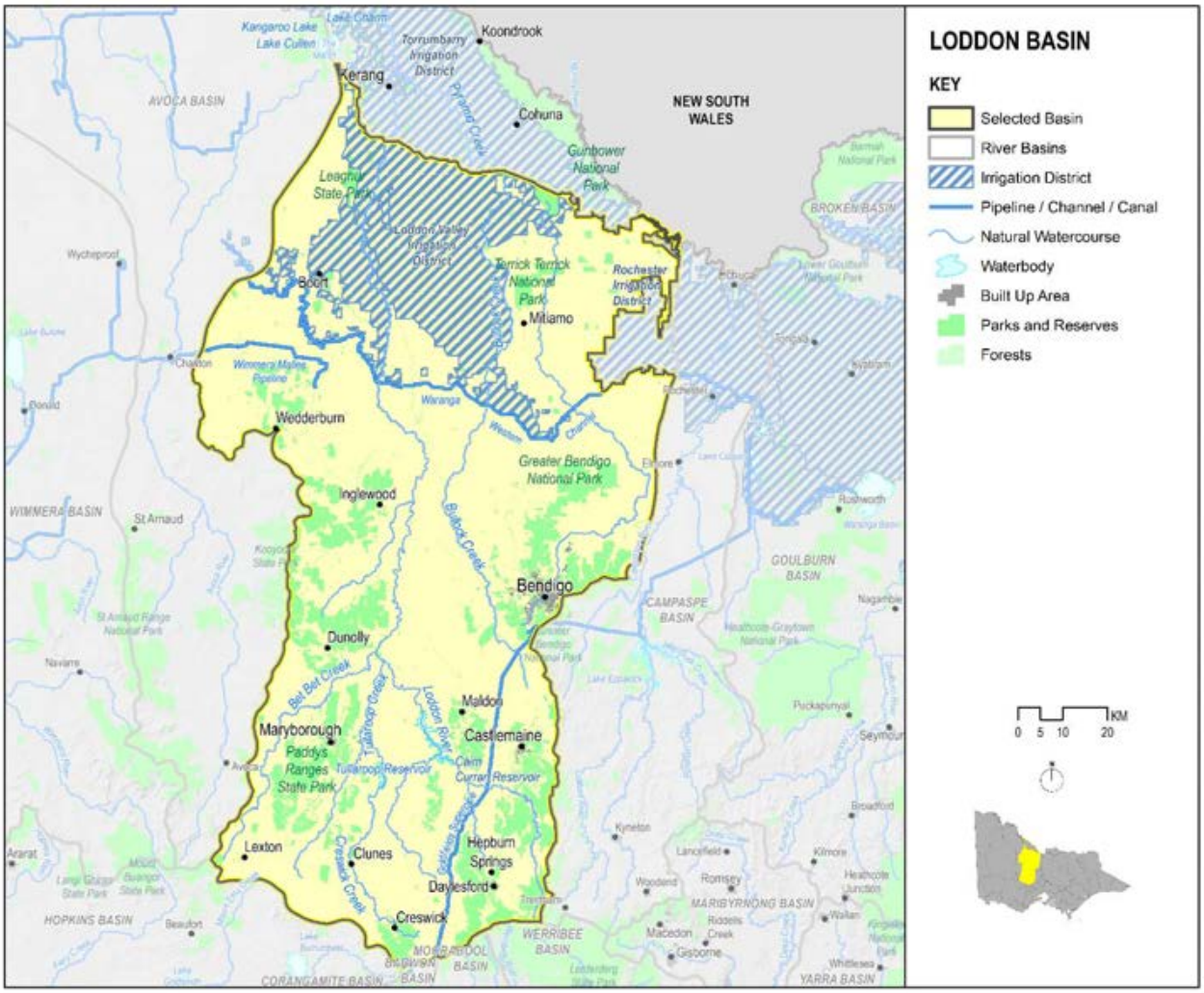
(3) The water taken reported in this line item represents the bulk diversion to supply primary entitlements and fulfil other operating requirements under the Campaspe system source bulk entitlement. It includes environment deliveries in-stream (23,356 ML).

(4) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19, the prior-year totals have been adjusted from the 2017–18 published accounts to reflect this change.

6.8 Loddon basin

The Loddon basin (Figure 6-13) is located in northern Victoria and includes the Loddon River, Bullock Creek and 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 Loddon Valley Irrigation Area). For the purposes of the Loddon water balance, the Loddon basin excludes the Torrumbarry Irrigation Area (supplied mostly from the Murray River) and the Loddon Valley Irrigation Area.

Figure 6-13 Map of the Loddon basin



6.8.1 Management arrangements

Management of water in the Loddon basin is undertaken by various parties as shown in Table 6-44.

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

Authority	Management responsibilities
Goulburn-Murray Water	• Supplies the Loddon Valley Irrigation Area and domestic and stock supplies in Normanville, East Loddon and West Loddon waterworks districts 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
Coliban Water	• Supplies towns in the eastern and northern parts of the Loddon basin including Bendigo, Castlemaine, Wedderburn, Mitiamo, Pyramid Hill and Boort
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Loddon basin

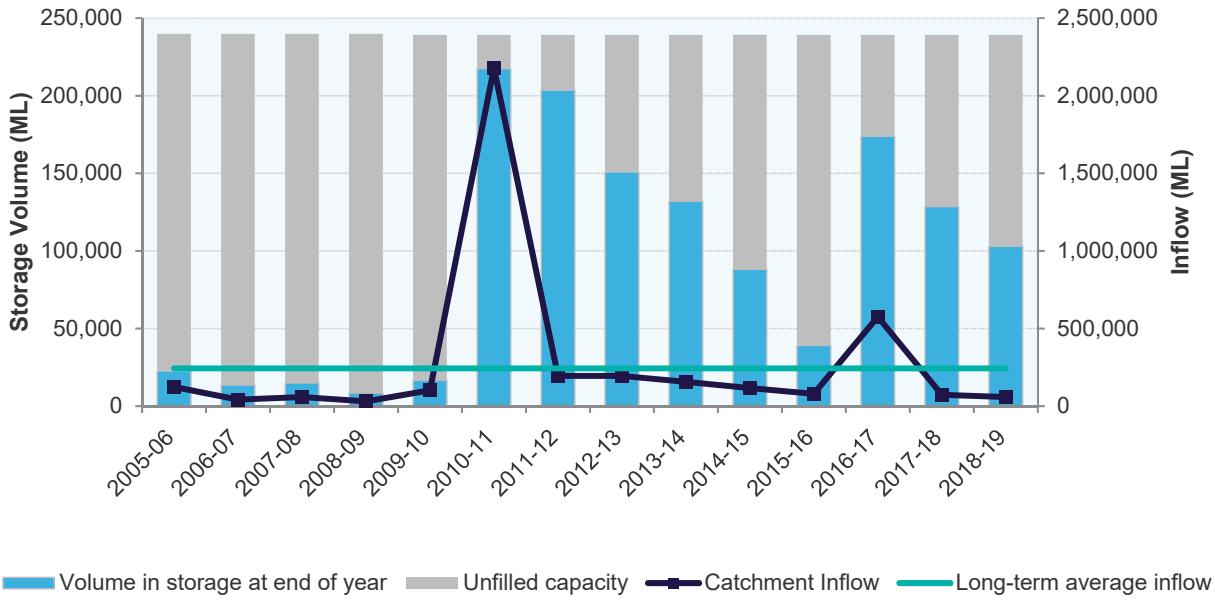
6.8.2 2018–19 water resources overview

In 2018–19, rainfall in most of the north and north-east of the basin was between 60% to 80% of the long-term average, with the south of the basin receiving between 80% and 100% of the long-term average. The lowest rainfall was received along the northern edge of the basin, with between 40% and 60% of the long-term average received.

Catchment inflows in 2018–19 were 24% of the long-term average annual volume of 243,400 ML: less than the inflows recorded in 2017–18, which were 29% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

The volume of water in major storages in the Loddon basin was 53% of capacity at the start of the year, and after below-average rainfall was received storages were 42% full by the end of June 2019.

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



On 2 July 2018, allocations for high-reliability water shares were announced at 32% allocation in the Loddon system. This increased to 100% by March 2019. No allocations were made to low-reliability water shares during the year. The Bullarook system received an initial allocation of 0% for high-reliability water shares, which reached 100% by September 2018. Low-reliability water shares also reached 100% by October 2018.

On 1 July 2018, Coliban Water announced a 2018–19 seasonal determination of 100% for its rural system (located in the Loddon basin but supplied out the of Campaspe system).

In July 2018, there were total bans on licensed diversions on 16 streams, and these bans were lifted on all but six streams from August to October 2018. Total bans were in place on diversions from most streams from November 2018 to May 2019, with a peak of 29 streams with total bans in place from March to April 2019. All of these bans except 17 continued for the remainder of 2018–19. Total bans were in place on five streams, and Twelve Mile Creek remained unrestricted for the whole of the year.

There were no restrictions on urban water use in the Loddon basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 28,589 ML of water was diverted from the Loddon basin for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 43,840 ML diverted in the previous year.

6.8.2.1 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 flows 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 endangered freckled duck and little bittern. Tullaroop Creek in the Loddon River system also has a population of regionally significant blackfish.

In 2018–19, water for the environment sourced from the Loddon basin comprised:

- the *Bulk Entitlement (Loddon River – Environmental Water Reserve) Order 2005*, which includes 3,480 ML high-reliability, 2,024 ML of low-reliability and 7,490 ML of provisional-reliability entitlements, passing flows and river freshening flows 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: this water also provides social, recreational and cultural benefits.

A total of 16,108 ML of environmental water was used in the Loddon basin in 2018–19: 7,198 ML of this was diverted off-stream, and the remaining 8,910 ML was delivered in-stream. 6,372 ML of the diversion was supplied from the Goulburn system to Little Lake Boort and Loddon Weir, so it is reported as a diversion from the Goulburn system water balance. Only 826 ML was diverted from the Loddon system.

6.8.3 Water balance

The total volumes of water available and supplied from water resources in the Loddon basin in 2018–19 are shown in Table 6-45.

Table 6-45 Water balance – Loddon basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	124,501	170,572
Volume in storage at end of year	1	98,211	124,501
Change in storage		**(26,290)**	**(46,071)**
Inflows			
Catchment inflow	2	58,090	71,767
Rainfall on major storages		8,554	10,631
Treated wastewater discharged back to river	3	5,167	5,645
Total inflows		**71,811**	**88,043**
Outflows			
Diversions			
Urban diversions		3,191	4,119
Licensed diversions and irrigation diversions from regulated streams		12,136	16,545
Transfer to Goulburn basin (through Loddon supplement)	4	0	8,554
Licensed diversions from unregulated streams	5	4,994	4,100
Environmental water diversions		826	3,047
Small catchment dams	6	7,442	7,475
Total diversions		***28,589***	***43,840***
Losses			
Evaporation losses from major storages		22,383	29,006
Evaporation from small catchment dams	6	6,145	6,624
In-stream infiltration to groundwater, flows to floodplain and evaporation		13,996	20,536
Total losses		***42,524***	***56,166***
Water passed at outlet of basin			
Loddon River outflow to Murray River (Appin South)		25,270	30,008
Wandella Creek at Fairley		0	0
Mount Hope Creek at Mitiamo		1,697	4,082
Bullock Creek, Calivil Creek and Nine Mile Creek		21	18
Total water passed at outlet of basin		***26,988***	***34,107***
Total outflows		**98,101**	**134,114**

6.8.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Loddon basin are included in the water balance. Table 6-46 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

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	77,728	3,497	11,432	(15,743)	54,050
Hepburn Lagoon	2,424	1,178	840	1,243	604	1,378
Laanecoorie Reservoir	8,000	3,020	1,722	2,868	4,380	6,255
Newlyn Reservoir	3,012	1,554	476	740	1,015	2,306
Tullaroop Reservoir	72,950	41,021	2,019	6,100	(2,717)	34,222
Sub-total	**233,516**	**124,501**	**8,554**	**22,383**	**(12,461)**	**98,211**
Off-stream storages						
Evansford Reservoir	1,346	1,009	99	260	524	1,371
Sandhurst Reservoir	2,595	2,180	123	296	392	2,399
Spring Gully Reservoir	1,680	917	148	288	240	1,017
Sub-total	**5,621**	**4,106**	**370**	**844**	**1,155**	**4,787**
Total 2018–19	**239,137**	**128,607**	**8,924**	**23,226**	**(11,306)**	**102,998**
Total 2017–18	239,170	173,987	11,588	29,822	(27,146)	128,607

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-47 lists the wastewater treatment plants in the Loddon basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-47 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bendigo	5,565	1,595	29%	1,191	404	0	0	3,969	0
Boort	5	5	100%	0	5	0	0	0	0
Bridgewater / Inglewood	0	0	0%	0	0	0	0	0	0
Castlemaine	1,309	111	9%	111	0	0	0	1,198	0
Clunes	23	23	100%	0	23	0	0	0	0
Daylesford	403	403	100%	12	390	0	0	0	0
Dunolly	4	4	100%	0	4	0	0	0	0
Kerang	521	0	0%	0	0	0	0	0	521
Maryborough	481	481	100%	29	452	0	0	0	0
Pyramid Hill	0	0	0%	0	0	0	0	0	0
Waubra	12	12	100%	0	12	0	0	0	0
Wedderburn	0	0	0%	0	0	0	0	0	0
Total 2018–19	**8,323**	**2,634**	**32%**	**1,343**	**1,290**	**0**	**0**	**5,167**	**521**
Total 2017–18	8,774	2,530	29%	1,297	1,232	0	0	5,645	600

4. Loddon supplement to the Goulburn

The Loddon supplement to the Goulburn provides supplementary supply to the Goulburn system from the Waranga Western Channel west of Loddon River via Serpentine Creek, in accordance with arrangements set out in *Bulk Entitlement (Loddon System – Goulburn-Murray Water) Conversion Order 2005*. As such, the volume is reported in this water balance as a transfer to the Goulburn basin.

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-48 provides information about small catchment dams in the basin.

Table 6-48 Estimated small catchment dam information for the Loddon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	42,665	4,884	5,221	10,106
Registered / licensed commercial and irrigation	16,978	2,558	923	3,481
Total 2018–19	**59,642**	**7,442**	**6,145**	**13,587**
Total 2017–18	59,642	7,475	6,624	14,099

6.8.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Loddon – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (39,503 ML) was within the volume available for the year (72,645 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Loddon basin provide the basis for how water is shared in the basin. Rights to water in the Loddon basin are outlined in Table 6-49.

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.

Diversions under 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 to the MDBA through the Transition Period Water Take Report (refer to the MDBA's website > Publications). Before this, details of this assessment were published annually in the MDBA's Water Audit Monitoring Report.

Table 6-49 Entitlement volumes in the Loddon basin

Water entitlement	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	8,079
Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005	
Loddon wetland entitlement	2,000
Loddon system – East Loddon Waterworks District modernisation savings entitlement	1,480
Loddon system – Wimmera-Mallee Pipeline savings entitlement (2)	7,490
Loddon environmental low-reliability entitlement	2,024
Subtotal: 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
Loddon supplement to the Goulburn (3)	n/a
Subtotal: Bulk Entitlement (Loddon System – Goulburn-Murray Water) Conversion Order 2005	**132,484**
Bulk Entitlement (Bullarook system – Goulburn-Murray Water) Conversion Order 2009 (4)	
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	15,954
Licensed small catchment dams – on-waterway (5)	6,165
Licensed small catchment dams – off-waterway (5)	10,808
Total (30 June 2019)	**83,610**
Total (30 June 2018) (5)	83,611

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) This entitlement is supplied from the Goulburn system by Goulburn-Murray Water under the *Bulk Entitlement (Eildon – Goulburn Weir) Conversion Order 1995*. The volume is also included in the Goulburn basin as a component of the Eildon – Goulburn Weir bulk entitlement called the 'Goulburn supplement for Loddon environmental'.

(3) The Loddon supplement to the Goulburn provides for Loddon system water to be supplied to the Goulburn system from the Waranga Western Channel west of Loddon River via Serpentine Creek. Goulburn-Murray Water's 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 and sufficient water is held in storage, additional resources in the Loddon system can be used to supplement the Goulburn system.

(4) 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.

(5) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change and correct an error regarding the Loddon supplement to the Goulburn. Chapter 6.1 explains the change.

Table 6-50 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-50 Available water and take for the Loddon basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Loddon system – Goulburn-Murray Water					
Water shares – Loddon	3,490	18,995	(10,026)	**12,459**	**8,083**
Loddon River – Environmental Reserve (1)	3,248	8,402	6,636	**18,286**	**15,547**
Loddon system – Part Maryborough – Central Highlands Water (2)	900	1,200	(263)	**1,837**	**1,077**
Loddon system – Coliban Water	165	655	0	**820**	**417**
Loddon supplement to the Goulburn (3)	-	-	-	**-**	**0**
Operating provisions (whole of system) (4)	-	-	-	**-**	**3,175**
Diversion: Loddon system – Goulburn-Murray Water (5)					**28,299**
Bullarook system – Goulburn-Murray Water					
Water shares – Bullarook	210	928	(11)	**1,128**	**879**
Bullarook system – Central Highlands Water	238	263	11	**511**	**510**
Environmental Entitlement Birch Creek – Bullarook system (6)	100	100	0	**200**	**0**
Diversion: Bullarook system – Goulburn-Murray Water (7)					**1,389**
Creswick	-	500	0	**500**	**245**
Daylesford – Hepburn Springs	-	916	0	**916**	**640**
Evansford-Talbot system – Part Maryborough – Central Highlands Water (2)	-	3,000	0	**3,000**	**1,378**
Lexton	-	45	0	**45**	**0**
Take and use licences – unregulated surface water	-	15,999	(7)	**15,991**	**4,994**
Licensed small catchment dams (8)	-	16,969	(16)	**16,952**	**2,558**
Total 2018–19	**8,350**	**67,971**	**(3,676)**	**72,645**	**39,503**
Total 2017–18 (8)	9,946	68,524	(3,183)	75,287	52,691

Notes

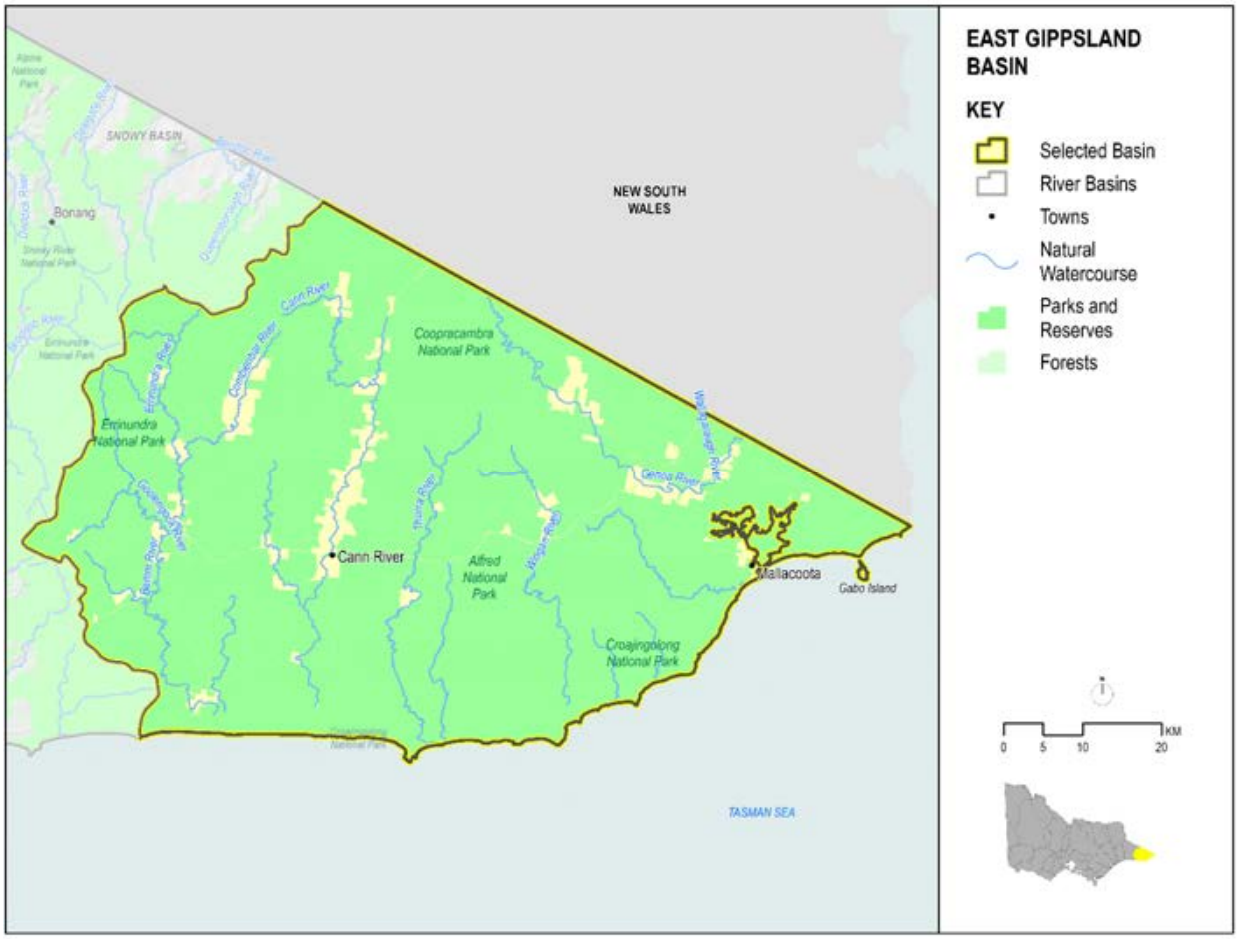
(1) The water taken under this entitlement reported here reflects the volume of water delivered under the components of the entitlement listed in Table 6-49. River freshening flows were also delivered under this entitlement, and they are not included in this table (561 ML). Part of this entitlement is supplied from the Goulburn system to Little Lake Boort and Loddon Weir; 6,372 ML was taken in 2018–19 under this component of the entitlement and is reported as a diversion in the Goulburn basin water balance. In the portion supplied from the Loddon basin, 826 ML of the water taken was diverted off-stream.

(2) The water taken under the Loddon system – Part Maryborough – Central Highlands Water bulk entitlement (1,077 ML) is transferred to the Evansford-Talbot system for supply to Maryborough. This water is then delivered to Maryborough under the Evansford-Talbot system – Part Maryborough – Central Highlands Water entitlement. This means that of the 1,378 ML supplied to Maryborough, 1,077 ML was supplied from the Loddon system.
(3) The Loddon supplement to the Goulburn supplies Loddon system 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. During 2018–19, there were no transfers from the Loddon system to the Goulburn system under this entitlement.
(4) This reflects use of water to manage the Loddon system. It equals the amount diverted to Serpentine Creek and not used by customers.
(5) 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. It includes environment deliveries in-stream (14,211 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 taken reported in this line item represents the bulk diversion to supply primary entitlements under the Bullarook system source bulk entitlement.
(8) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change.

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 Management arrangements

Management of water in the East Gippsland basin is undertaken by various parties as shown in Table 6-51.

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

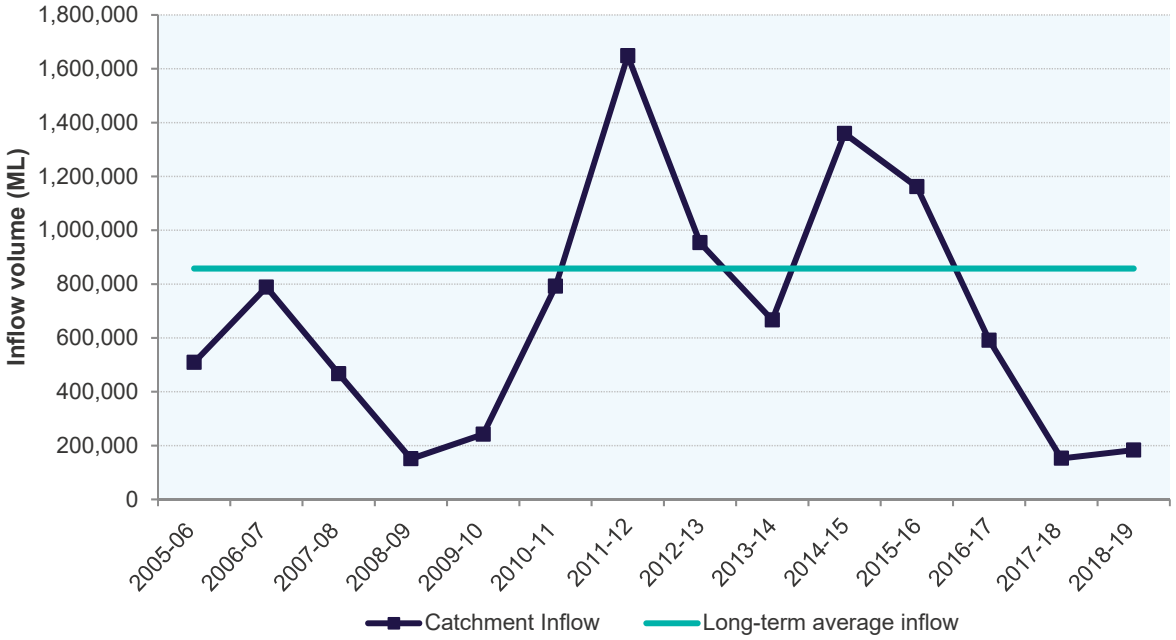
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies urban water to towns including Mallacoota, Cann River and Bemm River
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the entire East Gippsland basin

6.9.2 2018–19 water resources overview

In 2018–19, rainfall in the eastern and western corners of the East Gippsland basin was between 60% and 80% of the long-term average, and 80% to 100% in the centre.

Catchment inflows were 21% of the long-term annual average of 857,700 ML, more than the inflows recorded in 2017–18, which were 18% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. Consumptive use in the basin is generally very low compared to water availability, and almost 100% of total inflows passed to Bass Strait in 2018–19.

Figure 6-16 Catchment inflows in the East Gippsland basin



The only restriction placed on licensed diversions in East Gippsland basin during 2018–19 was in January 2019, with a ban implemented for the upstream section of the Cann River East Branch.

There were no restrictions on urban water use in the East Gippsland basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 446 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 529 ML diverted in the previous year.

6.9.2.1 Water for the environment

Environmental assets that rely on water in the East Gippsland basin include:

- the Bemm, Cann and Genoa rivers, which all feed into high-value wetlands
- 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 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.9.3 Water balance

The total volumes of water available and supplied from water resources in the East Gippsland basin in 2018–19 are shown in Table 6-52.

Table 6-52 Water balance – East Gippsland basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	182,905	152,362
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	0	0
Total inflows		**182,905**	**152,362**
Outflows			
Diversions			

Urban diversions		97	118
Licensed diversions from unregulated streams		64	49
Small catchment dams	4	285	362
Total diversions		***446***	***529***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	165	237
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***165***	***237***
Water passed at outlet of basin			
River outflows to the ocean	6	182,294	151,596
Total water passed at outlet of basin		***182,294***	***151,596***
Total outflows		**182,905**	**152,362**

6.9.3.1 Notes to the water balance

1. Storage

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

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-53 lists the wastewater treatment plants in the East Gippsland basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-53 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bemm River	7	7	100%	0	7	0	0	0	0
Cann River	27	27	100%	0	27	0	0	0	0
Mallacoota	57	57	100%	0	57	0	0	0	0
Total 2018–19	**91**	**91**	**100%**	**0**	**91**	**0**	**0**	**0**	**0**
Total 2017–18	73	73	100%	0	73	0	0	0	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-54 provides information about small catchment dams in the basin.

Table 6-54 Estimated small catchment dam information for the East Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	1,094	246	154	400
Registered / licensed commercial and irrigation	176	39	11	50
Total 2018–19	**1,271**	**285**	**165**	**450**
Total 2017–18	1,271	362	237	599

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the East Gippsland basin as no suitable models are available and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses: see chapter 6.1.2 for details.

6. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the East Gippsland basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method uses streamflow data from a new

gauge (which is downstream of the previous sites used) and estimates of outflows from small coastal streams, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to the ocean by 8% for 2018–19; the previous estimate would have resulted in outflows of 169,233 ML.

6.9.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

East Gippsland – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (200 ML) was within the volume available for the year (1,455 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the East Gippsland basin provide the basis for how water is shared in the basin. Rights to water in the East Gippsland basin are outlined in Table 6-55.

Table 6-55 Entitlement volumes in the East Gippsland basin

Water entitlement	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 (1)	657
Licensed small catchment dams – off-waterway (1)	176
Total (30 June 2019)	**1,455**
Total (30 June 2018) (1)	1,455

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-56 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-56 Available water and take for the East Gippsland basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Bemm River	-	100	0	**100**	**18**
Cann River	-	192	0	**192**	**33**
Mallacoota	-	330	0	**330**	**47**
Take and use licences – unregulated surface water	-	657	0	**657**	**64**
Licensed small catchment dams (1)	-	176	0	**176**	**39**
Total 2018–19	**-**	**1,455**	**0**	**1,455**	**200**
Total 2017–18 (1)	-	1,457	0	1,457	170

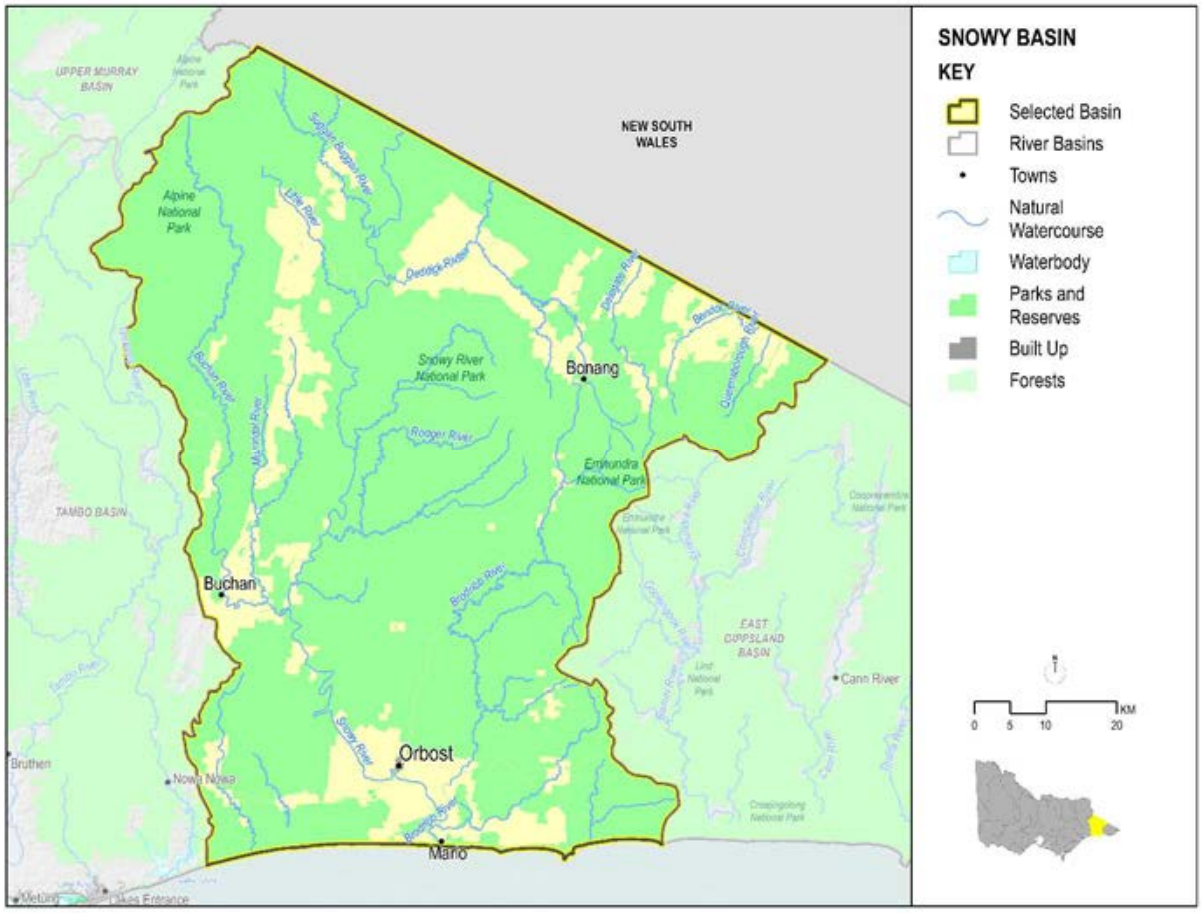
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

6.10 Snowy basin

Victoria's Snowy basin (Figure 6-17) is located in east Gippsland. 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. Major tributaries within the Victorian basin include the Deddick River, Buchan River and Brodribb River, which join the Snowy River before it flows into Bass Strait at Marlo. As these accounts provide a record of water availability and use across Victoria, this chapter only considers the portion of the Snowy basin located in Victoria.

Figure 6-17 Map of the Snowy basin



6.10.1 Management arrangements

Management of water in the Victorian portion of the Snowy basin is undertaken by various parties as shown in Table 6-57. In the New South Wales portion of the Snowy basin, Snowy Hydro Limited releases water under a licence issued by that state's Department of Planning, Industry and Environment.

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

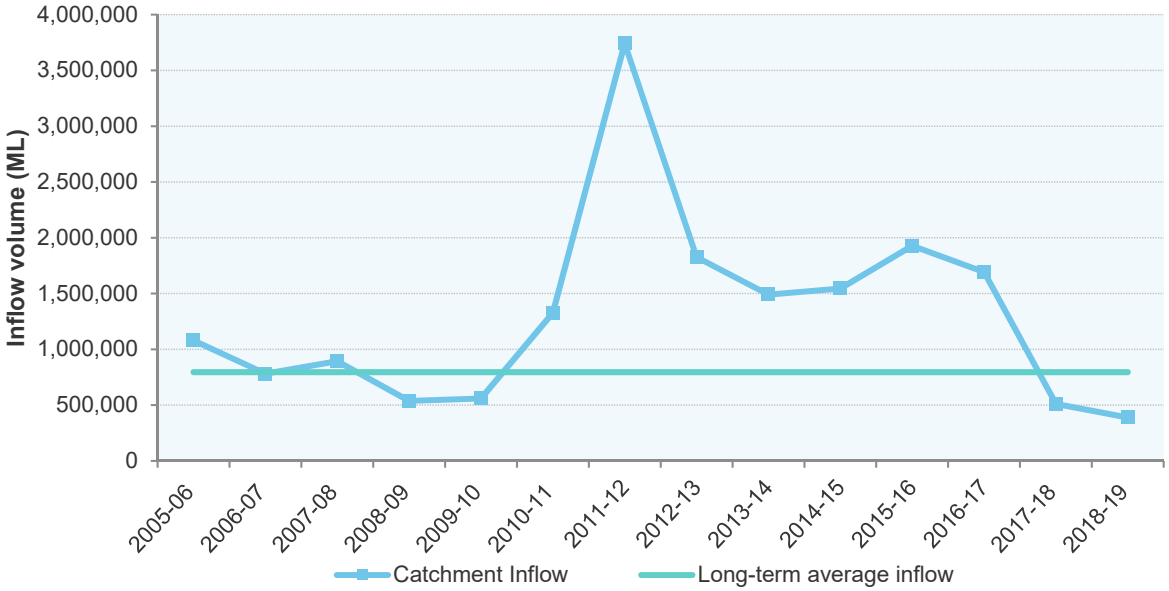
Authority	Management responsibilities
Southern Rural Water	• Manages surface water licensed diversions
East Gippsland Water	• Supplies towns including Buchan, Orbost and Marlo
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Victorian Snowy basin

6.10.2 2018–19 water resources overview

In 2018–19, the southern half of the Snowy basin received between 60% and 80% of long-term average rainfall, and the northern half received between 80% to 100%.

Catchment inflows were 49% of the long-term annual average of 795,600 ML, less than the inflows recorded in 2017–18, which were 64% of the long-term average.

Figure 6-18 Catchment inflows in the Snowy basin



The Jarrahmond section of the Snowy River remained unrestricted for the entirety of 2018–19. The Buchan River remained unrestricted from July through to December 2018, with stage 1 restrictions implemented for January 2019 only.

There were no restrictions on urban water use in the Snowy basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 3,151 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 2,683 ML diverted in the previous year.

6.10.2.1 Water for the environment

The health of the Snowy River depends on water. Environmental assets include:

- Australian grayling populations, heritage river reaches, the Ewings Marsh wetlands complex and the Snowy River daisy
- freshwater species (such as river blackfish and Australian grayling) found in the upper reaches and tributaries of the Snowy River
- the lower reaches of the Snowy River, which support species including estuary perch and Australian bass that move between saltwater and freshwater systems
- estuarine and saltwater species (such as flathead, mulloway and black bream) contained in the estuary
- the nationally important floodplain wetlands of the Snowy River near Marlo, which provide feeding and breeding areas for wetland and migratory birds.

In 2018–19, 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 recovered for the environment as part of the Snowy Water Inquiry and released by Snowy Hydro in accordance with conditions of its water licence
- 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
- 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: this water also provides social, recreational and cultural benefits.

A total of 138,400 ML of environmental water was delivered from the Snowy Mountains Hydro-Electric Scheme to the Snowy River between 1 April 2018 and 31 May 2019: the 2018–19 water year as defined under the Snowy Water Licence. This water was released downstream of Jindabyne Dam and Mowamba Weir in New South Wales, and it included 9,000 ML of passing flows and 129,400 ML of water recovered as part of the Snowy Water Inquiry.

6.10.3 Water balance

The total volumes of water available and supplied from water resources in the Snowy basin in 2018–19 are shown in

Table 6-58. As these accounts provide a record of water availability and use across Victoria, this balance only considers the Victorian portion of the Snowy basin.

Table 6-58 Water balance – Snowy basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow from Victoria	2	388,996	509,899
Catchment inflow from NSW	2	163,425	248,869
Rainfall on major storages	1	-	-
Treated effluent discharged back to river	3	0	0
Total inflows		**552,421**	**758,768**
Outflows			
Diversions			
Urban diversions		755	723
Licensed diversions from unregulated streams	4	1,433	868
Small catchment dams	5	963	1,092
Total diversions		***3,151***	***2,683***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	5	896	1,154
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***896***	***1,154***
Water passed at outlet of basin			
River outflows to the ocean	7	548,373	754,931
Total water passed at outlet of basin		***548,373***	***754,931***
Total outflows		**552,421**	**758,768**

6.10.3.1 Notes to the water balance

1. Storage

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

2. Catchment inflow

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

Catchment inflow from New South Wales is recorded as the volume flowing from the Snowy River at Burnt Hut Crossing (gauge 222013).

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-59 lists the wastewater treatment plants in the Snowy basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-59 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Orbost	174	174	100%	0	174	0	0	0	0
Total 2018–19	**174**	**174**	**100%**	**0**	**174**	**0**	**0**	**0**	**0**
Total 2017–18	161	161	100%	0	161	0	0	0	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-60 provides information about small catchment dams in the basin.

Table 6-60 Estimated small catchment dam information for the Snowy basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	2,840	649	779	1,427
Registered / licensed commercial and irrigation	1,590	314	118	432
Total 2018–19	**4,430**	**963**	**896**	**1,859**
Total 2017–18	4,430	1,092	1,154	2,245

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Snowy basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Snowy basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method also includes estimates of outflows from small coastal streams in the calculation, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to the ocean by 3% for 2018–19. The previous estimate would have resulted in outflows of 534,915 ML.

6.10.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Snowy – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (2,502 ML) was within the volume available for the year (7,710 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Snowy basin provide the basis for how water is shared in the basin. Rights to water in the Snowy basin are outlined in Table 6-61.

Table 6-61 Entitlement volumes in the Snowy basin

Water entitlement	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	3,919
Licensed small catchment dams – on-waterway (1)	30
Licensed small catchment dams – off-waterway (1)	1,560
Total (30 June 2019)	**7,710**
Total (30 June 2018) (1)	7,710

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-62 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-62 Available water and take for the Snowy basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Buchan	-	170	0	**170**	**18**
Orbost system	-	2,031	0	**2,031**	**737**
Take and use licences – unregulated surface water	-	3,947	0	**3,947**	**1,433**
Licensed small catchment dams (1)	-	1,562	0	**1,562**	**314**
Total 2018–19	**-**	**7,710**	**0**	**7,710**	**2,502**
Total 2017–18 (1)	-	7,719	0	7,719	1,956

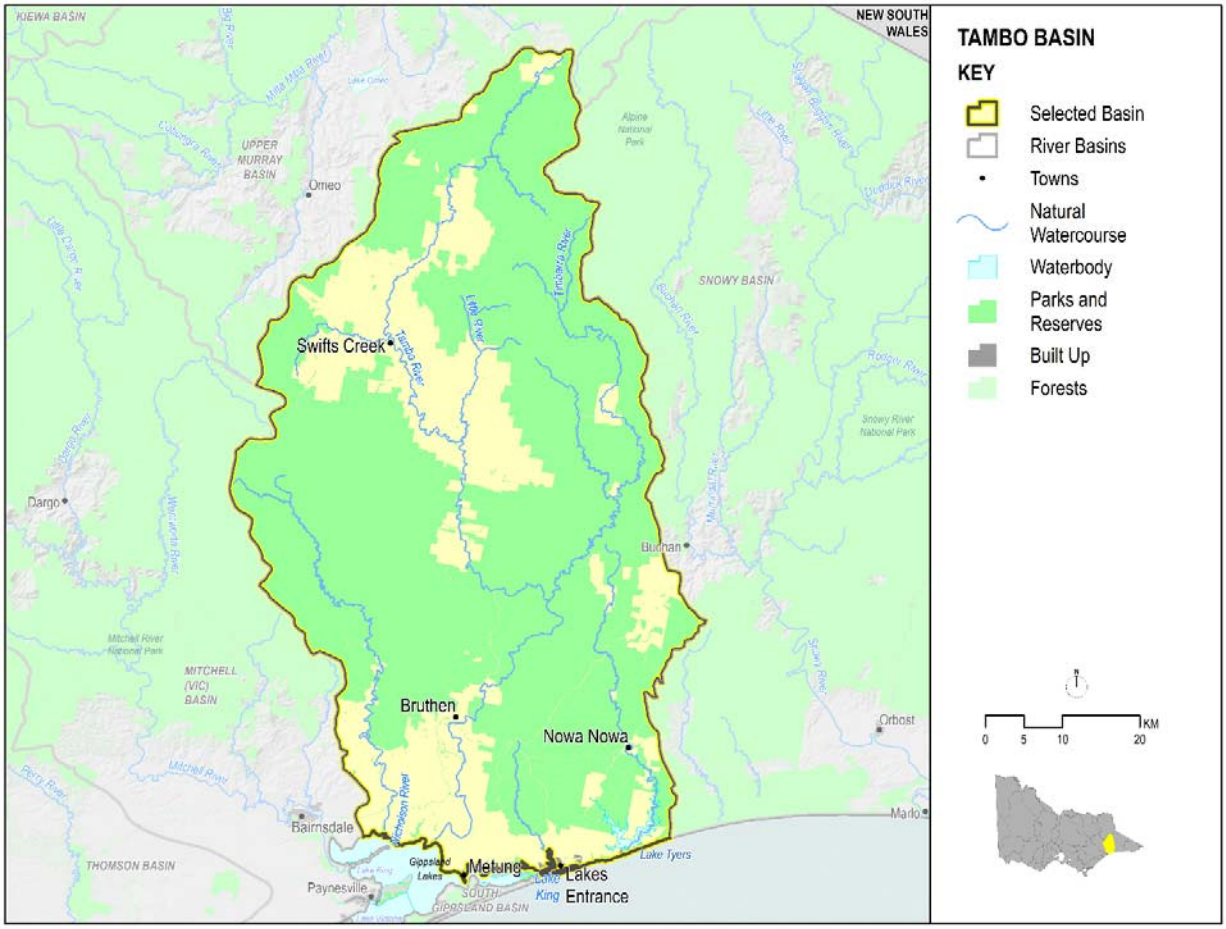
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.11.1 Management arrangements

Management of water in the Tambo basin is undertaken by various parties as shown in Table 6-63.

Table 6-63 Responsibilities for water resources management in the Tambo basin

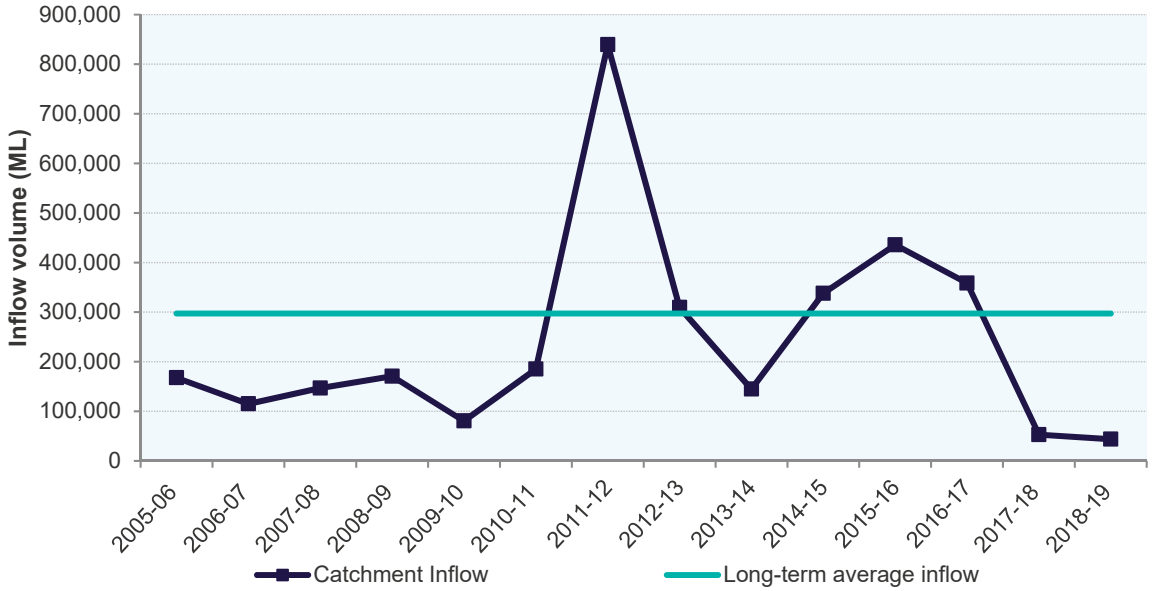
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies Swifts Creek; towns including Lakes Entrance, Bruthen and Nowa Nowa are supplied from neighbouring basins
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Tambo basin

6.11.2 2018–19 water resources overview

In 2018–19, rainfall in most of the Tambo basin was between 60% and 80% of the long-term average, and rainfall in the northern corner was between 80% and 100%.

Catchment inflows in 2018–19 were 15% of the long-term average annual volume of 297,200 ML, lower than the inflows recorded in 2017–18, which were 18% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. Diversions in the Tambo basin are minor compared to the total water resource. Swifts Creek is the only town supplied by the Tambo basin, while larger towns (such as Lakes Entrance and Bruthen) are supplied by the Bairnsdale water system (sourcing water from the Mitchell basin). Overall, about 94% of the basin inflows passed through to the Gippsland Lakes in 2018–19.

Figure 6-20 Catchment inflows in the Tambo basin



There were no restrictions on licensed diversions from unregulated streams in the Tambo basin from July to December 2018. Total bans on licensed diversions were placed on the Tambo River from January and were lifted in April 2019. The Tambo River downstream of Ramrod Creek had a stage 1 roster in place for the month of January 2019.

There were no restrictions on urban water use in the Tambo basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 1,710 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 1,563 ML diverted in the previous year.

6.11.2.1 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 Tambo and Nicholson rivers.

The Tambo River has an extensive estuary extending from The Cliffs (upstream of the town of Swan Reach) to the Gippsland Lakes at Lake King. Significant wetlands along the estuary reach of the river include the East Swamps (south of Sardine Flat Road), Lake King Wetlands and Russells Swamp.

The Nicholson River has an extensive estuary reach that extends from the Great Alpine Road bridge at Sarsfield to where the river enters the Gippsland Lakes at Jones Bay. There are several important wetlands on both sides of the river, the largest being Bosses Swamp and Nebbor Swamp.

In 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.11.3 Water balance

The total volumes of water available and supplied from water resources in the Tambo basin in 2018–19 are shown in Table 6-64.

Table 6-64 Water balance – Tambo basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		-	-
Inflows			
Catchment inflow	2	43,687	52,882
Rainfall on major storages		-	-
Treated wastewater discharged back to river	3	0	0

Total inflows		**43,687**	**52,882**
Outflows			
Diversions			
Urban diversions		29	28
Licensed diversions from unregulated streams	4	900	624
Small catchment dams	5	781	912
Total diversions		***1,710***	***1,563***
Losses			
Evaporation losses from major storages			
Evaporation from small catchment dams	5	929	1,090
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***929***	***1,090***
Water passed at outlet of basin			
River outflows to the ocean	7	41,048	50,229
Total water passed at outlet of basin		***41,048***	***50,229***
Total outflows		**43,687**	**52,882**

6.11.3.1 Notes to the water balance

1. Storage

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

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-65 lists the wastewater treatment plants in the Tambo basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance, but in 2018–19 there were no such discharges into the Tambo basin's waterways. In 2018–19, 100% of wastewater passing through treatment plants in the Tambo basin was recycled and used for agricultural applications including pastures, tree plantations, racecourses and golf courses.

Table 6-65 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Lakes Entrance	575	575	100%	0	575	0	0	0	0
Metung	226	226	100%	0	226	0	0	0	0
Total 2018–19	**801**	**801**	**100%**	**0**	**801**	**0**	**0**	**0**	**0**
Total 2017–18	862	862	100%	0	862	0	0	0	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-66 provides information about small catchment dams in the basin.

Table 6-66 Estimated small catchment dam information for the Tambo basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,933	646	867	1,513
Registered / licensed commercial and irrigation	1,357	135	62	197
Total 2018–19	**6,289**	**781**	**929**	**1,710**
Total 2017–18	6,289	912	1,090	2,002

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Tambo basin as there are no suitable models and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Tambo basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method also includes estimates of outflows from small coastal streams in the calculations, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to the ocean by 10% for 2018–19. The previous estimate would have resulted in outflows of 37,289 ML.

6.11.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Tambo – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (1,064 ML) was within the volume available for the year (5,744 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Tambo basin provide the basis for how water is shared in the basin. Rights to water in the Tambo basin are outlined in Table 6-67.

Table 6-67 Entitlement volumes in the Tambo basin

Water entitlement	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	4,043
Licensed small catchment dams – on-waterway (1)	106
Licensed small catchment dams – off-waterway (1)	1,251
Total (30 June 2019)	**5,741**
Total (30 June 2018) (1)	5,744

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-68 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-68 Available water and take for the Tambo basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Nowa Nowa [1]	-	118	0	**118**	**0**
Swifts Creek	-	224	0	**224**	**29**
Take and use licences – unregulated surface water	-	4,045	0	**4,045**	**900**
Licensed small catchment dams [2]	-	1,357	0	**1,357**	**135**
Total 2018–19	**-**	**5,744**	**0**	**5,744**	**1,064**
Total 2017–18 [2]	-	5,746	0	5,746	814

Notes

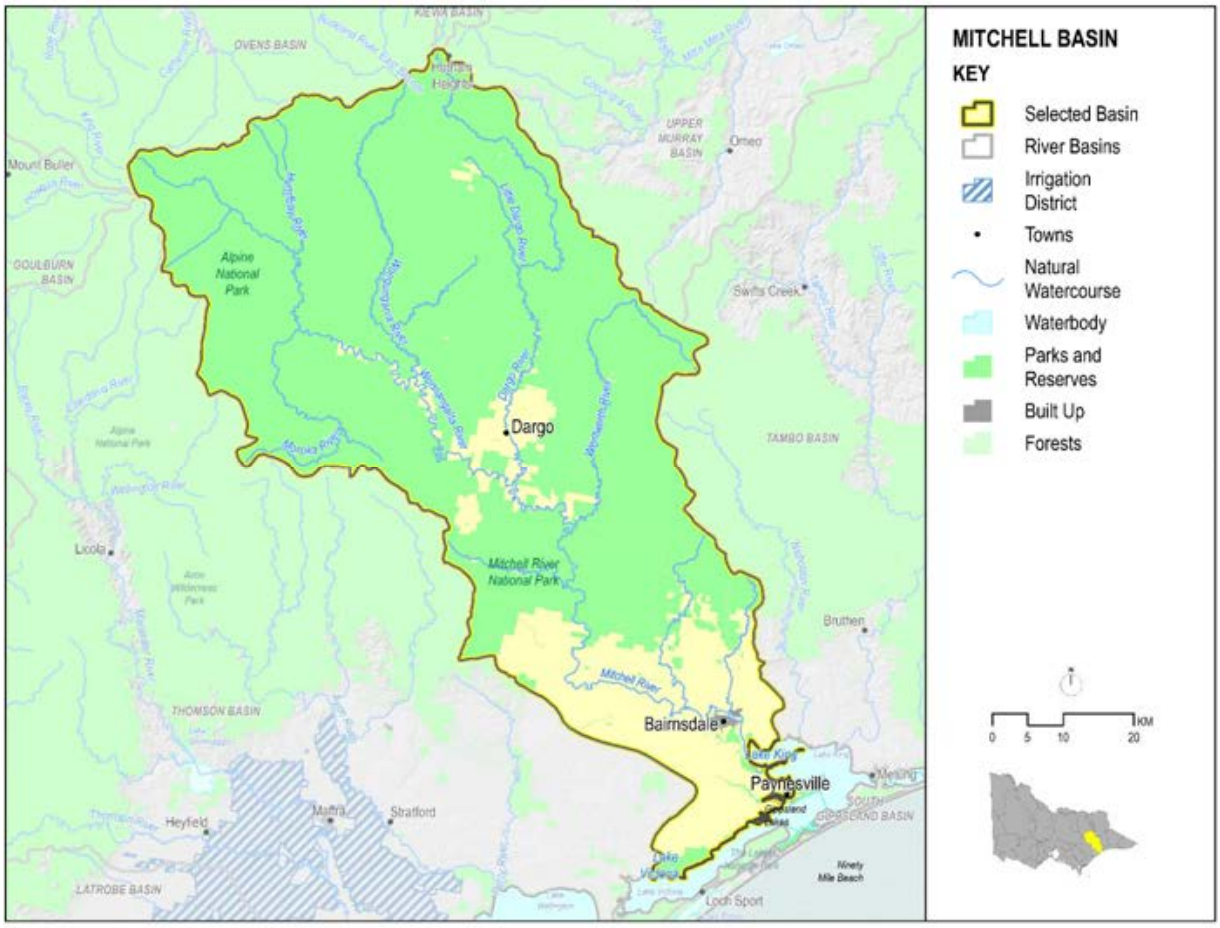
(1) No water was taken under the Nowa Nowa bulk entitlement in 2018–19 as the Nowa Nowa storage has been decommissioned. East Gippsland Water supplied Nowa Nowa under the Bairnsdale bulk entitlement, reported in Table 6-74 in the Mitchell basin.

(2) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

6.12 Mitchell basin

The Mitchell basin (Figure 6-21) is located in south-east Victoria. The Mitchell River flows into the Gippsland Lakes near Bairnsdale.

Figure 6-21 Map of the Mitchell basin



6.12.1 Management arrangements

Management of water in the Mitchell basin is undertaken by various parties as shown in Table 6-69.

Table 6-69 Responsibilities for water resources management in the Mitchell basin

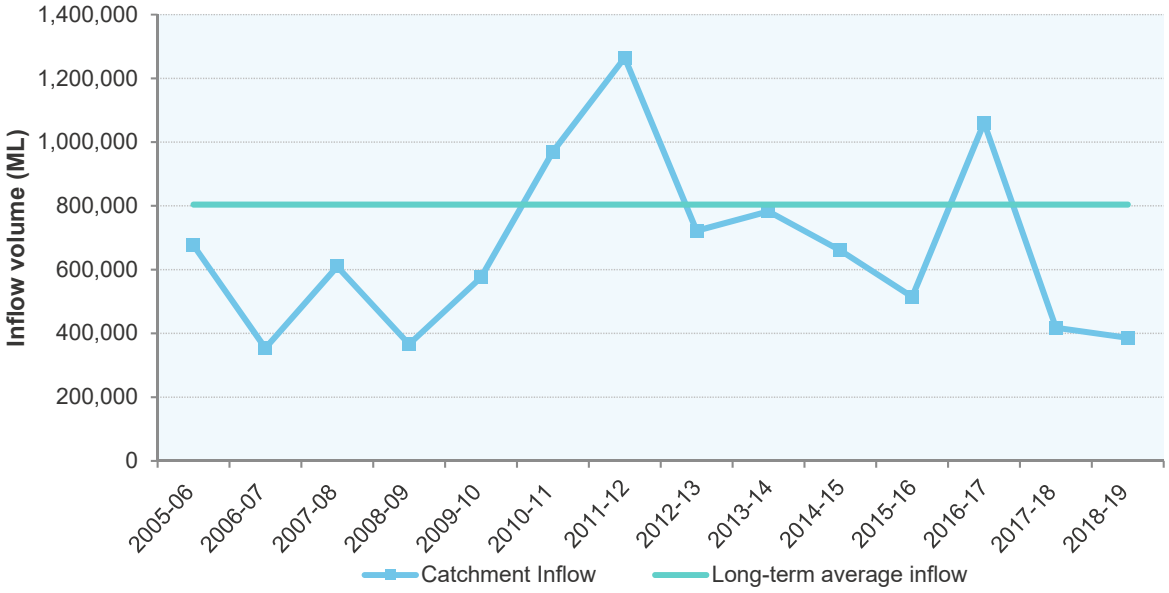
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
East Gippsland Water	• Supplies towns including Bairnsdale, Lakes Entrance and Paynesville
East Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Mitchell basin

6.12.2 2018–19 water resources overview

In 2018–19, between 60% to 80% of the long-term average rainfall was received in the majority of the basin, except for a small corner in the north-west which received between 80% and 100% of the long-term average.

Catchment inflows in the Mitchell basin were 48% of the long-term average of 804,100 ML, less than the inflows recorded in 2017–18, which were 52% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. Consumptive use in the basin is low, compared to the total water resource. About 95% of the total inflows were not diverted and therefore entered the Gippsland Lakes.

Figure 6-22 Catchment inflows in the Mitchell basin



Unregulated streams within the Mitchell basin remained unrestricted for most of 2018–19. Restrictions on licensed diversions from the Mitchell and Wonnangatta rivers were in place from January to April 2019 and the Dargo River from February to April 2019. Licensed diversions from all streams were unrestricted from May to June 2019.

There were no restrictions on urban water use in the Mitchell basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 17,899 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 19,181 ML diverted in the previous year.

6.12.2.1 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.

The Mitchell River has a long estuary reach which extends from the old barrier upstream from Bairnsdale to where the river enters the Gippsland Lakes at Lake King via the internationally significant silt jetties. There are important wetlands on both sides of the river including Macleod Morass, Jones Bay and the Lake King Wetlands at Eagle Point.

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 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.12.3 Water balance

The total volumes of water available and supplied from water resources in the Mitchell basin in 2018–19 are shown in Table 6-70.

Table 6-70 Water balance – Mitchell basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	385,870	417,895
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	65	88
Total inflows		**385,935**	**417,983**

Outflows			
Diversions			
Urban diversions		4,654	4,953
Licensed diversions from unregulated streams		12,746	13,623
Small catchment dams	4	499	605
Total diversions		***17,899***	***19,181***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	576	686
In-stream infiltration to groundwater, flows to floodplain and evaporation		1,399	1,316
Total losses		***1,976***	***2,003***
Water passed at outlet of basin			
River outflows to the Gippsland Lakes	5	366,060	396,799
Total water passed at outlet of basin		***366,060***	***396,799***
Total outflows		**385,935**	**417,983**

6.12.3.1 Notes to the water balance

1. Storage

There are no major storages located within the Mitchell basin.

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-71 lists the wastewater treatment plants in the Mitchell basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance, but during 2018–19 there were no such discharges.

Water for Mount Hotham Alpine Resort is sourced from Swindlers Creek, which is located in the upper Murray basin. In 2018–19, 65 ML of wastewater was treated and returned from the Mount Hotham Alpine Resort to the Dargo River. This volume is included as an inflow to the water balance for the Mitchell basin. A further 19 ML was treated to Class A and delivered to Loch Dam (Swindlers Creek catchment) and used for snow-making. This volume is not included in the water balance.

Table 6-71 Volume and use 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Bairnsdale	1,170	1,170	100%	0	41	1,129	0	0	0
Lindenow	10	10	100%	0	0	10	0	0	0
Paynesville	169	169	100%	0	169	0	0	0	0
Total 2018–19	**1,349**	**1,349**	**100%**	**0**	**210**	**1,138**	**0**	**0**	**0**
Total 2017–18	1,597	1,598	100%	0	473	1,125	0	0	(1)

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-72 provides information about small catchment dams in the basin.

Table 6-72 Estimated small catchment dam information for the Mitchell basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	3,957	322	487	809
Registered / licensed commercial and irrigation	2,912	177	89	267
Total 2018–19	**6,869**	**499**	**576**	**1,076**
Total 2017–18	6,869	605	686	1,291

5. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Mitchell basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method also includes estimates of outflows from small coastal streams in the calculations, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to the Gippsland Lakes by 0.3% for 2018–19. The previous estimate would have resulted in outflows of 365,085 ML.

6.12.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Mitchell – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (17,577 ML) was within the volume available for the year (28,402 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Mitchell basin provide the basis for how water is shared in the basin. Rights to water in the Mitchell basin are outlined in Table 6-73.

Table 6-73 Entitlement volumes in the Mitchell basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Bairnsdale) Conversion Order 2000	9,208
Take and use licences – unregulated surface water	16,238
Licensed small catchment dams – on-waterway (1)	147
Licensed small catchment dams – off-waterway (1)	2,766
Total (30 June 2019)	**28,358**
Total (30 June 2018) (1)	28,358

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-74 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-74 Available water and take for the Mitchell basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Bairnsdale	-	9,208	0	**9,208**	**4,654**
Take and use licences – unregulated surface water	-	16,281	0	**16,281**	**12,746**
Licensed small catchment dams (1)	-	2,912	0	**2,912**	**177**
Total 2018–19	**-**	**28,402**	**0**	**28,402**	**17,577**
Total 2017–18 (1)	-	28,358	0	28,358	18,793

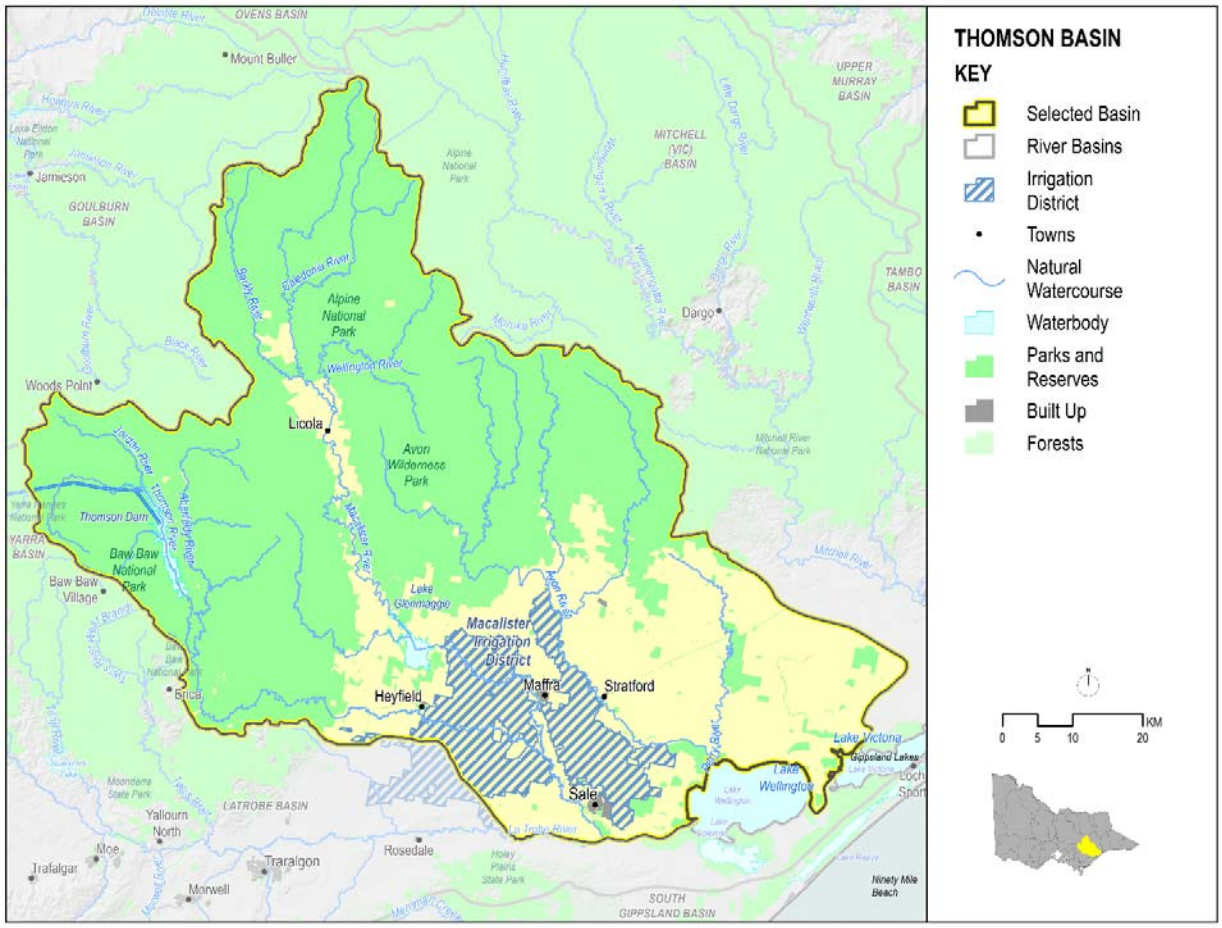
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.13.1 Management arrangements

Management of water in the Thomson basin is undertaken by various parties as shown in Table 6-75.

Table 6-75 Responsibilities for water resources management in the Thomson basin

Authority	Management responsibilities
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 and Southern Rural Water
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
Gippsland Water	• Supplies towns including Sale, Maffra, Heyfield, Stratford and Boisdale
West Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Thomson basin

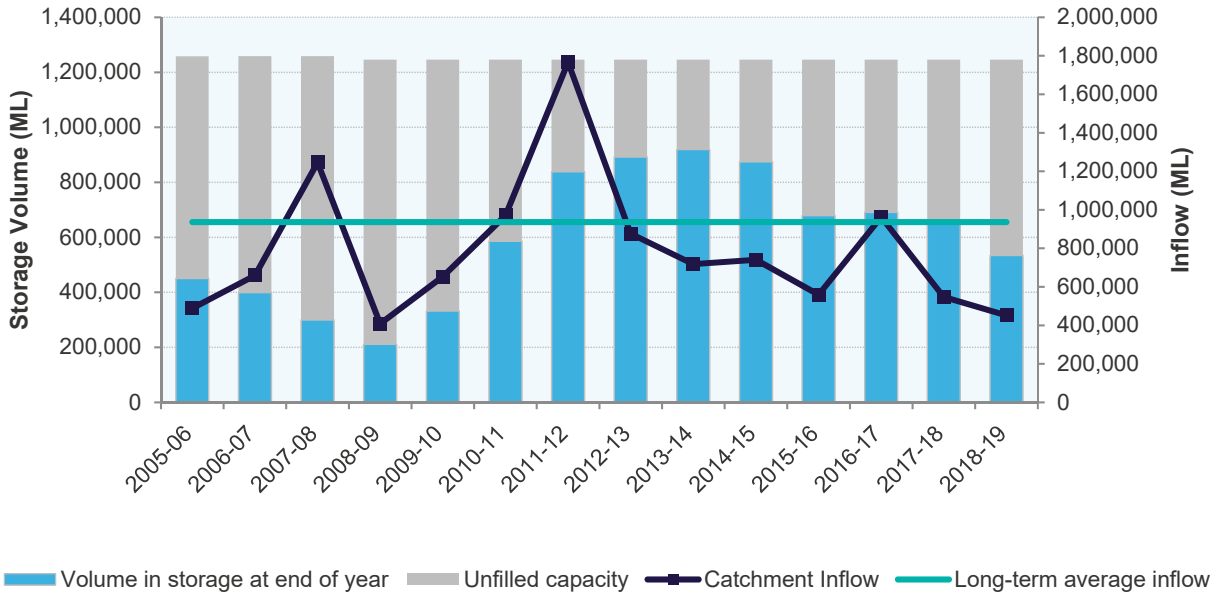
6.13.2 2018–19 Water resources overview

In 2018–19, rainfall throughout the Thomson basin was mostly 60% to 80% of the long-term average. The north-western corners — above the Thomson Reservoir and south of Mount Buller — received between 80% to 100% of the long-term average.

Catchment inflows were 48% of the long-term average of 936,400 ML, less than the inflows recorded in 2017–18, which were 58% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Storages started the year at 52% of capacity and ended the year slightly lower, at 43% of capacity.

Figure 6-24 Storage volumes and catchment inflows in the Thomson basin



In 2018–19, the first seasonal allocation for the Macalister Irrigation District for high-reliability water shares was announced on 4 July 2018 at 40% and increased to 100% by the end of August 2018. A seasonal allocation for low-reliability water shares was announced at 35% in December 2018.

Both sections of the Avon River had restrictions on licensed diversions from September to December 2018 and total bans from January to May 2019. Licensed diversions from Valencia Creek were restricted from August to December 2018, with total bans also implemented between January and May 2019. All streams reverted to a stage 1 roster in June 2019.

There were no restrictions on urban water use in the Thomson basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 418,827 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 377,070 ML diverted in the previous year.

6.13.2.1 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. Other important environmental assets include:

- the upper Thomson River (a heritage river reach) and its Australian grayling populations
- the Macalister River, supporting seven migratory native fish species, platypus and the water rat.

In 2018–19, water for the environment in the Thomson basin comprised:

- the *Bulk Entitlement (Thomson River – Environment) Order 2005* comprising 3.9% share of inflows (on average 8,000 ML a year) and 10,000 ML of high-reliability entitlement held by the VEWH and water set aside for the environment through the operation of passing flows
- 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: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 27,823 ML of environmental water was delivered in-stream in the Thomson basin.

6.13.3 Water balance

The total volumes of water available and supplied from water resources in the Thomson basin in 2018–19 are shown in Table 6-76.

Table 6-76 Water balance – Thomson basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	650,555	690,671
Volume in storage at end of year	1	534,357	650,555
Change in storage		**(116,198)**	**(40,116)**
Inflows			
Catchment inflow	2	451,419	546,194
Rainfall on major storages	1	12,605	14,931
Return flow from irrigation		1,184	1,745
Treated wastewater discharged back to river	3	28	31
Total inflows		**465,237**	**562,902**
Outflows			
Diversions			
Urban diversions		1,614	1,490
Transfers to Yarra River basin for urban use		198,850	133,540
Irrigation district diversions		191,057	211,347
Licensed diversions from regulated streams		29,954	26,155
Licensed diversions from unregulated streams	4	3,596	4,060
Small catchment dams	5	335	478
Total diversions		***425,406***	***377,070***
Losses			
Evaporation losses from major storages	5	16,543	18,756
Evaporation from small catchment dams		415	538
In-stream infiltration to groundwater, flows to floodplain and evaporation		10,695	12,761
Total losses		***27,652***	***32,055***
Water passed at outlet of basin			
River outflows to Latrobe River		106,794	164,487
River outflows to Lake Wellington		21,583	29,406
Total water passed at outlet of basin		***128,377***	***193,893***
Total outflows		**581,435**	**603,018**

6.13.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Thomson basin are included in the water balance. Table 6-77 shows how storage volumes changed 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	42,936	364	1,261	316	42,355
Thomson Reservoir (1)	1,068,000	607,619	12,241	15,282	(112,576)	492,002
Total 2018–19	**1,245,640**	**650,555**	**12,605**	**16,543**	**(112,261)**	**534,357**
Total 2017–18	1,245,640	690,671	14,931	18,756	(36,291)	650,555

Note
(1) Volumes in store in the Thomson Reservoir do not include 55,100 ML in dead storage.

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-78 lists the wastewater treatment plants in the Thomson basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

In addition to the recycled water reported below, 1 ML was returned from Mount Baw Baw to Charity Creek and other waterways during the water year.

Table 6-78 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heyfield	32	32	100%	0	32	0	0	0	0
Maffra	279	279	100%	0	279	0	0	0	0
Rawson	27	0	0%	0	0	0	0	27	0
Sale	923	923	100%	0	923	0	0	0	0
Stratford	66	66	100%	0	66	0	0	0	0
Total 2018–19	**1,327**	**1,300**	**98%**	**0**	**1,300**	**0**	**0**	**27**	**0**
Total 2017–18	1,427	1,395	98%	0	1,395	0	0	31	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-79 provides information about small catchment dams in the basin.

Table 6-79 Estimated small catchment dam information for the Thomson basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	5,396	250	378	628
Registered / licensed commercial and irrigation	3,175	85	37	121
Total 2018–19	**8,572**	**335**	**415**	**749**
Total 2017–18	8,572	478	538	1,016

6.13.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Thomson – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (452,370 ML) was within the volume available for the year (469,720 ML.**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
  - **Melbourne Water's Thomson River bulk entitlement has an annual diversion volume of 171,800, and in 2018–19 Melbourne Water took 198,850 ML under this entitlement. Annual exceedance is acceptable as long as the cumulative credit/debit balance meets the requirement of the diversion limit compliance method.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Thomson basin provide the basis for how water is shared in the basin. Rights to water in the Thomson basin are outlined in Table 6-80.

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 entitlement arrangements are provided in the Yarra basin chapter. Surface water is also diverted by licensed diverters and is harvested in small catchment dams.

The VEWH holds environmental entitlements for the Thomson River and the Macalister River. Water available under these entitlements is used to support streamflows and is not diverted out of waterways in the basin.

Table 6-80 Entitlement volumes in the Thomson basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001 [1]	
High-reliability water shares	155,819
Low-reliability water shares	74,605
Bulk Entitlement (Thomson Macalister Towns – Gippsland Water) Conversion Order 2005	2,335
Macalister River Environmental Entitlement 2010 [3]	
Macalister River Environmental Entitlement – high-reliability	12,461
Macalister River Environmental Entitlement – low-reliability	6,230
Subtotal: Macalister River Environmental Entitlement 2010	**18,690**
Subtotal: Bulk Entitlement (Thomson Macalister – Southern Rural Water) Conversion Order 2001	**251,449**
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014 [2]	**171,800**
Bulk Entitlement (Thomson River – Environment) Conversion Order 2005 [3]	
Thomson River – high-reliability	10,000
Share of inflows [3]	n/a
Subtotal: Bulk Entitlement (Thomson River – Environment) Conversion Order 2005	**10,000**
Take and use licences – unregulated surface water	**17,207**
Licensed small catchment dams – on-waterway [4]	**30**
Licensed small catchment dams – off-waterway [4]	**3,145**
Total (30 June 2019)	**453,632**
Total (30 June 2018) [4]	453,632

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) Melbourne Water holds the source bulk entitlement on the Thomson River. The annual entitlement volume is the annual diversion limit for Melbourne Water's Yarra River, Thomson River and Silver and Wallaby Creeks bulk entitlements. The limit is calculated using a method for showing compliance with diversion limits approved by the Minister for Water in February 2018. 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.

(3) The *Bulk Entitlement (Thomson River – Environment) 2005* previously consisted of a 10,000 ML high-reliability entitlement only. On 1 June 2017, the bulk entitlement was amended to reflect the addition of a new component of the entitlement, consisting of a 3.9% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions (8,000 ML a year on average).

(4) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-81 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-81 Available water and take for the Thomson basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Thomson Macalister – Southern Rural Water					
Water shares [1]	-	184,034	()	**184,034**	**176,872**
Thomson Macalister Towns – Gippsland Water	-	2,335	0	**2,335**	**1,614**
Macalister River Environmental Entitlement 2010 [2] [3]	7,773	14,641	0	**22,414**	**15,124**
Operating provisions [4]	-	42,955	-	**42,955**	**42,955**
Diversion: Thomson Macalister – Southern Rural Water [5]				**251,738**	**236,565**
Thomson River – Melbourne Water [6]	-	171,800	0	**171,800**	**198,850**
Thomson River – Environment [2] [7]	8,564	17,165	0	**25,729**	**12,699**
Take and use licences – unregulated surface water	-	17,278	0	**17,278**	**4,171**
Licensed small catchment dams [8]	-	3,175	0	**3,175**	**85**
Total 2018–19	**16,337**	**453,383**	**0**	**469,720**	**452,370**
Total 2017–18 [8]	17,388	453,659	0	471,047	409,676

Notes

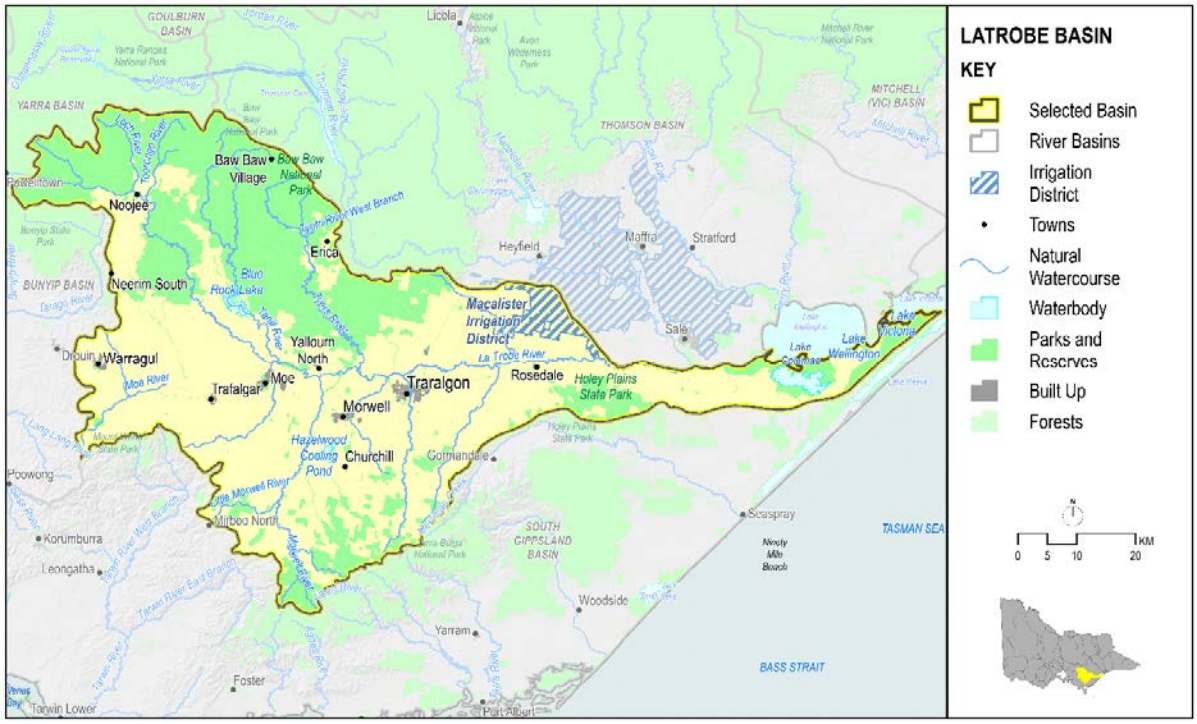
(1) Allocation issued includes 55,495 ML of spill allocation made available to water shares holders in 2017–18. This was available between 2 December and 15 December 2018, following a spill declaration for Lake Glenmaggie.

(2) 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 (Table 4-4).
(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. There is no specified volume for operating provisions under this source bulk entitlement.
(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 flow from irrigation). It includes in-stream environmental diversions of 15,884.
(6) This is the volume diverted in 2018–19. Annual exceedance is acceptable as long as the cumulative credit/debit balance meets the requirements of the diversion limit compliance method. As noted in the 2017–18 accounts, the 2017–18 annual diversion (133,540 ML) was recalculated as part of a diversion limit compliance assessment undertaken by Melbourne Water using the method approved by the Minister for Water in February 2018 for showing compliance with diversion limits for the Yarra River, Thomson River and Silver and Wallaby Creeks bulk entitlements, and it was confirmed to be compliant with the Thomson basin diversion limit.
(7) Allocation and use under the Thomson River – Environment entitlement included 2,500 ML allocated and used under the passing flows component of the entitlement.
(8) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.14.1 Management arrangements

Management of water in the Latrobe basin is undertaken by various parties as shown in Table 6-82.

Table 6-82 Responsibilities for water resources management in the Latrobe basin

Authority	Management responsibilities
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, the VEWH, power stations and licensed diverters
Gippsland Water	• Supplies towns including Moe, Morwell and Traralgon • Provides industrial supply to major industries • Operates Moondarra Reservoir
West Gippsland Catchment Management Authority	• Responsible for waterway and catchment management in the Latrobe basin

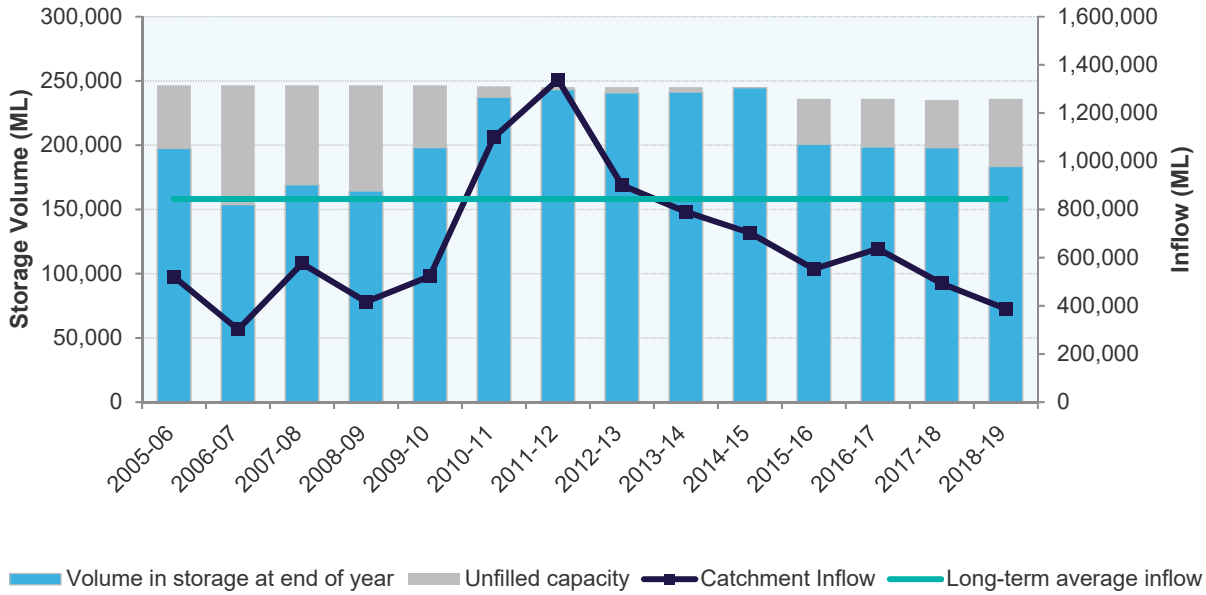
6.14.2 2018–19 water resource overview

In 2018–19, rainfall in the Latrobe basin was mostly 60% to 80% of the long-term average. The very eastern corner near the Gippsland Lakes received between 40% to 60% and the south-west area of the basin — bordering the South Gippsland basin — received 80 to 100% of the long-term average.

Catchment inflows were 46% of the long-term average of 843,300 ML, less than the inflows recorded in 2017–18, which were 58% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Storage levels in the Latrobe basin started 2018–19 at 84% of total capacity and ended at 78%.

Figure 6-26 Storage volumes and catchment inflows in the Latrobe basin



In 2018–19, licensed diversions from all streams were unrestricted until January 2019, when total bans were applied to seven streams and restrictions were placed on the Morwell River. The Upper Latrobe River, Middle Creek and Morwell River had bans or restrictions in place until April 2019, and all streams were unrestricted from May to end June 2019.

There were no restrictions on urban water use in the Latrobe basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 122,451 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 120,590 ML diverted in the previous year.

6.14.2.1 Water for the environment

The Latrobe River and lower Latrobe wetlands (including Sale Common, Dowd Morass and Heart Morass, which are part of the internationally recognised Gippsland Lakes Ramsar site) depend on water in the Latrobe basin.

The Latrobe River contains some continuous stands of river red gums in the upper reaches. The banks along the lower reaches support stands of swamp scrub, an endangered vegetation group. The Latrobe River contains native estuarine and freshwater fish species including black bream, Australian bass and short- and long-finned eel.

The lower Latrobe wetlands provide habitat for a variety of waterbirds. Mature river red gums also grow adjacent to the wetlands and provide nesting habitat for sea eagles and other birds of prey that hunt in the wetlands.

In 2018–19, water for the environment in the Latrobe basin comprised:

- the *Lower Latrobe Wetlands Environmental Entitlement 2010*, held by the VEWH, which allows water to be diverted to 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 which in 2018–19 provided a 9.45% share of inflows into Blue Rock Reservoir
- 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: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 5,502 ML of environmental water was delivered in-stream in the Latrobe basin. Water was also diverted to inundate Sale Common and Dowd Morass, but the volumes delivered to these wetlands are not measured so a volume is not available.

6.14.3 Water balance

The total volumes of water available and supplied from water resources in the Latrobe basin in 2018–19 are shown in Table 6-83.

Table 6-83 Water balance – Latrobe basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	198,154	198,676
Volume in storage at end of year	1	183,451	198,154
Change in storage		**(14,703)**	**(522)**
Inflows			
Catchment inflow	2	387,496	487,699
Rainfall on major storages	1	2,315	2,921
Return flow from power stations and major industry		32,656	33,953
Treated wastewater discharged back to river	3	3,496	3,691
Total inflows		**425,963**	**528,264**
Outflows			
Diversions			
Urban and industrial diversions		101,196	103,228
Licensed diversions from regulated streams		13,556	8,490
Licensed diversions from unregulated streams	4	1,550	1,484
Small catchment dams	5	6,149	7,388
Total diversions		***122,451***	***120,590***
Losses			
Evaporation losses from major storages	1	7,125	4,067
Evaporation from small catchment dams	5	2,587	2,570
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***9,712***	***6,637***
Water passed at outlet of basin			
River outflows to the Gippsland Lakes (excluding Thomson River)		308,503	401,559
Total water passed at outlet of basin		***308,503***	***401,559***
Total outflows		**440,666**	**528,786**

6.14.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Latrobe basin are included in the water balance. Table 6-84 shows how storage volumes changed during the year.

The end volume in store reported for 2017–18 has been amended from the *Victorian Water Accounts 2017–18*, due to new information being available from data providers.

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 Lake	198,280	168,277	504	1,196	(15,457)	152,128
Lake Narracan	7,230	6,138	541	3,074	2,743	6,348
Moondarra Reservoir	30,458	23,739	1,270	2,856	2,822	24,975
Total 2018–19	**235,968**	**198,154**	**2,315**	**7,125**	**(9,893)**	**183,451**
Total 2017–18	234,995	198,676	2,921	4,067	545	198,154

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion and closing balance on storages, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-85 lists the wastewater treatment plants in the Latrobe basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-85 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Mirboo North	62	62	100%	24	38	0	0	0	0
Moe	1,914	0	0%	0	0	0	0	1,914	0
Morwell	546	546	100%	0	0	546	0	0	0
Dutson Downs (regional outfall sewer)	8,667	58	1%	33	25	0	0	0	8,609
Saline wastewater outfall pipeline	9,439	0	0%	0	0	0	0	0	9,439
Warragul	1,582	0	0%	0	0	0	0	1,582	0
Willow Grove	9	9	100%	0	9	0	0	0	0
Total 2018–19	**22,219**	**675**	**3%**	**57**	**72**	**546**	**0**	**3,496**	**18,048**
Total 2017–18	22,209	777	3%	136	54	586	0	3,691	17,741

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-86 provides information about small catchment dams in the basin.

Table 6-86 Estimated small catchment dam information for the Latrobe basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	15,362	2,831	1,780	4,612
Registered / licensed commercial and irrigation	16,147	3,318	806	4,124
Total 2018–19	**31,509**	**6,149**	**2,587**	**8,736**
Total 2017–18	31,509	7,388	2,570	9,958

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Latrobe basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.14.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Latrobe – Key compliance points

- ✓ **There was a 25 ML net increase in the total entitlement volume from the previous year.**
  - **Unregulated take and use licence volume increased by 25 ML during the year.**
- ✓ **The total volume diverted (138,678 ML) was within the volume available for the year (284,951 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **under the Moe bulk entitlement, non-compliance was reported as a failure to pass required minimum flow as specified in clause 7.1 for a period of four days due to human error. Actual flow diverted from Narracan Creek to Moe Water Treatment Plant during this period exceeded that**

allowed under the flow-sharing requirements of clause 7.1. Gippsland Water has implemented measures to prevent this from reoccurring.

Entitlements in the Latrobe basin provide the basis for how water is shared in the basin. Rights to water in the Latrobe basin are outlined in Table 6-87.

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.

Table 6-87 Entitlement volumes in the Latrobe basin

Water entitlement	Annual entitlement volume (ML)
Blue Rock Environmental Entitlement 2013 (1)	n/a
Bulk Entitlement (Boolarra) Conversion Order 1997	145
Bulk Entitlement (Gippsland Water – Blue Rock) Conversion Order 1997	20,000
Bulk Entitlement (Erica) Conversion Order 1997	340
Bulk Entitlement (Latrobe – Southern Rural) Conversion Order 1996 (2)	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 (4)	80
Bulk Entitlement (Latrobe – Loy Yang B) Conversion Order 1996	20,000
Bulk Entitlement (Latrobe – Loy Yang A) Conversion Order 1996	40,000
Bulk Entitlement (Latrobe – Loy Yang 3/4 Bench) Conversion Order 1996	25,000
Bulk Entitlement (Latrobe – Yallourn) Conversion Order 1996	36,500
Bulk Entitlement (Latrobe Reserve) Order 2013 (5)	n/a
Take and use licences – unregulated surface water (6)	12,967
Licensed small catchment dams – on-waterway (7)	10,949
Licensed small catchment dams – off-waterway (7)	5,242
Total (30 June 2019)	**250,850**
Total (30 June 2018) (7)	250,825

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 the lower Latrobe River: 13,215 ML of entitlement was issued for take and use licences for the 2018–19 year.

(3) Use of this entitlement depends on suitable river heights, as specified in the entitlement.

(4) Thorpdale is no longer supplied from the Easterbrook Creek under the *Thorpdale Bulk Entitlement 1997*. Since September 2015, Thorpdale has been supplied by water-carting from the Moe treated water system. This is now the normal supply mode for Thorpdale.

(5) The Latrobe Reserve consists of a 18.87% share of inflows into Blue Rock Reservoir after passing flow requirements have been met. This bulk entitlement is held by Southern Rural Water and managed in line with very specific rules to provide a reserve of water for the bulk/environmental entitlement holders and section 51 licence holders in the Latrobe regulated system.

(6) The volume of unregulated surface water entitlements now includes licences for in-stream diversions. In the Latrobe basin, there is 5,000 ML of in-stream licence as well as 457 ML of licence for extraction with full return to the waterway.

(7) Reporting of unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-88 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-88 Available water and take for the Latrobe basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Blue Rock Environmental Entitlement (1)	11,670	3,092	0	**14,762**	**5,502**
Boolarra	-	145	0	**145**	**0**
Gippsland Water – Blue Rock	-	15,150	0	**15,150**	**2,332**
Erica	-	340	0	**340**	**71**
Latrobe – Southern Rural Water (2) (3)	-	13,795	2,119	**15,914**	**13,556**
Lower Latrobe Wetlands Environmental Entitlement (4)	-	-	-	**-**	**-**

Mirboo North	-	270	0	**270**	**197**
Moe – Narracan Creek	-	3,884	0	**3,884**	**2,176**
Moondarra Reservoir	-	62,000	0	**62,000**	**35,241**
Noojee [5]	-	73	0	**73**	**0**
Thorpdale	-	80	0	**80**	**0**
Latrobe – Loy Yang B	-	20,000	0	**20,000**	**11,012**
Latrobe – Loy Yang A	-	40,000	0	**40,000**	**24,206**
Latrobe – Loy Lang 3/4 Bench	-	25,000	0	**25,000**	**0**
Latrobe – Yallourn	-	36,500	0	**36,500**	**25,961**
Latrobe Reserve [3]	-	2,000	(2,000)	**0**	**-**
Take and use licences – unregulated surface water	-	12,854	(152)	**12,703**	**1,550**
Licensed small catchment dams [6]	-	16,234	83	**16,317**	**3,318**
Total 2018–19	**11,670**	**265,212**	**2,169**	**279,051**	**138,678**
Total 2017–18 [6]	15,622	260,860	(12)	276,470	136,848

Notes

(1) 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 4-4.

(2) This represents the water allocated and used by take and use licence holders. Allocation issued includes 2,410 ML of water allocated to take and use licences under spill rules.

(3) In line with the rules in the Latrobe Reserve bulk entitlement, licence holders purchased 2,000 ML of temporary water from the Latrobe Reserve.

(4) Use of this entitlement depends on suitable river heights, as specified in the entitlement. In 2018–19, water under this entitlement was used to inundate Sale Common and Dowd Morass. Volumes delivered in the wetlands are not measured.

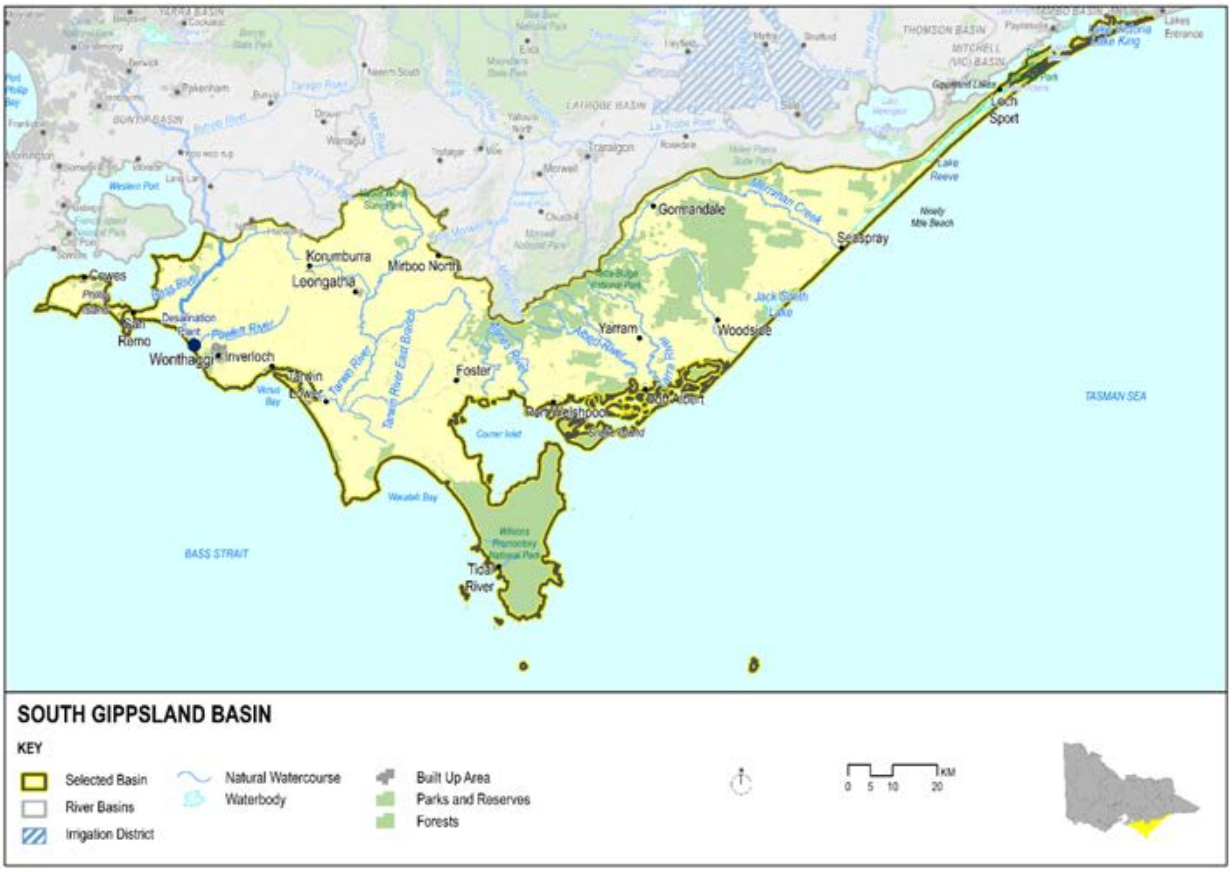
(5) Gippsland Water is not taking water from the Loch River under its Noojee bulk entitlement, and instead it supplies Noojee from Tarago Reservoir in the Bunyip basin.

(6) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.15.1 Management arrangements

Management of water in the South Gippsland basin is undertaken by various parties as shown in Table 6-89.

Table 6-89 Responsibilities for water resources management in the South Gippsland basin

Authority	Management responsibilities
Southern Rural Water	• Manages surface water licensed diversions
South Gippsland Water	• Supplies towns including Leongatha, Inverloch, Wonthaggi, Korumburra and Foster
Westernport Water	• Supplies towns including San Remo and Phillip Island
Gippsland Water	• Supplies towns in the far east of the basin including Seaspray
West Gippsland Catchment Management Authority	• Manages most waterways and catchment 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

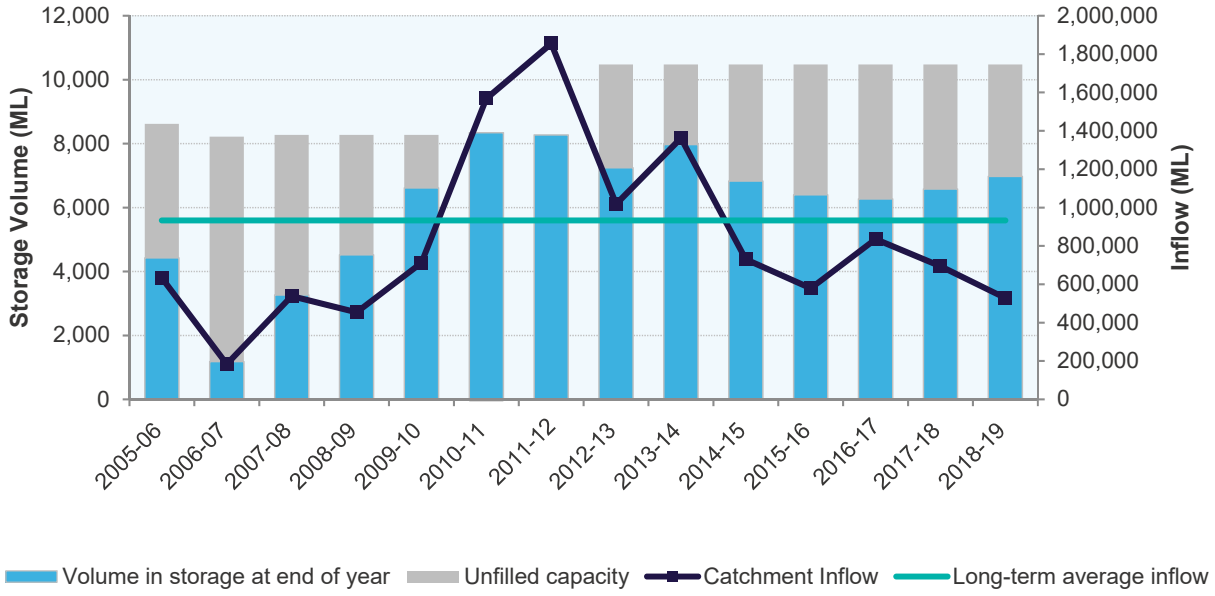
6.15.2 2018–19 water resource overview

In 2018–19, the southern half of the South Gippsland basin had rainfall between 80% and 100% of the long-term average, with most of the northern half receiving between 60% and 80% and the north-east corner receiving between 40% and 60%.

Catchment inflows were 57% of the long-term average of 932,900 ML, less than the inflows recorded in 2017–18, which were 74% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. The amount of water flowing from the South Gippsland basin into Bass Strait and Western Port represented 95% of the catchment inflows to the basin in 2018–19.

Storage levels in the South Gippsland basin started 2018–19 at 63% of total capacity and ended at 67%.

Figure 6-28 Storage volumes and catchment inflows in the South Gippsland basin



Licensed diversions from streams remained unrestricted in the South Gippsland basin from July to December 2018. Bans were then placed on licensed diversions from Greigs Creek and Tarra River in January 2019, and they remained in place until 30 June 2019.

There were no restrictions on urban water use in the South Gippsland basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 21,270 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 24,952 ML diverted in the previous year.

6.15.2.1 Water for the environment

Important environmental assets in the South Gippsland basin depend on water. These include:

- the Bald Hills Wetland, which is a rehabilitated wetland complex that supports rare and intact vegetation communities in a largely agricultural environment
- the Bunurong Coast wetlands, which provide habitat connectivity with the marine and estuarine systems
- Corner Inlet and Western Port, which are listed as internationally significant wetlands under the Ramsar Convention and rely on 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*, which also relies on water for the environment.

In 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.15.3 Water balance

The total volumes of water available and supplied from water resources in the South Gippsland basin in 2018–19 are shown in Table 6-90.

Table 6-90 Water balance – South Gippsland basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	6,576	6,270
Volume in storage at end of year	1	6,974	6,576
Change in storage		**398**	**306**
Inflows			
Catchment inflow	2	528,478	693,510
Rainfall on major storages		1,275	1,602
Treated wastewater discharged back to river	3	1,218	1,199
Total inflows		**530,970**	**696,312**
Outflows			
Diversions			
Urban diversions		7,207	7,871
Licensed diversions from unregulated streams	4	2,327	2,662
Small catchment dams	5	11,736	14,419
Total diversions		***21,270***	***24,952***
Losses			
Evaporation losses from major storages		1,414	1,760
Evaporation from small catchment dams	5	5,650	6,344
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***7,064***	***8,104***
Water passed at outlet of basin			
River outflows to Bass Strait and Westernport		502,238	662,949
Total water passed at outlet of basin		***502,238***	***662,949***
Total outflows		**530,572**	**696,006**

6.15.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the South Gippsland basin are included in the water balance. Table 6-91 shows how storage volumes changed 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	2,518	313	452	(182)	2,197
Hyland Reservoir	671	193	83	83	104	297
Lance Creek Reservoir	4,200	3,081	751	751	668	3,749
Western Reservoir	1,137	784	128	128	(53)	731
Total 2018–19	**10,471**	**6,576**	**1,275**	**1,414**	**537**	**6,974**
Total 2017–18	10,471	6,270	1,602	1,760	464	6,576

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin.

Table 6-92 lists the wastewater treatment plants in the South Gippsland basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Recycling opportunities within the basin are limited, due to a small industrial base and crop types that are not suited to recycled water. 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 6-92 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Coronet Bay	199	179	90%	0	179	0	0	0	20
Cowes	1,241	159	11%	72	69	0	18	0	1,082
Foster	147	0	0%	0	0	0	0	0	147
Korumburra	651	0	0%	0	0	0	0	651	0
Leongatha Domestic	541	0	0%	0	0	0	0	541	0
Leongatha Trade Waste	938	0	0%	0	0	0	0	0	938
Meeniyan	32	7	22%	5	2	0	0	25	0
Seaspray	0	0	100%	0	0	0	0	0	0
Toora	37	2	5%	2	0	0	0	0	35
Waratah Bay	11	11	100%	0	11	0	0	0	0
Welshpool	43	0	0%	0	0	0	0	0	43
Wonthaggi / Cape Paterson / Inverloch	1,303	0	0%	0	0	0	0	0	1,303
Yarram / Tarraville	104	104	100%	0	104	0	0	0	0
Total 2018–19	**5,247**	**462**	**8%**	**79**	**365**	**0**	**18**	**1,217**	**3,568**
Total 2017–18	5,221	464	9%	81	373	0	11	1,199	3,559

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-93 provides information about small catchment dams in the basin.

Table 6-93 Estimated small catchment dam information for the South Gippsland basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	31,815	8,069	4,801	12,871
Registered / licensed commercial and irrigation	13,983	3,667	849	4,516
Total 2018–19	**45,798**	**11,736**	**5,650**	**17,387**
Total 2017–18	45,798	14,419	6,344	20,764

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation was not made in the South Gippsland basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (as chapter 6.1.6.3 explains).

6.15.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

South Gippsland – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (13,201 ML) was within the volume available for the year (42,381 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the South Gippsland basin provide the basis for how water is shared in the basin. Rights to water in the South Gippsland basin are outlined in Table 6-94.

Table 6-94 Entitlement volumes in the South Gippsland basin

Water entitlement	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 (1)	9,510
Licensed small catchment dams – on-waterway (1)	3,232
Licensed small catchment dams – off-waterway (1)	10,751
Total (30 June 2019)	**42,381**
Total (30 June 2018) (1)	42,381

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-95 shows the amount available to be taken by entitlement holders and the amount they took in the water year.

Table 6-95 Available water and take for the South Gippsland basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Devon North Alberton-Yarram and Port Albert	-	853	0	**853**	**306**
Dumbalk	-	100	0	**100**	**17**
Fish Creek	-	251	0	**251**	**109**
Foster	-	326	0	**326**	**157**
Korumburra	-	1,000	0	**1,000**	**315**
Leongatha	-	2,476	0	**2,476**	**1,696**
Loch, Poowong and Nyora	-	420	0	**420**	**126**
Meeniyan	-	200	0	**200**	**50**
Seaspray	-	133	0	**133**	**21**
Toora Port Franklin-Welshpool and Port Welshpool	-	1,617	0	**1,617**	**585**
Westernport	-	2,911	0	**2,911**	**1,926**
Westernport-Bass River	-	3,000	0	**3,000**	**428**
Wonthaggi-Inverloch	-	5,600	0	**5,600**	**1,471**
Take and use licences – unregulated surface water	-	9,503	4	**9,507**	**2,327**
Licensed small catchment dams (1)	-	13,990	(4)	**13,986**	**3,667**
Total 2018–19	**-**	**42,381**	**0**	**42,381**	**13,201**
Total 2017–18 (1)	-	42,611	(2)	42,609	15,190

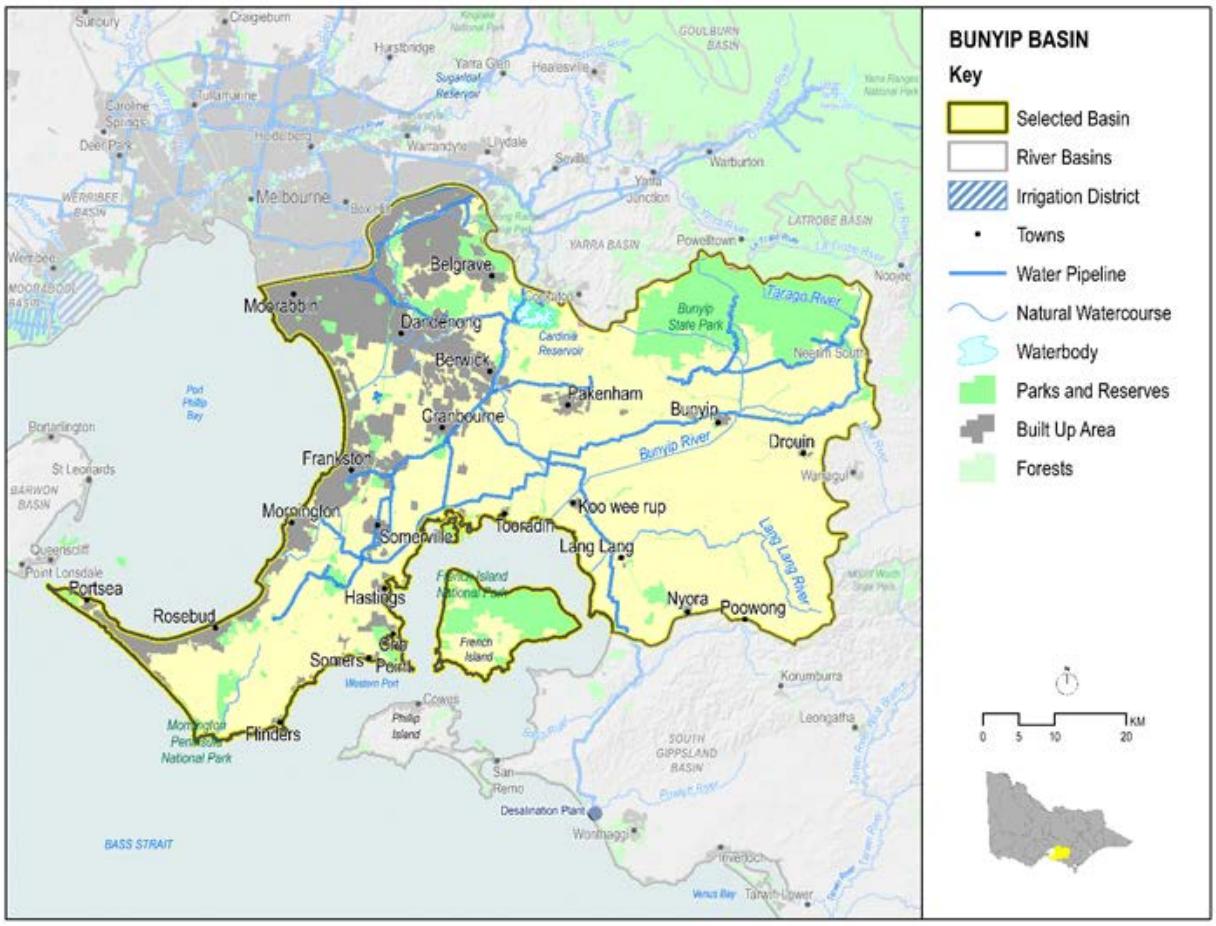
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.16.1 Management arrangements

Management of water in the Bunyip basin is undertaken by various parties as shown in Table 6-96.

Table 6-96 Responsibilities for water resources management in the Bunyip basin

Authority	Management responsibilities
Southern Rural Water	• Manages surface water and private licensed diversions
Melbourne Water	• Operates Eastern Treatment Plant • Provides bulk water supply to South East Water • Operates Tarago Reservoir • Responsible for waterway management in the Bunyip basin
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
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment management in the Bunyip basin

Note
(1) Metropolitan Melbourne is mostly supplied from the Yarra and Thomson basins.

6.16.2 2018–19 water resource overview

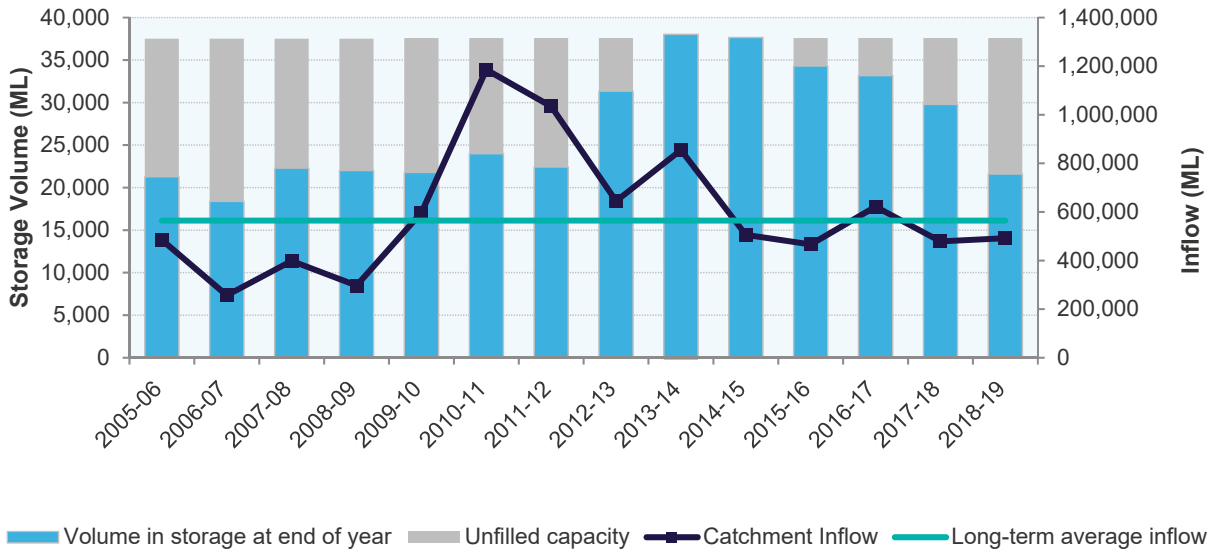
In 2018–19, rainfall in the Bunyip basin was mostly between 80% and 100% of the long-term average. The northern corners bordering the Yarra and Latrobe basins received between 60% and 80% of the long-term average rainfall.

Catchment inflows were 87% of the long-term average of 564,400 ML, more than the inflows recorded in 2017–18, which were 85% of the long-term average. The long-term average presented has been revised from the previous

accounts: see chapter 6.1.2 for details. The amount of water flowing from the Bunyip basin into Port Phillip Bay and Westernport Bay represented 93% of the catchment inflows to the basin in 2018–19.

Storage levels in the Bunyip basin started 2018–19 at 79% of total capacity and ended at 58%.

Figure 6-30 Storage volumes and catchment inflows in the Bunyip basin



All unregulated streams remained unrestricted throughout 2018–19 except for Dandenong Creek (Monbulk Creek), which maintained relatively steady flows through until March 2019 when a total ban was placed on licensed diversions until May 2019.

There were no restrictions on urban water use in the Bunyip basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 40,516 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 42,310 ML diverted in the previous year.

6.16.2.1 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 maintain healthy ecological functions. There are also populations of threatened dwarf galaxias and Australian grayling in the Tarago and Bunyip systems.

In 2018–19, 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 conditions as part of the environmental entitlement 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: this water also provides social, recreational and cultural benefits.

In 2018–19, 1,210 ML of environmental water was delivered in-stream in the Bunyip basin.

6.16.3 Water balance

The total volumes of water available and supplied from water resources in the Bunyip basin in 2018–19 are shown in Table 6-97.

Table 6-97 Water balance – Bunyip basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	29,783	33,181
Volume in storage at end of year	1	21,611	29,783
Change in storage		**(8,172)**	**(3,398)**
Inflows			
Catchment inflow	2	489,980	478,488

Rainfall on major storages	1	2,542	3,140
Treated wastewater discharged back to river	3	2,203	2,252
Total inflows		**494,725**	**483,880**
Outflows			
Diversions			
Urban diversions		24,094	22,797
Licensed diversions from regulated streams		2,149	1,507
Licensed diversions from unregulated streams		5,246	5,416
Small catchment dams	4	9,027	12,590
Total diversions		***40,516***	***42,310***
Losses			
Evaporation losses from major storages	1	2,268	2,383
Evaporation from small catchment dams	4	4,793	5,993
In-stream infiltration to groundwater, flows to floodplain and evaporation		787	866
Total losses		***7,848***	***9,241***
Water passed at outlet of basin			
River outflows to Port Phillip Bay and Westernport Bay	5	454,534	435,726
Total water passed at outlet of basin		***454,534***	***435,726***
Total outflows		**502,897**	**487,278**

6.16.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Bunyip basin are included in the water balance. Table 6-98 shows how storage volumes changed during the year.

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	29,783	2,542	2,268	(8,446)	21,611
Total 2018–19	**37,580**	**29,783**	**2,542**	**2,268**	**(8,446)**	**21,611**
Total 2017–18	37,580	33,181	3,140	2,383	(4,155)	29,783

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin.

Table 6-99 lists the wastewater treatment plants in the Bunyip basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-99 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Blind Bight	181	181	98%	0	177	0	4	0	0
Boneo [1]	4,434	1,615	30%	145	1,171	0	299	0	2,819
Drouin	776	79	10%	12	67	0	0	697	0
Eastern Treatment Plant	136,146	16,880	6%	7,782	0	0	9,098	0	119,266
Koo Wee Rup [2]	171	179	67%	0	115	0	64	0	(8)
Lang Lang	151	6	0%	0	0	0	6	102	43
Longwarry	285	121	42%	0	121	0	0	15	149
Mt Martha	5,544	1,002	0%	0	26	0	975	0	4,542
Neerim South	48	0	0%	0	0	0	0	48	0

Pakenham [2]	1,173	1,189	95%	272	839	0	78	0	(16)
Somers	1,836	494	22%	238	169	0	87	1,342	0
Total 2018–19	**150,745**	**21,746**	**7%**	**8,449**	**2,685**	**0**	**10,611**	**2,204**	**126,795**
Total 2017–18	153,613	21,945	7%	9,370	666	0	11,843	2,252	129,418

Notes

(1) The 2,819 ML 'Volume of ocean or other discharges' figure is made up of 2,786 ML outflow to Bass Strait and a 33 ML 'other' amount.

(2) The 'Volume of ocean or other discharges' is negative primarily due to changes in storage, rainfall and evaporation. As these plants partially rely on lagoons for their treatment process and have exposed storages, they are subject to external climatic conditions. This can contribute to the situation where the amount recycled is greater than the amount produced.

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-100 provides information about small catchment dams in the basin.

Table 6-100 Estimated small catchment dam information for the Bunyip basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	23,583	4,584	3,343	7,927
Registered / licensed commercial and irrigation	23,668	4,442	1,450	5,892
Total 2018–19	**47,251**	**9,027**	**4,793**	**13,820**
Total 2017–18	47,251	12,590	5,993	18,583

5. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Bunyip basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method uses streamflow data from a new gauge downstream of the previous site used to estimate outflows. The downstream site provides a higher level of certainty in the outflow calculation. This has increased the reported outflows to Port Phillip Bay and Western Port by 28% for 2018–19. The previous estimate would have resulted in outflows of 353,974 ML.

6.16.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Bunyip – Key compliance points

- ✓ **There was 100 ML net increase in total entitlement volume from the previous year.**
  - **This increase was a result of a net increase in unregulated take and use licences.**
- ✓ **The total volume diverted (37,141 ML) was within the volume available for the year (80,177 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
  - **Southern Rural Water took more than their yearly limit under the Tarago River – Southern Rural Water bulk entitlement. This is allowed under the provisions of the entitlement, as there is a maximum take of 6,300 ML over any five-year period. Overuse in any one year is within obligations, as long as the five-year rolling volume of take does not exceed 6,300 ML.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Bunyip basin provide the basis for how water is shared in the basin. Rights to water in the Bunyip basin are outlined in Table 6-101.

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).

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.

Table 6-101 Entitlement volumes in the Bunyip basin

Water entitlement	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)	n/a
Take and use licences – unregulated surface water	16,911
Licensed small catchment dams – on-waterway (5)	2,219
Licensed small catchment dams – off-waterway (5)	21,450
Total (30 June 2019)	**77,174**
Total (30 June 2018) (5)	77,074

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.
(5) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-102 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-102 Available water and take for the Bunyip basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Tarago River – Gippsland Water	-	4,825	0	**4,825**	**3,699**
Tarago River – Southern Rural Water (1)	-	1,260	0	**1,260**	**2,149**
Tarago and Bunyip rivers – Melbourne Water	-	30,510	0	**30,510**	**20,395**
Tarago and Bunyip Rivers Environmental Entitlement (2)	1,453	1,281	0	**2,734**	**1,210**
Take and use licences – unregulated surface water	0	16,964	100	**17,064**	**5,246**
Licensed small catchment dams (3)	0	23,883	(100)	**23,783**	**4,442**
Total 2018–19	**1,453**	**78,724**	**0**	**80,177**	**37,141**
Total 2017–18 (3)	1,658	79,034	(1)	80,691	38,410

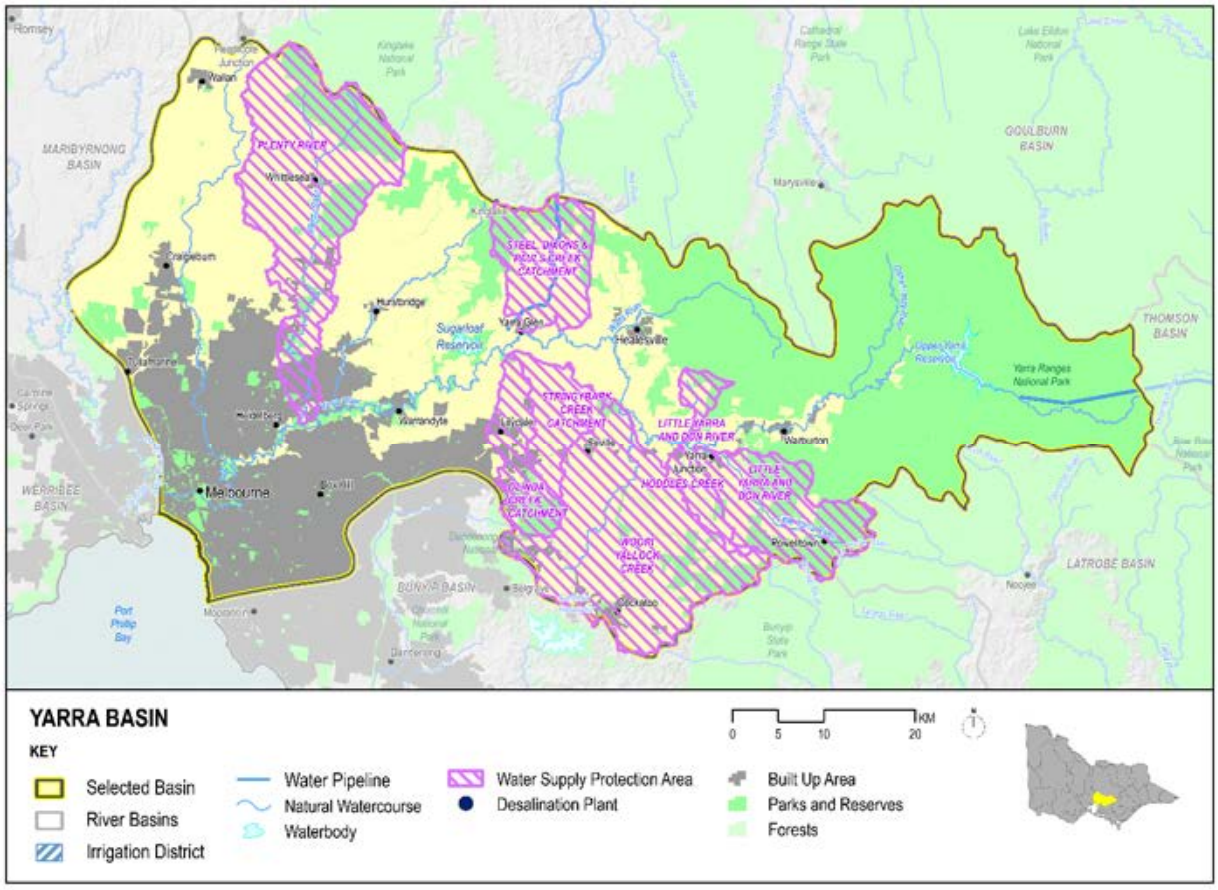
Notes

(1) Water use represents the volume of water ordered via regulated release from Tarago Reservoir to supply licensed diverters downstream of Tarago Reservoir. Water released from Tarago Reservoir to supply Southern Rural Water section 51 licence holders on the Bunyip and Tarago rivers is higher than the entitlement volume, but this is allowed under the bulk entitlement as long as the five-year rolling average total does not exceed 6,300 ML.
(2) Opening carryover represents the opening carryover and net spills. Any unused water under this environmental entitlement is available to carry over.
(3) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Yarra basin is undertaken by various parties as shown in Table 6-103.

Table 6-103 Responsibilities for water resources management in the Yarra basin

Authority	Management responsibilities
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)
Yarra Valley Water	• Supplies the northern 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 the Yarra basin, using water sources from outside the basin
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment 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.

6.17.1.1 Melbourne headworks system: Greater Yarra system – Thomson River Pool

Melbourne's water has traditionally been sourced from the Yarra, Thomson, Bunyip and Tarago basins and the Goulburn (Silver and Wallaby creeks) basin. Since the Millennium Drought, major investment in infrastructure has brought other water sources online 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.

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 (Note

The annual entitlement volume is the annual diversion limit for Melbourne Water's Yarra River, Thomson River and Silver and Wallaby Creeks bulk entitlements. The limit is calculated using a method for showing compliance with diversion limits approved by the Minister for Water in February 2018.

Table 6-105). Melbourne Water makes an allocation at the beginning of each month to distribute the available water to entitlement holders according to their entitlement share. In 2018–19, the allocation reached 50.9%.

Volumes of water taken from the river systems to supply the Greater Yarra system – Thomson River Pool are reported in each individual river basin subchapter 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 entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Yarra River – Melbourne Water) Order 2014 (1)	400,000
Bulk Entitlement (Tarago and Bunyip Rivers – Melbourne Water) Order 2014	30,510
Bulk Entitlement (Thomson River – Melbourne Water) Order 2014 (1)	171,800
Bulk Entitlement (Silver and Wallaby Creeks – Melbourne Water) Order 2014	22,000
Total (30 June 2019)	**624,310**
Total (30 June 2018)	624,310

Note

(1) The annual entitlement volume is the annual diversion limit for Melbourne Water's Yarra River, Thomson River and Silver and Wallaby Creeks bulk entitlements. The limit is calculated using a method for showing compliance with diversion limits approved by the Minister for Water in February 2018.

Table 6-105 Greater Yarra system – Thomson River Pool bulk entitlements

Water entitlement	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 Limited) Conversion Order 2014	152,797
Bulk Entitlement (Greater Yarra System – Thomson River Pool – South East Water Limited) Conversion Order 2014	206,281
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 Limited) Conversion Order 2014	219,776
Total (30 June 2019)	**615,104**
Total (30 June 2018)	615,104

6.17.1.2 Victorian Desalination Project

Desalinated seawater from the Victorian Desalination Project near Wonthaggi may be sourced to supplement surface water supplies from the Melbourne Headworks system. The three metropolitan water corporations — City West Water, Yarra Valley Water and South East Water — hold the bulk entitlements to this desalinated seawater. These entitlements are shown in Table 6-106.

In 2018–19, 21,966 ML of water was delivered from the Victorian Desalination Project, and this water was allocated to the three Melbourne retailers in accordance with their bulk entitlements. The volume delivered is included as an inflow into the Yarra basin, as it represents an inflow of water into part of the Melbourne headworks system in the Yarra basin. This can be seen in Table 6-107.

Table 6-106 Desalinated water bulk entitlements

Water entitlement	Annual entitlement volume (ML)
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 (30 June 2019)	**150,000**
Total (30 June 2018)	150,000

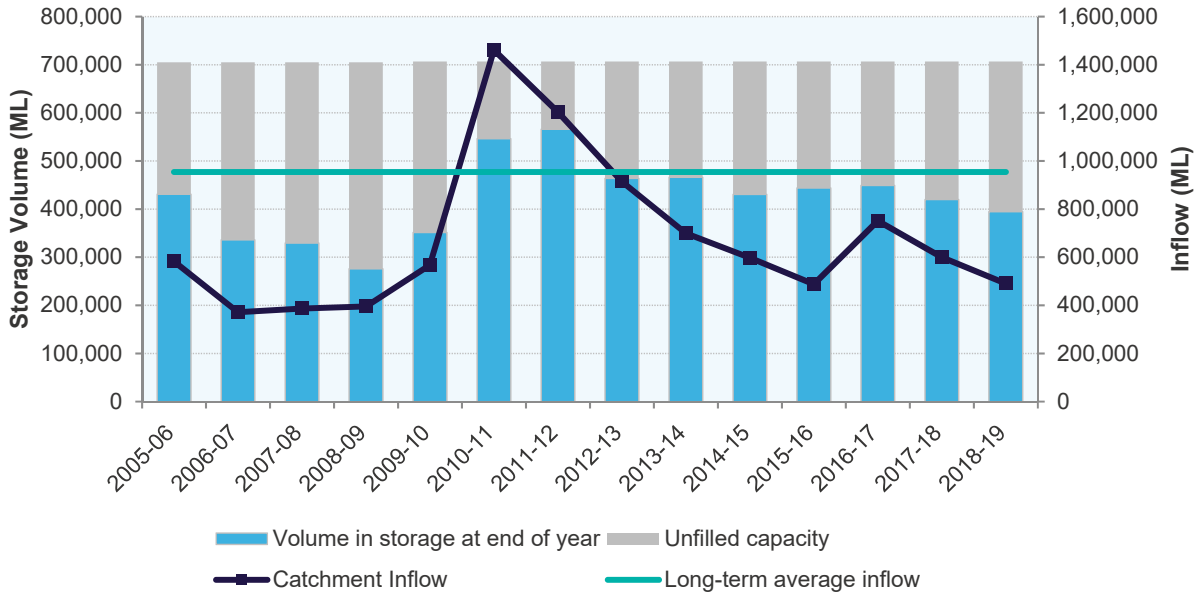
6.17.2 2018–19 water resource overview

In 2018–19, rainfall in the Yarra basin was mostly between 60% and 80% of the long-term average. The south-east corner near Cockatoo and the north-east corner bordering the Goulburn basin both received higher rainfall of between 80% and 100%.

Catchment inflows were 51% of the long-term average of 954,200 ML, less than the inflows recorded in 2017–18, which were 63% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Major storages in the Yarra basin started the year at 53% of capacity and were at 49% at the end of June 2019.

Figure 6-32 Storage volumes and catchment inflows in the Yarra basin



In 2018–19, nine of the Yarra basin's unregulated streams began the year with restrictions on licensed diversions. Licensed diversions on almost all streams were either banned or restricted in September and October. Most were lifted in November 2018, but three streams remained on diversion restrictions for the entirety of 2018–19 (Dixons, Pauls and Steels creeks). Between December 2018 and April 2019, almost all streams were placed under diversion restriction at various intervals. In February 2019, a peak of 21 streams had bans or restrictions on licensed diversions. Most streams across the basin remained under bans until April 2018, with diversion restrictions removed from ten streams by May 2019.

There were no restrictions on urban water use in the Yarra basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

Another order for water from the Victorian Desalination Project was made for 2018–19 by the Minister for Water. The total volume delivered to 30 June 2019 was 21,966 ML, representing 1.21% of Melbourne's storage capacity. This is more than the 15,000 ML (or 0.83%) delivered in 2017–18.

In 2018–19, 424,029 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 403,559 ML diverted in the previous year.

6.17.2.1 Water for the environment

Important environmental assets (such as the Australian grayling, river blackfish, Macquarie perch and numerous billabongs and wetlands) depend on water in the Yarra basin. Significant environmental assets include:

- the Yarra River between Warburton and Warrandyte, which has been identified as a Victorian heritage river and depends on water for the environment

- billabongs on the Yarra River floodplain between Millgrove and Yering Gorge as well as on the reach around Banyule Flats near Heidelberg, which support distinct vegetation communities and provide foraging and breeding habitat for waterbirds and frogs.

In 2018–19, water for the environment in the Yarra basin comprised:

- the *Yarra River Environmental Entitlement 2006*, comprising 17,000 ML of high-reliability entitlement and 55 ML of unregulated surface water entitlement held by the VEWH
- water set aside for the environment through the operation of passing flows released as a condition of the *Yarra River Environmental Entitlement 2006*
- water set aside for the environment through the operation of seven streamflow management plans (see chapter 4.2.2)
- 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: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 16,518 ML of environmental water was delivered in-stream in the Yarra basin: 59 ML of this was diverted off-stream.

6.17.3 Water balance

The total volumes of water available and supplied from water resources in the Yarra basin in 2018–19 are shown in Table 6-107.

Table 6-107 Water balance – Yarra basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	136,129	134,833
Volume in storage at end of year	1	125,851	136,129
Change in storage		**(10,278)**	**1,296**
Inflows			
Catchment inflow	2	490,538	599,427
Rainfall on major storages	1	8,955	11,326
Transfers from Thomson		198,850	133,540
Inflow of desalinated water	3	21,966	15,000
Transfers from Goulburn (Silver and Wallaby Creeks)		356	757
Transfers from Goulburn via North-South pipeline		0	7
Treated wastewater discharged back to river	4	6,185	6,735
Total inflows		**726,850**	**766,792**
Outflows			
Diversions			
Urban diversions		412,237	389,614
Licensed diversions from unregulated streams	5	6,835	6,054
Environmental water diversions	6	59	19
Small catchment dams	7	4,899	7,872
Total diversions		***424,029***	***403,559***
Losses			
Evaporation losses from major storages	1	11,387	11,450
Evaporation from small catchment dams	7	2,976	3,542
In-stream infiltration to groundwater, flows to floodplain and evaporation	8	n/a	n/a
Total losses		***14,363***	***14,992***
Water passed at outlet of basin			
River outflows to Port Phillip Bay	9	298,736	346,945
Total water passed at outlet of basin		***298,736***	***346,945***
Total outflows		**737,128**	**765,496**

6.17.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Yarra basin are included in the water balance. Table 6-108 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

Melbourne Water operates eight 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.

Table 6-108 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	12,004	1,590	1,582	(3,802)	8,210
O'Shannassy Reservoir	3,123	2,670	201	107	(2,440)	324
Upper Yarra Reservoir	200,579	96,517	4,609	4,796	(762)	95,568
Yan Yean Reservoir	30,266	24,938	2,555	4,902	(842)	21,749
Sub-total	**256,147**	**136,129**	**8,955**	**11,387**	**(7,846)**	**125,851**
Off-stream storages						
Cardinia Reservoir	286,911	169,485	7,700	7,218	1,094	171,061
Greenvale Reservoir	26,839	22,946	729	2,044	(1,829)	19,802
Silvan Reservoir	40,445	35,590	2,455	2,254	(1,564)	34,227
Sugarloaf Reservoir	96,253	55,573	1,852	2,631	(11,142)	43,652
Sub-total	**450,448**	**283,594**	**12,736**	**14,147**	**(13,441)**	**268,742**
Total 2018–19	**706,595**	**419,723**	**21,691**	**25,534**	**(21,287)**	**394,593**
Total 2017–18	706,595	448,995	25,840	28,194	(26,918)	419,723

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the environmental water diversions volume and the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Desalinated water

This is the net volume into the three metropolitan water corporations accounts. It includes 6,868 ML of brought-forward water from 2019–20. Brought-forward water is delivered during one year and paid for in the next.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-109 lists the wastewater treatment plants in the Yarra basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-109 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aurora	1,211	100	0%	0	0	0	100	0	1,111
Brushy Creek	3,578	679	3%	94	0	0	585	2,900	0
Craigieburn	978	476	6%	56	0	0	419	502	0
Healesville	457	106	0%	0	0	0	106	350	0
Kinglake	5	0	0%	0	0	0	0	0	5
Lilydale	2,486	773	4%	98	0	0	675	1,713	0
Monbulk	26	0	0%	0	0	0	0	26	0
Upper Yarra	961	301	0%	0	0	0	301	660	0
Wallan	1,087	992	91%	172	813	0	7	34	61
Whittlesea	285	295	97%	119	158	0	19	0	(11)
Total 2018–19	**11,072**	**3,722**	**14%**	**538**	**971**	**0**	**2,212**	**6,185**	**1,166**
Total 2017–18	12,088	4,020	12%	299	1,151	0	2,569	6,735	1,334

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

6. Environmental water diversions

This volume represents the amount that was diverted by the VEWH to Burke Road Billabong, Willsmere Billabong and Yering Backswamp.

The 2017–18 environmental water diversions and catchment inflow figure have been corrected from the 2017–18 accounts.

7. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-110 provides information about small catchment dams in the basin.

Table 6-110 Estimated small catchment dam information for the Yarra basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	17,935	3,169	2,431	5,601
Registered / licensed commercial and irrigation	9,477	1,729	545	2,274
Total 2018–19	**27,412**	**4,899**	**2,976**	**7,875**
Total 2017–18	27,412	7,872	3,542	11,414

8. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Yarra basin as there are no suitable models, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.6.3).

9. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Yarra basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method replaces data from the previous site used to estimate outflows with streamflow data from three new gauged sites, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to Port Phillip Bay by 15% for 2018–19. The previous estimate would have resulted in outflows of 260,445 ML.

6.17.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Yarra – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (238,113 ML) was within the volume available for the year (478,660 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Yarra basin provide the basis for how water is shared in the basin. Rights to water in the Yarra basin are outlined in Table 6-111.

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).

Table 6-111 Entitlement volumes in the Yarra basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Yarra River – Melbourne Water) Order 2014 (1)	400,000
Yarra River Environment Entitlement 2006	
High-reliability	17,000
Unregulated surface water	55
Subtotal: Yarra River Environment Entitlement 2006	**17,055**
Take and use licences – unregulated surface water (2)	39,505
Licensed small catchment dams – on-waterway (3)	1,708
Licensed small catchment dams – off-waterway (3)	7,769
Total (30 June 2019)	**466,037**
Total (30 June 2018) (3)	467,543

Notes

(1) Melbourne Water holds the source bulk entitlement on the Yarra River. The annual entitlement volume is the annual diversion limit for Melbourne Water's Yarra River, Thomson River and Silver and Wallaby creeks bulk entitlements. The limit is calculated using a method for showing compliance with diversion limits approved by the Minister for Water in February 2018. 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.

(2) The volume of unregulated surface water entitlements includes licences with full return to the waterway. In the Yarra basin, there is 12,234 ML of entitlement in this category.

(3) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-112 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-112 Permitted and actual take for the Yarra basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Yarra River – Melbourne Water (1)	-	400,000	0	**400,000**	**213,031**
Yarra River Environment Entitlement (2)	12,655	17,000	0	**29,655**	**16,518**
Take and use licences – unregulated surface water	0	39,528	(56)	**39,472**	**6,835**
Licensed small catchment dams (3)	0	9,477	56	**9,533**	**1,729**
Total 2018–19	**12,655**	**466,005**	**()**	**478,660**	**238,113**
Total 2017–18 (3)	19,734	467,513	(79)	487,168	287,935

Notes

(1) This is the volume diverted in 2018–19. As noted in the 2017–18 accounts, the 2017–18 annual diversion (255,317 ML) was recalculated as part of a diversion limit compliance assessment undertaken by Melbourne Water using the method approved by the Minister for Water in February 2018 for showing compliance with diversion limits for the Yarra River, Thomson River and Silver and Wallaby Creeks bulk entitlements, and confirmed to be compliant with the Yarra basin diversion limit.

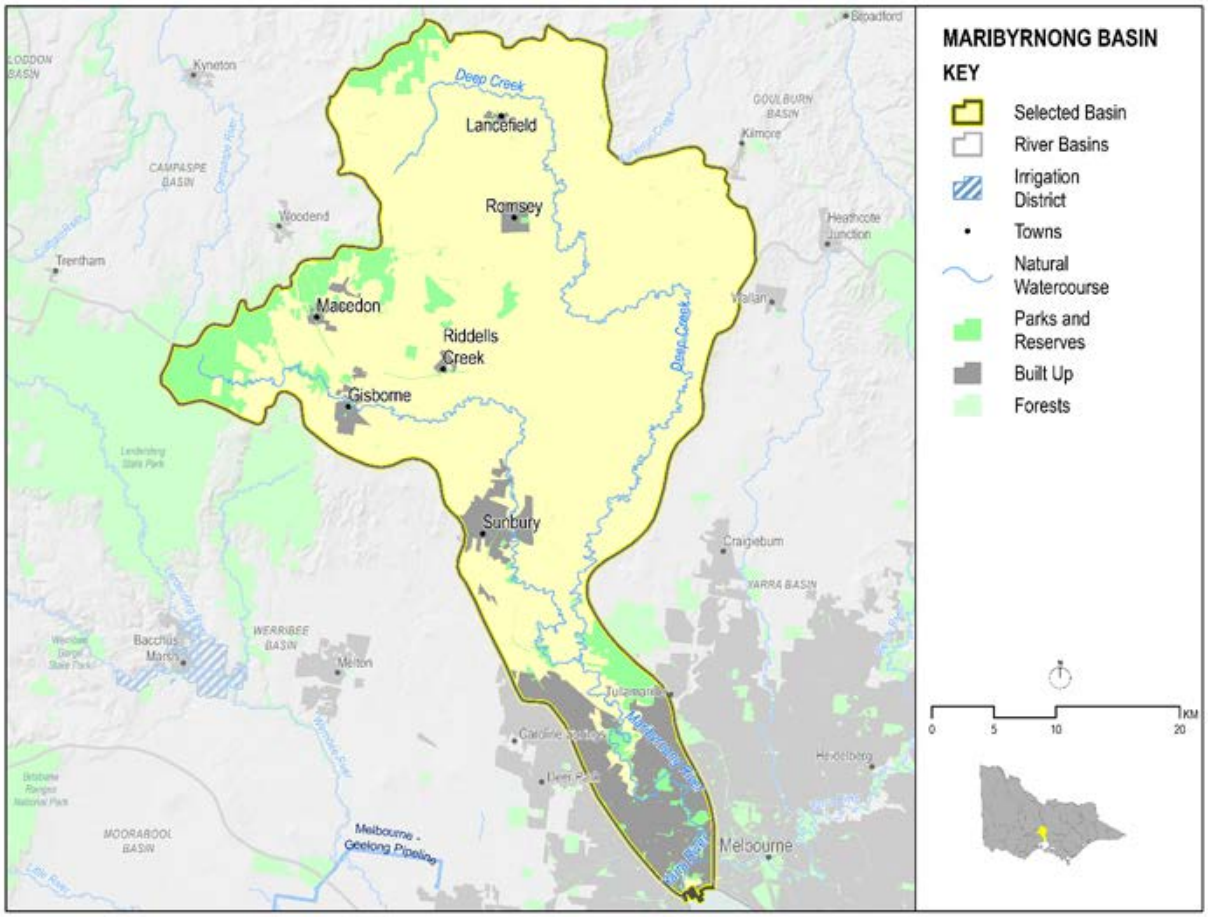
(2) Water taken under the Yarra environmental entitlement includes 59 ML of diversions to wetlands and 16,459 ML of environmental in-stream use. The in-stream use amount is not included in the water balance in Table 6-107 as it is not an actual diversion from the waterway.

(3) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Maribyrnong basin is undertaken by various parties as shown in Table 6-113.

Table 6-113 Responsibilities for water resources management in the Maribyrnong basin

Authority	Management responsibilities
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 the Greater Yarra system – Thomson River Pool) • Manages waterways, drainage and floodplains in the Maribyrnong basin
City West Water	• Supplies part of metropolitan Melbourne (largely from the Yarra and Thomson basins)
Western Water	• Supplies towns in the basin outside metropolitan Melbourne • Operates Macedon reservoirs
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
Port Phillip and Westernport Catchment Management Authority	• Responsible for catchment management in the Maribyrnong basin

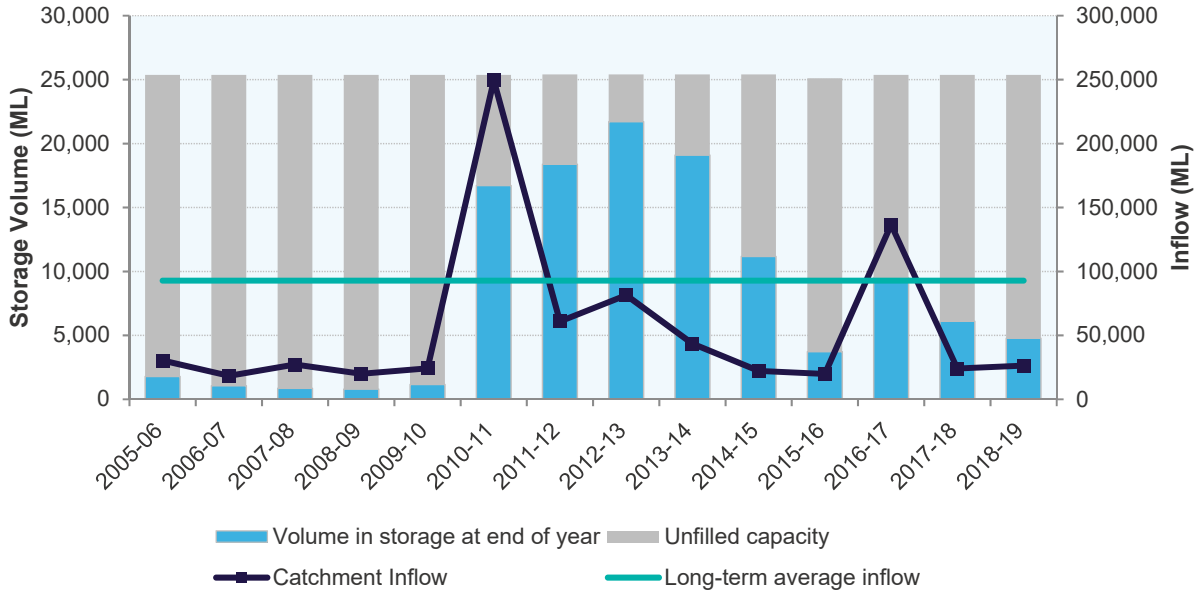
6.18.2 2018–19 water resource overview

Rainfall across the Maribyrnong basin in 2018–19 was mostly between 60% and 80% of the long-term average, except for a small area in the north-west corner — west of Gisborne — which received between 80% and 100%.

Catchment inflows were 28% of the long-term average annual volume of 92,800 ML, more than the inflows recorded in 2017–18, which were 26% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

The storage volume in Rosslynne Reservoir started the year at 24% of capacity; it was at 19% of capacity at the end of June 2019.

Figure 6-34 Storage volumes and catchment inflows in the Maribyrnong basin



A licensed diversion ban was in place on the Maribyrnong River for surface water users with winterfill licences for most of the year, except in July and August 2018. Diversions for all-year licences were banned on the Maribyrnong from February to April 2019 and on Deep, Turitable and Willimigongon creeks from March until June 2019.

There were no restrictions on urban water use in the Maribyrnong basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 4,636 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 5,957 ML diverted in the previous year.

6.18.2.1 Water for the environment

Important environmental assets (such as the Australian grayling and the Jacksons Creek platypus population) depend on water in the Maribyrnong. The upper Maribyrnong catchment contains areas of intact streamside vegetation, which provide important habitat for native fish including migratory short-finned eels, common and ornate galaxias, flathead gudgeon, tupong and Australian smelt. A large population of waterbugs provides an abundant food source for a significant platypus population in several reaches in the Maribyrnong system.

In 2018–19, 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 traded temporarily from rural customers to the VEWH for release to meet environmental objectives in the Maribyrnong system
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 180 ML of environmental water was used in the Maribyrnong basin.

6.18.3 Water balance

The total volumes of water available and supplied from water resources in the Maribyrnong basin in 2018–19 are shown in Table 6-114.

Table 6-114 Water balance – Maribyrnong basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	6,102	9,526
Volume in storage at end of year	1	4,776	6,102
Change in storage		**(1,325)**	**(3,424)**
Inflows			
Catchment inflow	2	26,319	23,944
Rainfall on major storages	1	591	716
Treated wastewater discharged back to river	3	2,413	1,751
Total inflows		**29,322**	**26,410**
Outflows			
Diversions			
Urban diversions		2,038	3,038
Licensed diversions from regulated streams		564	426
Licensed diversions from unregulated streams	4	201	245
Small catchment dams	5	1,833	2,247
Total diversions		***4,636***	***5,957***
Losses			
Evaporation losses from major storages	1	2,877	903
Evaporation from small catchment dams	5	1,523	1,549
In-stream infiltration to groundwater, flows to floodplain and evaporation		2,765	1,971
Total losses		***7,165***	***4,423***
Water passed at outlet of basin			
River outflows to the Yarra River	6	18,847	19,455
Total water passed at outlet of basin		***18,847***	***19,455***
Total outflows		**30,647**	**29,835**

6.18.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Maribyrnong basin are included in the water balance. Table 6-115 shows how storage volumes changed during the year.

Table 6-115 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	6,102	591	2,877	961	4,776
Total 2018–19	**25,368**	**6,102**	**591**	**2,877**	**961**	**4,776**
Total 2017–18	25,368	9,526	716	903	(3,237)	6,102

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-116 lists the wastewater treatment plants in the Maribyrnong basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-116 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Gisborne	915	416	12%	95	12	0	309	499	0
Riddells Creek	148	111	75%	9	102	0	0	37	0
Romsey	285	285	100%	6	279	0	0	0	0
Sunbury	2,911	1,034	23%	382	278	0	374	1,877	0
Total 2018–19	**4,259**	**1,846**	**27%**	**492**	**671**	**0**	**683**	**2,413**	**0**
Total 2017–18	5,755	4,004	18%	519	502	0	2,983	1,751	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-117 provides information about small catchment dams in the basin.

Table 6-117 Estimated small catchment dam information for the Maribyrnong basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	10,262	1,566	1,417	2,982
Registered / licensed commercial and irrigation	1,790	267	106	374
Total 2018–19	**12,052**	**1,833**	**1,523**	**3,356**
Total 2017–18	12,052	2,247	1,549	3,796

6. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Maribyrnong basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method estimates outflows using streamflow data from a second gauge in addition to the data from the previous site, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to the Yarra River by 30% for 2018–19. The previous estimate would have resulted in outflows of 14,456 ML.

6.18.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Maribyrnong – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (3,070 ML) was within the volume available for the year (14,469 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **passing flow requirements on Willimigongon Creek require manual operation and are difficult to meet under most conditions, due to large variations in daily flows. As a result, shortfalls to the daily passing flows occurred during 2018–19. Shortfalls within a given day are not unusual, but in most other years these have been compensated by extra subsequent releases, ensuring average passing flows over the reporting period meet or exceed the minimum requirements. The 2018–19 reporting period saw a 0.8% shortfall in passing flow volumes. To supplement the manual process, telemetry was introduced in 2017–18 to further improve compliance with passing flow requirements.**

Entitlements in the Maribyrnong basin provide the basis for how water is shared in the basin. Rights to water in the Maribyrnong basin are outlined in Table 6-118.

Table 6-118 Entitlement volumes in the Maribyrnong basin

Water entitlement	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	1,925
Licensed small catchment dams – on-waterway (6)	130
Licensed small catchment dams – off-waterway (6)	1,659
Total (30 June 2019)	**14,426**
Total (30 June 2018) (6)	14,426

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: 1,124 ML of entitlement was allocated for the 2018–19 year.
(4) This entitlement supplies water for take and use licences: 214 ML of entitlement was allocated for the 2018–19 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.
(6) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-119 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-119 Available water and take for the Maribyrnong basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Gisborne – Barringo Creek	-	585	0	**585**	**0**
Lancefield	-	315	0	**315**	**54**
Macedon and Mount Macedon	-	873	0	**873**	**204**
Maribyrnong – Melbourne Water (1)	-	1,396	0	**1,396**	**557**
Maribyrnong – Southern Rural Water	-	682	0	**682**	**7**
Maribyrnong – Western Water	-	6,100	0	**6,100**	**1,569**
Riddells Creek	-	300	0	**300**	**9**
Romsey (2)	98	460	0	**558**	**202**
Take and use licences – unregulated surface water	-	1,925	0	**1,925**	**201**
Licensed small catchment dams (3)	-	1,735	0	**1,735**	**267**
Total 2018–19	**98**	**14,371**	**0**	**14,469**	**3,070**
Total 2017–18 (3)	-	14,426	0	14,426	4,169

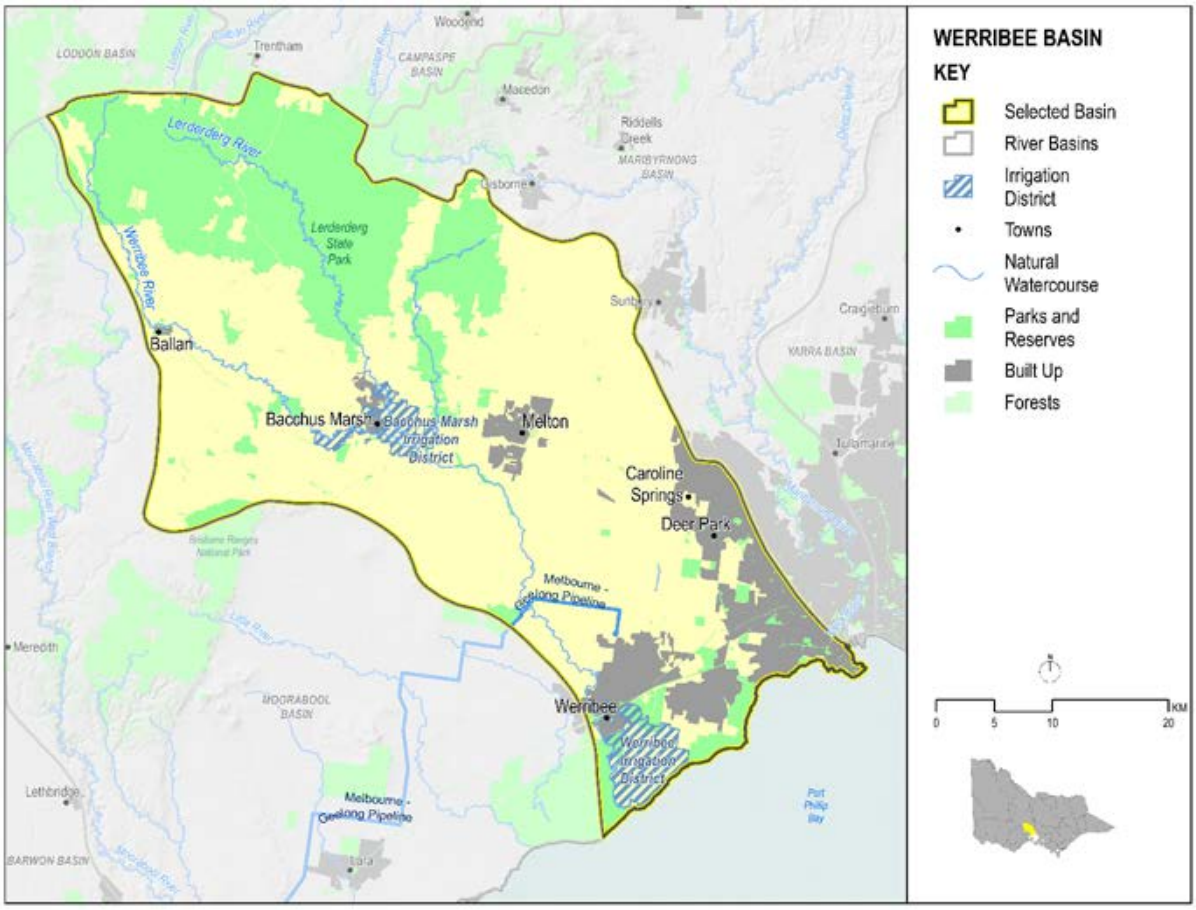
Notes

(1) Use against the Melbourne Water entitlement includes 180 ML of temporary water purchased by the VEWH from take and use licence holders to be used to provide environmental releases in the Maribyrnong system.
(2) Western Water can use unused allocation of up to 280 ML from a previous year under a drought reserve arrangement. 98 ML was added to the drought reserve for this entitlement from 2017–18.
(3) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.19.1 Management arrangements

Management of water in the Werribee basin is undertaken by various parties as shown in Table 6-120.

Table 6-120 Responsibilities for water resources management in the Werribee basin

Authority	Management responsibilities
Southern Rural Water	• Manages Werribee and Bacchus Marsh irrigation districts • Manages licensed diversions • Operates Pykes Creek Reservoir, Melton Reservoir and Merrimu Reservoir
Western Water	• Supplies towns in the north of the basin including Melton and Bacchus Marsh • Operates Djerriwarrh Reservoir
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
Port Phillip and Westernport Catchment Management Authority	• Responsible for waterway and catchment management in the Werribee basin

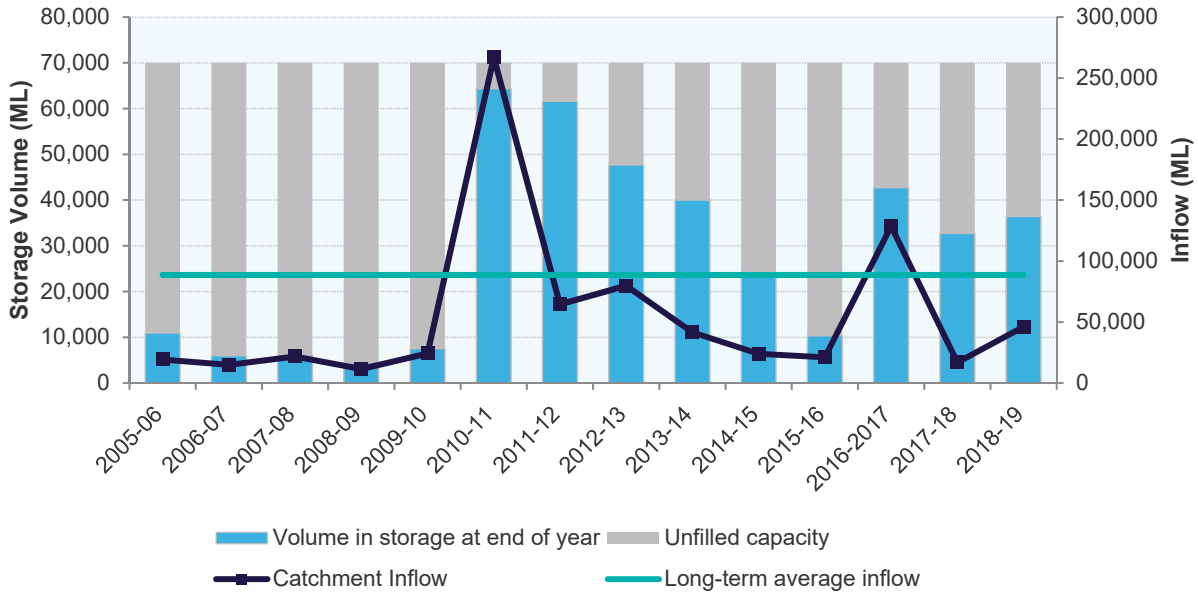
6.19.2 2018–19 water resource overview

Rainfall in the northern half of the Werribee basin in 2018–19 was between 80% and 100% of the long-term average, and the southern half received between 60% and 80%.

Catchment inflows were 52% of the long-term average (88,600 ML), higher than the inflows recorded in 2017–18, which were 19% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Major storages in the Werribee basin started the year at 47% of capacity and were at 52% by the end of June 2019.

Figure 6-36 Storage volumes and catchment inflows in the Werribee basin



In 2018–19, the first seasonal allocation for high-reliability water shares was announced on 4 July 2018 at 10%, which was increased to 45% by April 2019. There were no seasonal allocations for low-reliability water shares in 2018–19.

In 2018–19, a total ban was placed on licensed diversions from the Lerderderg River in December 2018, which was maintained for the rest of the year. There were also restrictions on licensed diversions from Cockatoo and Shepherd Creek for most of the year, with total bans in place in September to October and December 2018 to April 2019.

There were no restrictions on urban water use in the Werribee basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 14,594 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 16,108 ML diverted in the previous year.

6.19.2.1 Water for the environment

Important environmental assets (such as the Australian grayling, tupong and red gums) depend on water in the Werribee basin. A highly diverse community of frogs and waterbugs inhabit the upper reaches of the Werribee River, and platypus are present in the lower reaches. The freshwater-saltwater interface of the Werribee River estuary is a regionally significant ecosystem, due to the many aquatic plants and animals it supports and its provision of nursery habitat for juvenile freshwater fish species and estuarine species (such as black bream).

In 2018–19, 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
- 281 ML of water traded temporarily to the VEWH for release to meet environmental objectives in the Werribee system
- 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: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 793 ML of environmental water was delivered in-stream in the Werribee basin.

6.19.3 Water balance

The total volumes of water available and supplied from water resources in the Werribee basin in 2018–19 are shown in Table 6-121.

Table 6-121 Water balance – Werribee basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	32,721	42,669
Volume in storage at end of year	1	36,429	32,721
Change in storage		**3,708**	**(9,948)**
Inflows			
Catchment inflow	2	46,148	16,847
Rainfall on major storages	1	1,457	1,642
Transfers from other basins		0	0
Return flow from irrigation		246	57
Treated wastewater discharged back to river	3	0	412
Total inflows		**47,850**	**18,957**
Outflows			
Diversions			
Urban diversions		2,549	2,554
Irrigation district diversions		10,819	12,272
Licensed diversions from regulated streams		177	116
Licensed diversions from unregulated streams	4	0	23
Small catchment dams	5	1,048	1,144
Total diversions		***14,594***	***16,108***
Losses			
Evaporation losses from major storages		4,788	1,587
Evaporation from small catchment dams	5	757	940
In-stream infiltration to groundwater, flows to floodplain and evaporation		902	1,007
Total losses		***6,447***	***3,534***
Water passed at outlet of basin			
River outflows to Port Phillip Bay	6	23,101	9,263
Total water passed at outlet of basin		***23,101***	***9,263***
Total outflows		**44,142**	**28,905**

6.19.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Werribee basin are included in the water balance. Table 6-122 shows how storage volumes changed during the year.

Table 6-122 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	762	40	132	4	674
Melton Reservoir	14,364	3,247	321	3,211	5,995	6,352
Merrimu Reservoir (total)	32,516	12,189	500	1,440	(288)	10,961
Pykes Creek Reservoir	22,119	16,523	596	6	1,327	18,441
Total 2018–19	**70,013**	**32,721**	**1,457**	**4,788**	**7,039**	**36,429**
Total 2017–18	70,013	42,669	1,642	1,587	(10,003)	32,721

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-123 lists the wastewater treatment plants in the Werribee basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-123 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within process		
Altona	5,491	2,196	40%	2,185	0	0	11	0	3,295
Ballan	140	140	100%	0	140	0	0	0	0
Melton	4,501	4,501	92%	623	3,538	0	340	0	0
Parwan (Bacchus Marsh)	352	352	100%	37	315	0	0	0	0
Sunshine Golf Course Sewer Mining Plant	37	37	100%	37	0	0	0	0	0
Western Treatment Plant	169,363	31,744	19%	6,889	19,714	5,091	50	0	137,619
Total 2018–19	**179,884**	**38,970**	**21%**	**9,771**	**23,707**	**5,091**	**401**	**0**	**140,914**
Total 2017–18	184,358	34,118	14%	2,887	17,495	6,089	443	412	149,827

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-124 provides information about small catchment dams in the basin.

Table 6-124 Estimated small catchment dam information for the Werribee basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,033	956	723	1,678
Registered / licensed commercial and irrigation	936	93	34	127
Total 2018–19	**9,969**	**1,048**	**757**	**1,805**
Total 2017–18	9,969	1,144	940	2,084

6. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Werribee basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method replaces data from the previous sites used to estimate outflows with streamflow data from two new gauged sites, providing a higher level of certainty in the outflow calculation. This has increased the reported outflows to Port Phillip Bay by 165% for 2018–19. The previous estimate would have resulted in outflows of 8,715 ML.

6.19.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Werribee – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (14,186 ML) was within the volume available for the year (31,480 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Werribee basin provide the basis for how water is shared in the basin. Rights to water in the Werribee basin are outlined in Table 6-125.

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 they can hold up to 100% of their entitlement volume. The VEWH holds an environmental entitlement in the Werribee basin, which also enables it to carry over 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.

Table 6-125 Entitlement volumes in the Werribee basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	
High-reliability water shares	15,475
Low-reliability water shares	7,256
Bulk Entitlement (Myrniong) Conversion Order 2004	58
Operating provision	4,251
Subtotal: Bulk Entitlement (Werribee system – Irrigation) Conversion Order 1997	**27,040**
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)	**n/a**
Take and use licences – unregulated surface water	**697**
Licensed small catchment dams – on-waterway (2)	**187**
Licensed small catchment dams – off-waterway (2)	**749**
Total (30 June 2019)	**39,251**
Total (30 June 2018) (2)	39,263

Notes

(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.

(2) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-126 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-126 Permitted and actual take for the Werribee basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Werribee system – Irrigation – SRW					
Water shares (1)	8,402	6,470	0	**14,872**	**7,945**
Myrniong	3	55	0	**58**	**53**
Operating provision (2)	-	3,086	-	**3,086**	**3,086**
Net diversion: Werribee system – Irrigation – SRW (3)				**18,016**	**11,085**
Ballan	-	451	0	**451**	**0**
Blackwood and Barry's Reef	-	140	0	**140**	**43**
Werribee system – Western Water	-	9,986	0	**9,986**	**2,453**
Werribee River Environment Entitlement 2011 (4)	775	462	0	**1,237**	**512**
Take and use licences – unregulated surface water	-	714	0	**714**	**0**
Licensed small catchment dams (5)	-	936	0	**936**	**93**
Total 2018–19	**9,180**	**22,300**	**0**	**31,480**	**14,186**
Total 2017–18 (5)	13,030	20,235	(186)	33,079	17,582

Notes

(1) Water use reported includes 281 ML of environmental in-stream use. This amount is not reflected in the water balance in Table 6-121, as it does not reflect an actual diversion from the waterway

(2) This reflects use of water to manage the system. It includes any loss incurred in supplying the primary entitlements.

(3) The water use reported in this line item represents the net diversion to supply primary entitlements and fulfil other operating requirements under the Werribee system bulk entitlement (net of return flow from irrigation). It includes environment deliveries in-stream (281 ML).

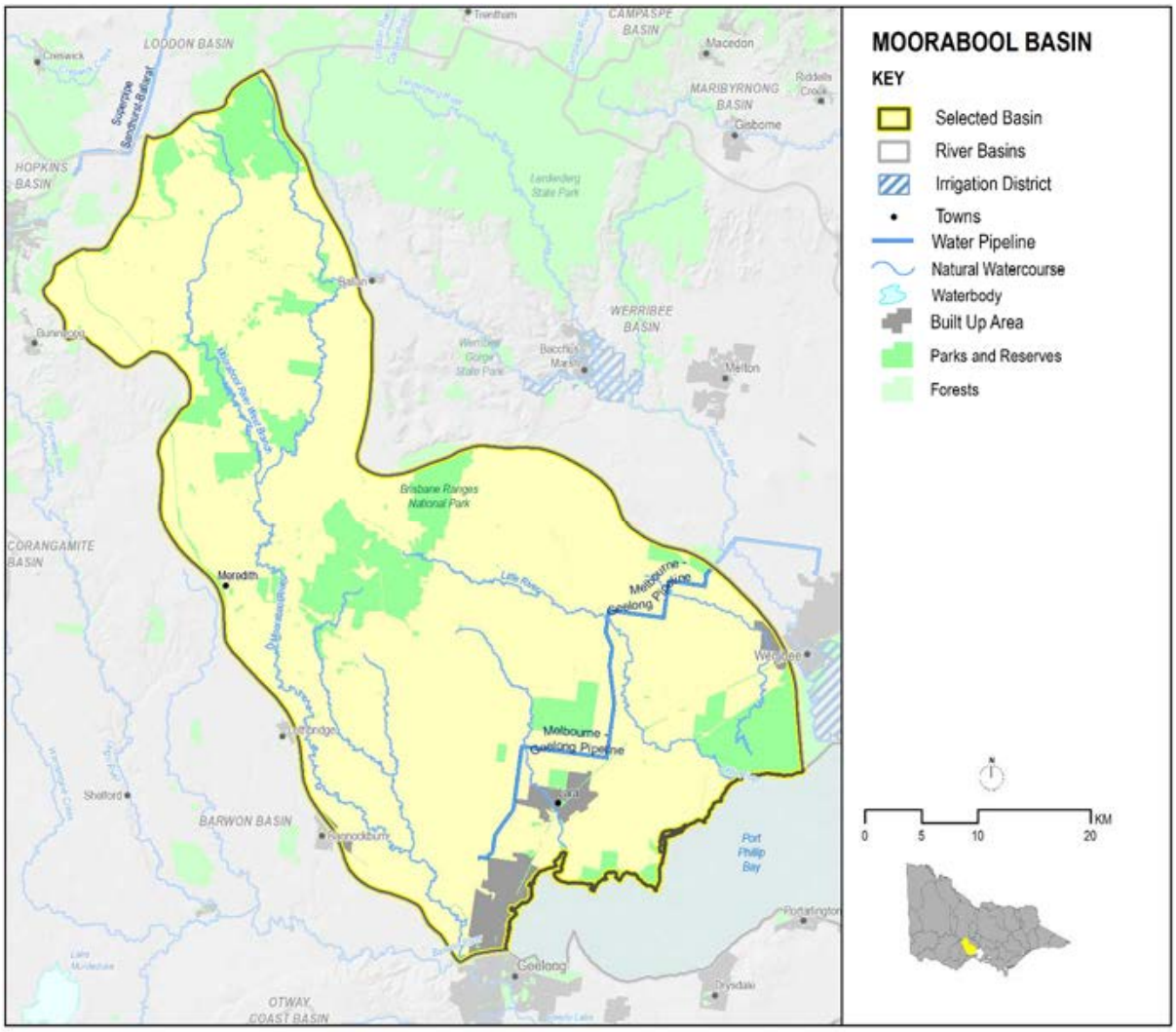
(4) Allocation issued reflects the share of inflows available under this entitlement during the year including adjustments made to account for water lost from internal spills, evaporation or changes in storage volume. Water use reported reflects environmental in-stream use: this amount is not reflected in the water balance in Table 6-121 as it is not an actual diversion from the waterway.

(5) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Moorabool basin is undertaken by various parties as shown in Table 6-127.

Table 6-127 Responsibilities for water resources management in the Moorabool basin

Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Barwon Water	• Supplies Geelong and surrounding towns (mainly sourced from the Barwon basin) • 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
Central Highlands Water	• Supplies Ballarat and surrounding towns (sourced from both the Barwon and Moorabool basins) • Manages reservoirs on the west Moorabool River and has two-thirds of the share of Lal Lal Reservoir
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Moorabool basin

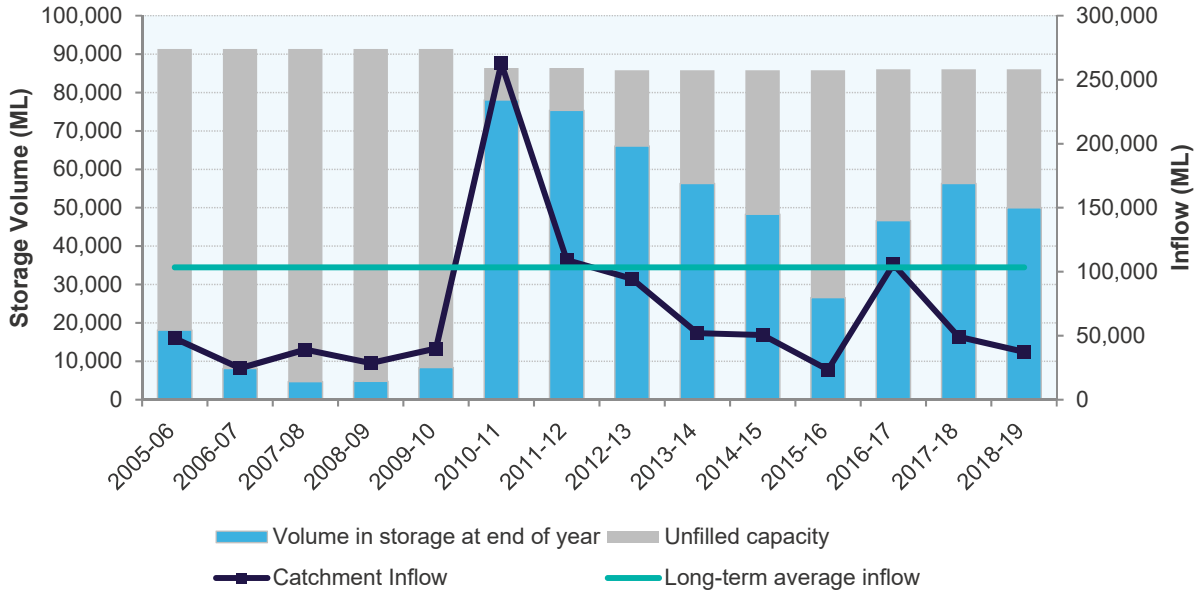
6.20.2 2018–19 water resource overview

Rainfall in the northern half of the Moorabool basin in 2018–19 was between 80% and 100% of the long-term average, and the southern half received between 60% and 80%.

Catchment inflows were 36% of the long-term average annual volume of 103,400 ML, less than the inflows recorded in 2017–18, which were 47% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Storage levels for the major storages in the basin started the year at 67% of capacity and held 59% at the end of June 2019.

Figure 6-38 Storage volumes and catchment inflows in the Moorabool basin



In 2018–19, licensed diversions from the Moorabool River were on a stage 3 roster from October 2018, which increased to a total ban in November 2018 until April 2019. Little River had a total ban on licensed diversions in place from March until May 2019.

There were no restrictions on urban water use in the Moorabool basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 17,900 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 17,531 ML diverted in the previous year.

6.20.2.1 Water for the environment

Important environmental assets (such as river blackfish) between Lal Lal Reservoir and She Oaks Weir, as well as the lower Barwon Wetlands (which is part of the Port Phillip Bay and Bellarine Peninsula Ramsar Site) depend on water in the Moorabool basin. The system contains extensive areas of endangered remnant vegetation including streambank shrubland and riparian woodland ecological vegetation communities. Platypus, water rats and a range of waterbugs are also present.

In 2018–19, water for the environment in the Moorabool basin comprised:

- the *Moorabool River Environmental Entitlement 2010* comprising 11.9% of inflows held by the VEWH
- 3,457 ML of treated groundwater discharged from the Fyansford quarry to the lower Moorabool River
- 500 ML of water traded temporarily to 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 and the VEWH's *Moorabool River Environmental Entitlement 2010*
- 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: this water also provides social, recreational and cultural benefits.

Including the treated groundwater discharged from the Fyansford quarry, in 2018–19, a total of 5,457 ML of environmental water was delivered in-stream in the Moorabool basin.

6.20.3 Water balance

The total volumes of water available and supplied from water resources in the Moorabool basin in 2018–19 are shown in Table 6-128.

Table 6-128 Water balance – Moorabool basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	51,355	41,209
Volume in storage at end of year	1	45,169	51,355
Change in storage		**(6,186)**	**10,146**
Inflows			
Catchment inflow	2	37,362	48,573
Rainfall on major storages	1	3,929	3,498
Treated wastewater discharged back to river	3	0	0
Total inflows		**41,291**	**52,071**
Outflows			
Diversions			
Urban diversions	4	11,999	10,220
Transfers to Barwon basin (White Swan Reservoir)	4	2,421	3,389
Licensed diversions from unregulated streams	5	833	794
Small catchment dams	6	2,647	3,127
Total diversions		***17,900***	***17,531***
Losses			
Evaporation losses from major storages	1	5,577	6,683
Evaporation from small catchment dams	6	1,433	1,839
In-stream infiltration to groundwater, flows to floodplain and evaporation		6,944	7,594
Total losses		***13,955***	***16,115***
Water passed at outlet of basin			
River outflows to Port Phillip Bay (Little River) and other small coastal streams		8,338	1,788
River outflows to the Barwon River (Moorabool River)		7,285	6,491
Total water passed at outlet of basin	7	***15,623***	***8,279***
Total outflows		**47,477**	**41,924**

6.20.3.1 Notes to the water balance

1. Storage

Only major on-stream storages in the Moorabool basin are included in the water balance. Table 6-129 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

Table 6-129 Storage volumes in the Moorabool basin

Storage	Total capacity (ML)	Start volume in store (ML)	Rainfall (ML)	Evaporation (ML) (2)	Catchment inflows less regulated releases (ML)	End volume in store (ML)
On-stream storages						
Bostock Reservoir	7,455	2,996	674	463	70	3,276
Korweinguboora Reservoir	2,327	15	544	56	(146)	357
Lal Lal Reservoir	59,549	45,578	1,897	3,926	(4,660)	38,889
Moorabool Reservoir	6,192	2,733	765	1,044	(98)	2,355
Wilsons Reservoir	1,010	33	51	87	295	292
Total on-stream storages	**76,533**	**51,355**	**3,929**	**5,577**	**(4,539)**	**45,169**
Off-stream storages						
Upper Stony Creek Reservoir	9,494	4,974	n/a	n/a	(177)	4,797
Total off-stream storages	**9,494**	**4,974**	**n/a**	**n/a**	**(177)**	**4,797**
Total 2018–19	**86,027**	**56,329**	**3,929**	**5,577**	**(4,716)**	**49,966**
Total 2017–18	86,027	46,629	3,498	6,683	12,885	56,329

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-130 lists the wastewater treatment plants in the Moorabool basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-130 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Gordon	39	39	100%	0	39	0	0	0	0
Northern WRP	1,327	1,327	90%	1,201	0	0	126	0	0
Total 2018–19	**1,366**	**1,366**	**91%**	**1,201**	**39**	**0**	**126**	**0**	**0**
Total 2017–18	1,345	1,345	95%	1,256	21	0	68	0	0

4. Inter-basin transfers

The 2,421 ML transfer represents water 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.

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-131 provides information about small catchment dams in the basin.

Table 6-131 Estimated small catchment dam information for the Moorabool basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,067	1,685	1,154	2,838
Registered / licensed commercial and irrigation	7,259	963	280	1,242
Total 2018–19	**20,326**	**2,647**	**1,433**	**4,081**
Total 2017–18	20,326	3,127	1,839	4,966

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Moorabool basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The previous calculation was corrected to reflect ungauged outflows to Port Phillip Bay. The new calculation provides a higher level of certainty in the outflow calculation. This has decreased the total reported outflows by 12% for 2018–19. The previous estimate would have resulted in outflows of 17,777 ML.

6.20.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Moorabool – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (18,215 ML) was within the volume available for the year (53,249 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Moorabool basin provide the basis for how water is shared in the basin. Rights to water in the Moorabool basin are outlined in Table 6-132.

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. As this water use is not a diversion from the waterway, it has not been included as part of the water balance diversions in Table 6-128.

Table 6-132 Entitlement volumes in the Moorabool basin

Water entitlement	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
Moorabool River Environment Entitlement 2010 (3)	n/a
Bulk Entitlement (Meredith) Conversion Order 1995	600
Bulk Entitlement (She Oaks) Conversion Order 1995 (4)	2,000
Bulk Entitlement (Upper East Moorabool System) Conversion Order 1995	9,000
Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	10,500
Take and use licences – unregulated surface water	2,105
Licensed small catchment dams – on-waterway (5)	1,469
Licensed small catchment dams – off-waterway (5)	5,790
Total (30 June 2019)	**49,963**
Total (30 June 2018) (5)	49,963

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) The *Moorabool River Environmental Entitlement 2010* consists of an 11.9% share of inflows into storage, up to 7,500 ML every three years, with the actual volume available in any year varying depending on inflow conditions.
(4) Under this entitlement, the authority may take up to 6,000 ML in any three consecutive years.
(5) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-133 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-133 Available water and take for the Moorabool basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Lal Lal – Barwon	-	5,925	0	**5,925**	**4,584**
Lal Lal – Central Highlands	-	12,575	0	**12,575**	**5,345**
Moorabool River Environment Entitlement (1)	2,662	124	500	**3,286**	**2,000**
Meredith	-	600	0	**600**	**0**
She Oaks	-	2,000	0	**2,000**	**0**
Upper East Moorabool system	-	9,000	0	**9,000**	**2,070**
Upper West Moorabool system	-	10,500	0	**10,500**	**2,421**
Take and use licences – unregulated surface water	-	2,100	0	**2,100**	**833**
Licensed small catchment dams (2)	-	7,264	0	**7,264**	**963**
Total 2018–19	**2,662**	**50,087**	**500**	**53,249**	**18,215**
Total 2017–18 (2)	4,923	49,963	491	55,377	18,298

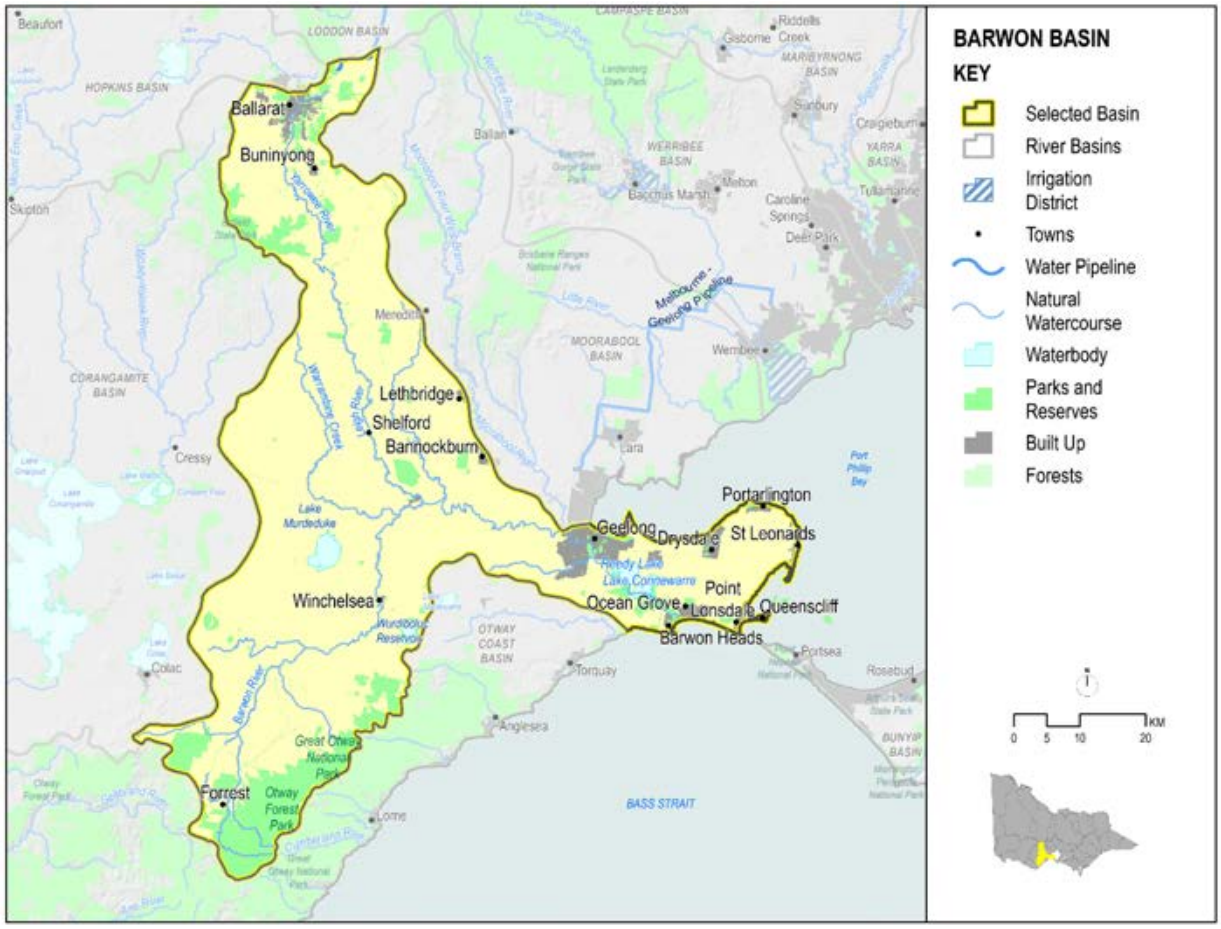
Notes

(1) 'Water taken' reported reflects environmental in-stream use: this amount is not included in the water balance in Table 6-128, as it is not an actual diversion from the waterway. Unused water is available to carry over under this entitlement.
(2) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.21.1 Management arrangements

Management of water in the Barwon basin is undertaken by various parties as shown in Table 6-134.

Table 6-134 Responsibilities for water resources management in the Barwon basin

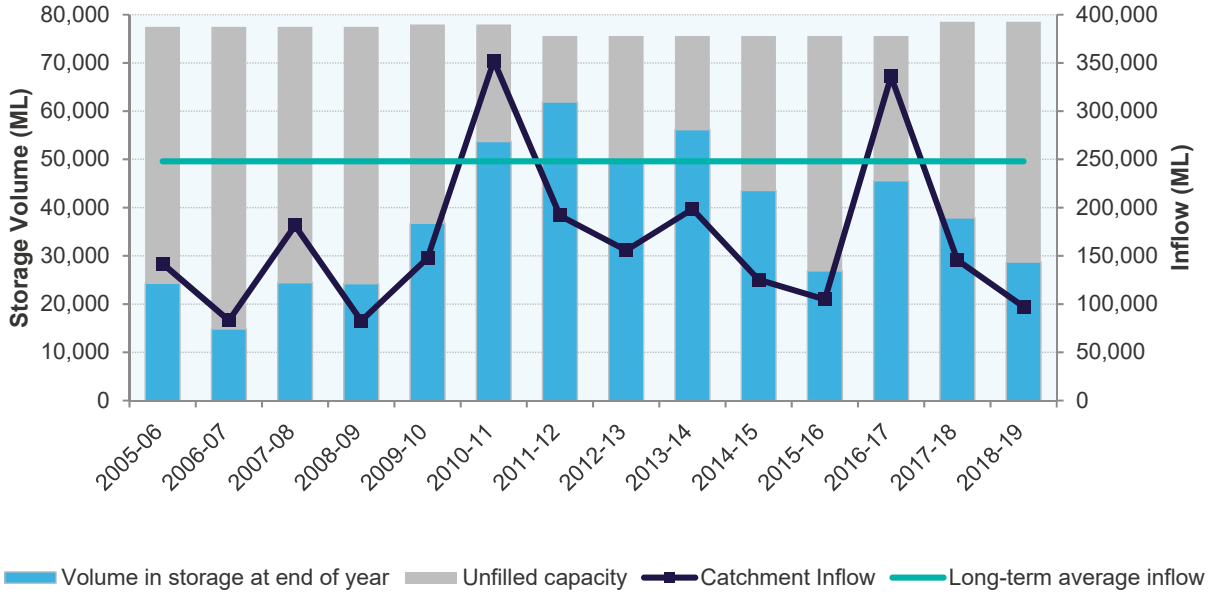
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Barwon Water	• Supplies Geelong and surrounding towns, also by sourcing water from the Moorabool basin and from the Melbourne system via the Melbourne to Geelong Pipeline • Operates West Barwon Reservoir and Lake Wurdee Boluc
Central Highlands Water	• Supplies Ballarat and surrounding towns, mainly with water sourced from the Moorabool basin and the Campaspe and Goulburn basins via the Goldfields Superpipe • Operates White Swan and Gong Gong reservoirs
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Barwon basin

6.21.2 2018–19 water resource overview

Rainfall in the centre of the Barwon basin in 2018–19 was between 60% and 80% of the long-term average. The eastern leg, south-western corner (near Forrest) and northern parts of the basin received between 80% and 100% of the long-term average.

Catchment inflows were 39% of the long-term average of 248,000 ML, less than the inflows recorded in 2017–18, which were 59% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. Storage levels in the Barwon basin started the year at 48% and ended the year at 40% of total capacity.

Figure 6-40 Storage volumes and catchment inflows in the Barwon basin



The Barwon River remained unrestricted from July to December 2018. Low rainfall during summer resulted in bans on licensed diversions in January 2019 at the Inverleigh, Pollocksford and Ricketts Marsh sections of the Barwon River. These bans were maintained for four months, before being lifted in May 2019.

There were no restrictions on urban water use in the Barwon basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 39,387 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 44,213 ML diverted in the previous year.

6.21.2.1 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 2018–19, water for the environment in the Barwon basin comprised:

- the *Barwon River Environmental Entitlement 2011*
- the *Upper Barwon River Environmental Entitlement 2018*
- water from the Ballarat South Wastewater Treatment Plant released into the Leigh and Barwon rivers
- a portion of the treated groundwater discharged from the Fyansford quarry to the lower Moorabool River
- 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: this water also provides social, recreational and cultural benefits.

6.21.3 Water balance

The total volumes of water available and supplied from water resources in the Barwon basin in 2018–19 are shown in Table 6-135.

Table 6-135 Water balance – Barwon basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	18,345	22,627
Volume in storage at end of year	1	15,407	18,345
Change in storage		**(2,938)**	**(4,282)**
Inflows			
Catchment inflow	2	97,286	145,446
Rainfall on major storages	1	2,739	2,253
Inflows from the Moorabool River		7,285	6,491
Transfers from the Corangamite basin via Woady Yaloak Channel		0	0
Transfers from Moorabool basin to White Swan Reservoir	3	2,421	3,389
Transfers from Campaspe basin to White Swan Reservoir	3	931	0
Treated wastewater discharged back to river	4	9,471	9,440
Total inflows		**120,133**	**167,019**
Outflows			
Diversions			
Urban diversions		34,123	38,559
Licensed diversions from unregulated streams	5	1,140	870
Small catchment dams	6	4,123	4,785
Total diversions		***39,387***	***44,213***
Losses			
Evaporation losses from major storages	1	2,686	3,089
Evaporation from small catchment dams	6	2,839	3,300
In-stream infiltration to groundwater, flows to floodplain and evaporation		10,325	11,745
Total losses		***15,851***	***18,135***
Water passed at outlet of basin			
River outflows to the ocean	7	67,833	108,953
Total water passed at outlet of basin		***67,833***	***108,953***
Total outflows		**123,071**	**171,301**

6.21.2.2 Notes to the water balance

1. Storage

Major on-stream storages in the Barwon basin are included in the water balance. Table 6-136 shows how storage volumes changed during the year. Volumes in off-stream storages are presented for additional information about the resource condition.

Table 6-136 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	1,351	99	130	103	1,423
West Barwon Reservoir (1)	22,064	6,736	1,826	1,408	(1,397)	5,756
White Swan Reservoir (2)	14,107	10,258	814	1,148	(1,696)	8,228
Sub-total	**38,073**	**18,345**	**2,739**	**2,686**	**(2,991)**	**15,407**
Off-stream storages						
Wurdee Boluc Reservoir (3)	40,431	19,522	n/a	n/a	(6,216)	13,306
Sub-total	**40,431**	**19,522**	**n/a**	**n/a**	**(6,216)**	**13,306**
Total 2018–19	**78,504**	**37,867**	**2,739**	**2,686**	**(9,207)**	**28,713**
Total 2017–18	78,504	45,567	2,253	3,089	(6,864)	37,867

Notes
(1) Total capacity includes dead storage volume of 560 ML.
(2) White Swan Reservoir is treated as an on-stream storage for the purpose of the water balance.
(3) Total capacity includes dead storage volume of 2,077 ML. Volumes for rainfall and evaporation are not available for this site.

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Transfer of water

The 2,421 ML transfer represents water that is transferred to White Swan Reservoir from the Moorabool basin and the 931 ML was transferred to White Swan Reservoir from the Campaspe. This water is used to supply urban customers in the Ballarat area, which is located within both the Barwon and Moorabool basins.

4. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-137 lists the wastewater treatment plants in the Barwon basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Barwon Water and Central Highlands Water operate treatment plants within the Barwon basin.

Table 6-137 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ballarat North	2,684	357	6%	13	0	147	197	2,326	0
Ballarat South	7,247	102	0%	0	0	0	102	7,145	0
Bannockburn	161	161	47%	76	0	0	85	0	0
Birregurra	4	4	0%	0	0	0	4	0	0
Black Rock	23,369	3,918	10%	1,195	1,138	0	1,585	0	19,451
Portarlington	310	310	80%	49	199	0	63	0	0
Winchelsea	67	67	11%	7	0	0	60	0	0
Total 2018–19	**33,842**	**4,919**	**8%**	**1,340**	**1,337**	**147**	**2,096**	**9,471**	**19,451**
Total 2017–18	34,648	3,584	8%	966	1,649	232	738	9,440	21,623

5. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

6. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-138 provides information about small catchment dams in the basin.

Table 6-138 Estimated small catchment dam information for the Barwon basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	24,060	2,967	2,426	5,392
Registered / licensed commercial and irrigation	9,849	1,156	414	1,570
Total 2018–19	**33,909**	**4,123**	**2,839**	**6,963**
Total 2017–18	33,909	4,785	3,300	8,085

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Barwon basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method uses streamflow data from a new gauge downstream of the previous site used to estimate outflows, providing a higher level of certainty in the outflow calculation. This has decreased the reported outflows to the ocean by 26%. The previous estimate would have resulted in outflows of 91,609 ML.

6.21.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Barwon – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (37,440 ML) was within the volume available for the year (71,039 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Barwon basin provide the basis for how water is shared in the basin. Rights to water in the Barwon basin are outlined in Table 6-139.

Table 6-139 Entitlement volumes in the Barwon basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlements (Upper Barwon System) Conversion Order 2002 (1)	42,466
Bulk Entitlement (Yarrowee-White Swan System) Conversion Order 2002 (2)	12,267
Barwon River Environmental Entitlement 2011 (3)	n/a
Upper Barwon River Environmental Entitlement 2018 (4)	n/a
Take and use licences – unregulated surface water	4,627
Licensed small catchment dams – on-waterway (5)	921
Licensed small catchment dams – off-waterway (5)	8,928
Total (30 June 2019)	**69,209**
Total (30 June 2018) (5)	69,209

Notes

(1) This entitlement specifies that the authority may take up to 127,400 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, it 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.
(3) The *Barwon River Environmental Entitlement 2011* allows unregulated flows to be diverted to floodplain wetlands. The volume of unregulated flows available for diversion varies, as it depends on suitable river heights as specified in the entitlement. As such, an annual volume is not applicable for this entitlement.
(4) An annual volume is not applicable for the *Upper Barwon River Environmental Entitlement 2018* as it allows for a 3.8% share of inflows into storage, with the actual volume available in any year varying, depending on inflow conditions.
(5) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-140 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-140 Available water and take for the Barwon basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Upper Barwon system	-	42,466	0	**42,466**	**25,951**
Yarrowee – White Swan system	-	12,267	0	**12,267**	**8,172**
Barwon River Environmental Entitlement (1)	-	-	-	**-**	**-**
Upper Barwon River Environmental Entitlement	1,000	752	0	**1,752**	**1,020**
Take and use licences – unregulated surface water	-	4,755	60	**4,815**	**1,140**
Licensed small catchment dams (2)	-	9,799	(60)	**9,739**	**1,156**
Total 2018–19	**1,000**	**70,039**	**0**	**71,039**	**37,440**
Total 2017–18 (2)	-	70,211	0	70,211	40,802

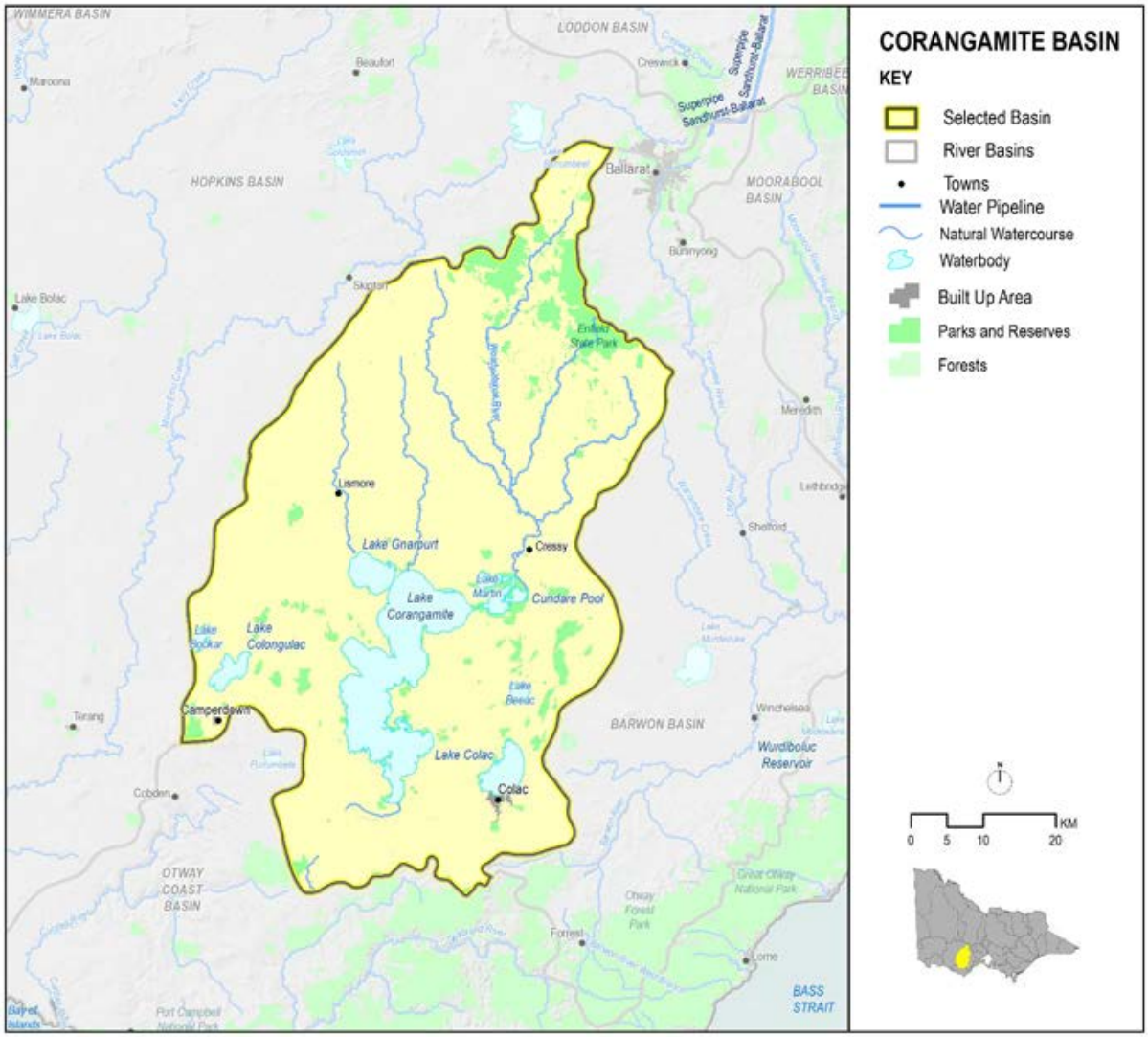
Notes

(1) Use under this entitlement depends on suitable river heights, no water was available in 2018–19.
(2) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Corangamite basin is undertaken by various parties as shown in Table 6-141.

Table 6-141 Responsibilities for water resources management in the Corangamite basin

Authority	Management responsibilities
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 (Ballarat system, sourced from the Moorabool, Barwon and Goulburn basins)
Wannon Water	• Provides urban water supply to Camperdown, Lismore and Derrinallum (from the Otway Coast basin)
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Corangamite basin

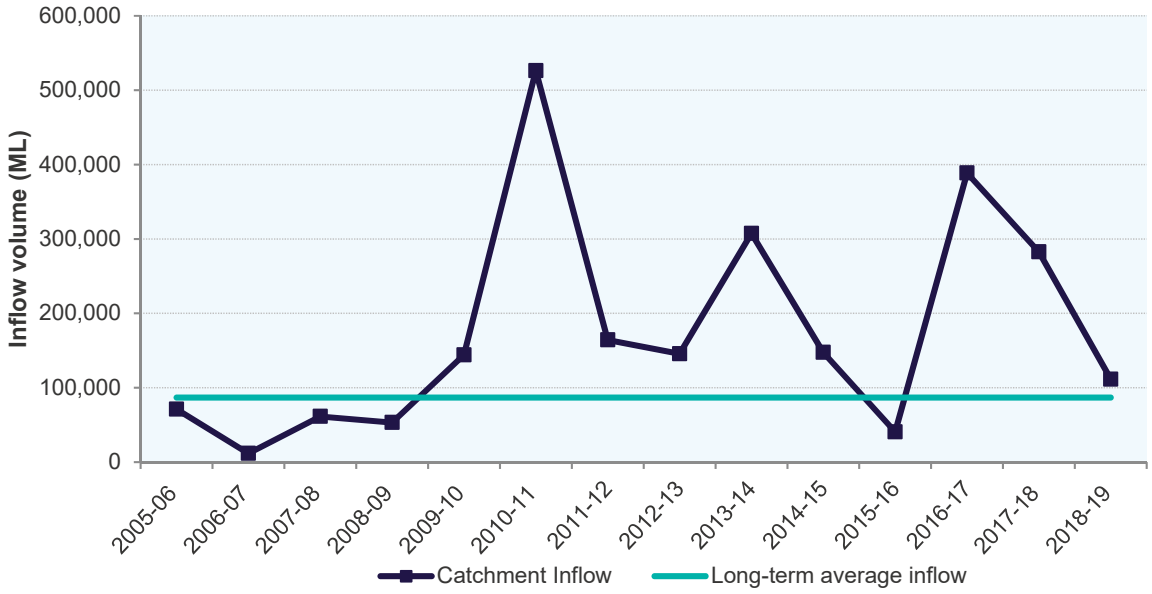
6.22.2 2018–19 water resource overview

In 2018–19, rainfall in the Corangamite basin was mostly between 80% and 100% of the long-term average, with an area north of Lake Beeac receiving between 60% to 80% of the long-term average.

Catchment inflows across the basin were 128% of the long-term average of 86,800 ML, less than the inflows recorded in 2017–18, which were 326% of the long-term average. The long-term average presented has been revised from the

previous accounts: see chapter 6.1.2 for details. The amount of water flowing from the Corangamite basin into the Ramsar-listed Western District Lakes represented 99% of the catchment inflows in 2018–19.

Figure 6-42 Catchment inflows in the Corangamite basin



In 2018–19, all licensed diversions from Lake Tooliorook were banned from July to December 2018 and were then unrestricted until the end of June 2019.

There were no restrictions on urban water use in the Corangamite basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 1,944 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 2,051 ML diverted in the previous year.

6.22.2.1 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 2018–19, water for the environment in the Corangamite basin comprised:

- the component of water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits
- water set aside for the environment through the operation of passing flow conditions on licensed diversions.

6.22.3 Water balance

The total volumes of water available and supplied from water resources in the Corangamite basin in 2018–19 are shown in Table 6-142.

Table 6-142 Water balance – Corangamite basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	111,426	282,555
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	2,004	1,991
Total inflows		**113,429**	**284,546**
Outflows			
Diversions			
Urban diversions		0	0
Licensed diversions from unregulated streams	4	60	43

Small catchment dams	5	1,884	2,009
Total diversions		***1,944***	***2,051***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	5	1,353	1,393
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***1,353***	***1,393***
Water passed at outlet of basin			
River outflows to the Corangamite lakes	7	110,132	281,102
River outflows to Barwon basin via Woady Yaloak Channel		0	0
Total water passed at outlet of basin		***110,132***	***281,102***
Total outflows		**113,429**	**284,546**

6.22.3.1 Notes to the water balance

1. Storage

There are no major water supply storages in the Corangamite basin.

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-143 lists the wastewater treatment plants in the Corangamite basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-143 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Camperdown Industrial	34	34	100%	0	34	0	0	0	0
Camperdown Municipal	407	407	100%	15	392	0	0	0	0
Colac	2,092	88	0%	0	0	0	88	2,004	0
Total 2018–19	**2,533**	**529**	**17%**	**15**	**426**	**0**	**88**	**2,004**	**0**
Total 2017–18	2,368	377	16%	12	365	0	0	1,991	0

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-144 provides information about small catchment dams in the basin.

Table 6-144 Estimated small catchment dam information for the Corangamite basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,864	1,289	1,182	2,471
Registered / licensed commercial and irrigation	3,851	595	171	767
Total 2018–19	**13,715**	**1,884**	**1,353**	**3,238**
Total 2017–18	13,715	2,009	1,393	3,402

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Corangamite basin as there are no suitable models available, and this basin is primarily occupied by Lake Corangamite, making it difficult to derive losses across the basin (see chapter 6.1.2).

7. Water passed at outlet of basin

The method used to calculate the outflows to terminal lakes in the Corangamite basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The previous method overstated the outflow amount and the update has improved our estimation. The new method includes data from two new gauges in addition to data from the previous three gauges, providing a higher level of certainty in the outflow calculation. This has decreased the reported outflows to the terminal lakes by 57%. The previous estimate would have resulted in outflows of 253,579 ML.

6.22.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Corangamite – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (655 ML) was within the volume available for the year (4,725 ML).**

Entitlements in the Corangamite basin provide the basis for how water is shared in the basin. Rights to water in the Corangamite basin are outlined in Table 6-145.

Table 6-145 Entitlement volumes in the Corangamite basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water (1)	874
Licensed small catchment dams – on-waterway (1)	243
Licensed small catchment dams – off-waterway (1)	3,608
Total (30 June 2019)	**4,725**
Total (30 June 2018) (1)	4,725

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19, the definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-146 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-146 Permitted and actual take for the Corangamite basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	874	0	**874**	**60**
Licensed small catchment dams (1)	-	3,851	0	**3,851**	**595**
Total 2018–19	**-**	**4,725**	**0**	**4,725**	**655**
Total 2017–18 (1)	-	4,725	0	4,725	688

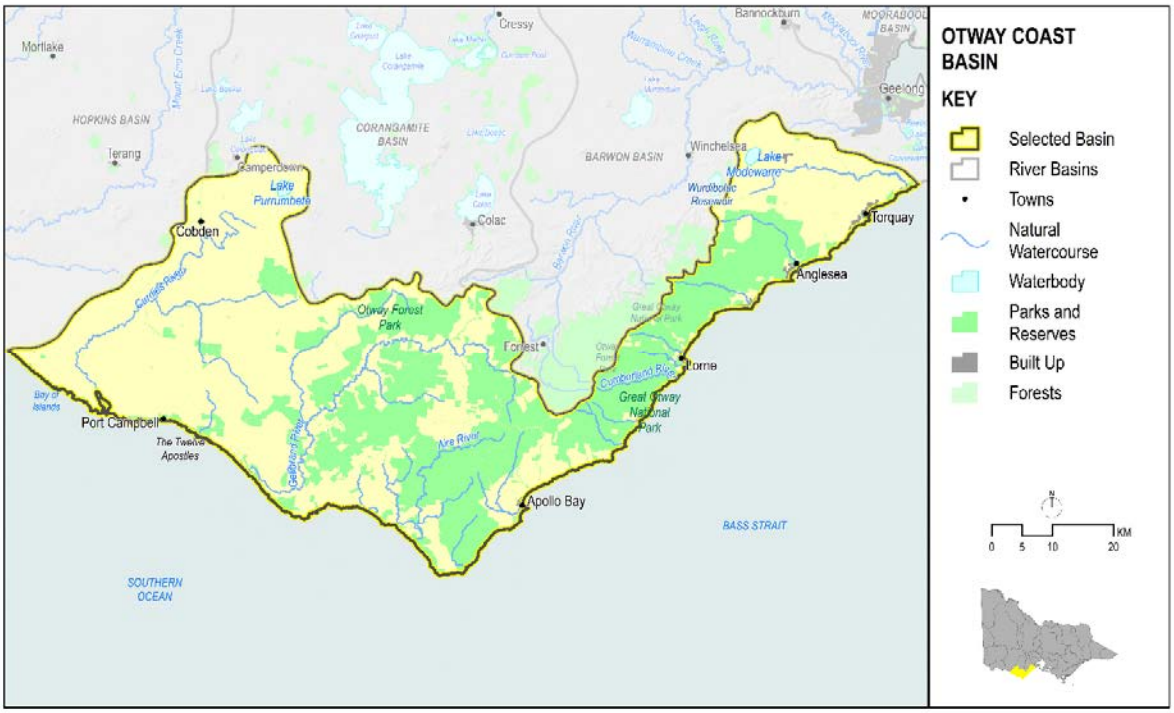
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Otway Coast basin is undertaken by various parties as shown by Table 6-147.

Table 6-147 Responsibilities for water resources management in the Otway Coast basin

Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Wannon Water	• Supplies towns including Port Campbell, Peterborough, Simpson and Cobden
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) • Transfers water out of the basin to supply Colac and surrounding towns • Operates West Gellibrand Reservoir and other reservoirs used to supply towns
Corangamite Catchment Management Authority	• Responsible for waterway and catchment management in the Otway Coast basin

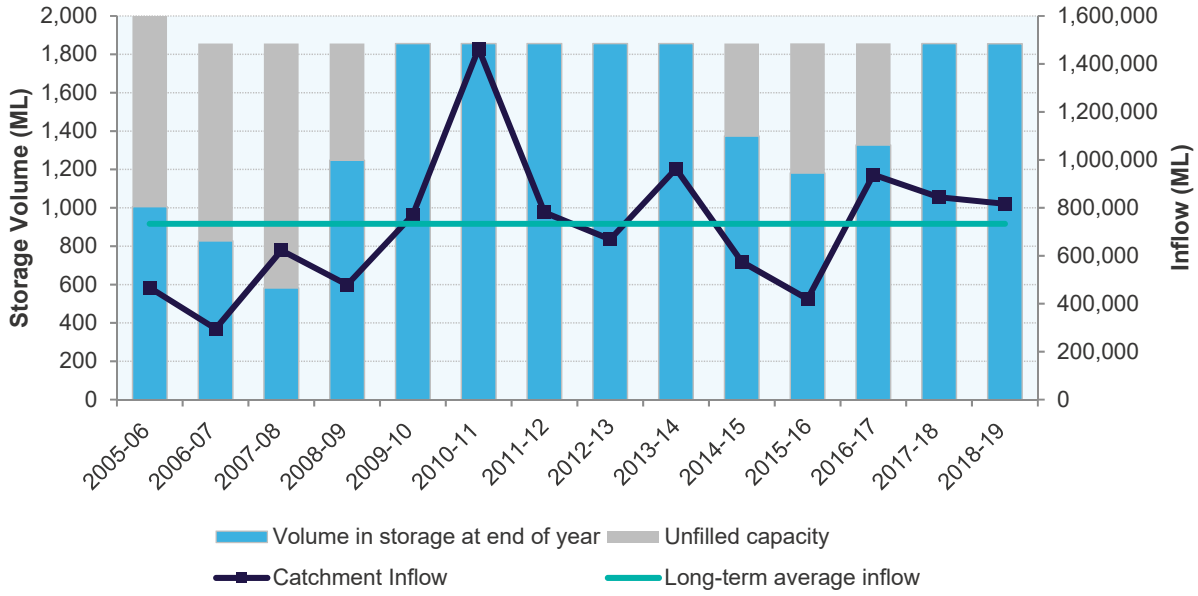
6.23.2 2018–19 water resource overview

In 2018–19, the Otway Coast basin was one of two basins (along with a small area in the Wimmera basin) that received above-average rainfall. Rainfall in most of the south of the basin — from Apollo Bay to the Twelve Apostles — was between 100% and 125% of the long-term average. Most of the remainder of the basin received between 80% and 100% of the long-term average, except for two small areas near the Barwon basin border — one north of Lorne and the other near the Wurdee Boluc Reservoir — that received between 60% and 80%.

Catchment inflows were 111% of the long-term average of 733,300 ML, less than the inflows recorded in 2017–18, which were 115% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details. The amount of water flowing into Bass Strait represented 97% of the catchment inflows in the basin in 2018–19.

Storage levels in West Gellibrand Reservoir started 2018–19 at 100% and reached 100% again by the end of the year.

Figure 6-44 Storage volumes and catchment inflows in the Otway Coast basin



In 2018–19, licensed diversions from the Curdies River were banned from February to May 2019. Licensed diversions from the Carlisle River were unrestricted for the whole year.

There were no restrictions on urban water use in the Otway Coast basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 22,620 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 22,941 ML diverted in the previous year.

6.23.2.1 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 waterways
- native fish communities (such as river blackfish and Australian grayling) and their habitats (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 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.23.3 Water balance

The total volumes of water available and supplied from water resources in the Otway Coast basin in 2018–19 are shown in Table 6-148.

Table 6-148 Water balance – Otway Coast basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	1,856	1,327
Volume in storage at end of year	1	1,855	1,856
Change in storage		**(1)**	**529**
Inflows			
Catchment inflow	2	816,710	843,521
Rainfall on major storages		342	339
Treated wastewater discharged back to river	3	72	96
Total inflows		**817,124**	**843,956**
Outflows			
Diversions			
Urban diversions		13,531	13,262
Licensed diversions from unregulated streams	4	175	144
Small catchment dams	5	8,914	9,535
Total diversions		***22,620***	***22,941***
Losses			
Evaporation losses from major storages		326	295
Evaporation from small catchment dams	5	3,760	3,353
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***4,086***	***3,648***
Water passed at outlet of basin			
River outflows to the ocean	7	790,420	816,839
Total water passed at outlet of basin		***790,420***	***816,839***
Total outflows		**817,125**	**843,427**

6.23.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Otway Coast basin are included in the water balance. Table 6-149 shows how storage volumes changed during the year.

Table 6-149 Storage volumes in the Otway Coast 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						
West Gellibrand Reservoir	1,856	1,856	342	326	(17)	1,855
Total 2018–19	**1,856**	**1,856**	**342**	**326**	**(17)**	**1,855**
Total 2017–18	1,856	1,327	339	295	485	1,856

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin.

Table 6-150 lists the wastewater treatment plants in the Otway Coast basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-150 Volume and use of recycled water in the Otway 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Aireys Inlet	0	0	0%	0	0	0	0	0	0
Anglesea	310	93	26%	82	0	0	11	0	217
Apollo Bay	492	15	0%	0	0	0	15	0	477
Cobden	177	116	66%	0	116	0	0	61	0
Lorne	302	15	0%	0	0	0	15	0	287
Peterborough	9	9	100%	0	9	0	0	0	0
Port Campbell	59	59	100%	0	59	0	0	0	0
Simpson	11	0	0%	0	0	0	0	11	0
Timboon	65	65	100%	0	65	0	0	0	0
Total 2018–19	**1,425**	**372**	**23%**	**82**	**249**	**0**	**41**	**72**	**981**
Total 2017–18	1,407	297	21%	0	296	0	0	96	1,015

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-151 provides information about small catchment dams in the basin.

Table 6-151 Estimated small catchment dam information for the Otway Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	13,676	4,628	2,813	7,441
Registered / licensed commercial and irrigation	10,014	4,286	947	5,233
Total 2018–19	**23,691**	**8,914**	**3,760**	**12,674**
Total 2017–18	23,691	9,535	3,353	12,887

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Otway Coast basin as there are no suitable models available to make an estimate of the total losses (as chapter 6.1.2 explains).

7. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Otway Coast basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method replaces the previous sites used to estimate outflows with streamflow data from three new gauged sites, providing a higher level of certainty in the outflow calculation. This has decreased the reported outflows to the ocean by 5% for 2018–19. The previous estimate would have resulted in outflows of 833,782 ML.

6.23.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Otway Coast – Key compliance points

- ✓ **There was a net increase of 4 ML to the total entitlement volume from the previous year.**
  - **This increase was a result of a net increase in unregulated take and use licences.**
- ✓ **The total volume diverted (17,992 ML) was within the volume available for the year (34,393 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Otway Coast basin provide the basis for how water is shared in the basin. Rights to water in the Otway Coast basin are outlined in Table 6-152

Table 6-152 Entitlement volumes in the Otway Coast basin

Water entitlement	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 (1)	4,467
Licensed small catchment dams – on-waterway (1)	1,965
Licensed small catchment dams – off-waterway (1)	8,050
Total (30 June 2019)	**34,149**
Total (30 June 2018) (1)	34,143

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-153 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-153 Available water and take for the Otway Coast basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Aireys Inlet	-	317	0	**317**	**0**
Apollo Bay	-	800	0	**800**	**537**
Colac	-	5,400	0	**5,400**	**3,645**
Gellibrand	-	60	0	**60**	**22**
Lorne	-	510	0	**510**	**432**
Otway system	-	12,580	0	**12,580**	**8,895**
Take and use licences – unregulated surface water	-	4,712	0	**4,712**	**175**
Licensed small catchment dams (1)	-	10,014	0	**10,014**	**4,286**
Total 2018–19	**-**	**34,393**	**0**	**34,393**	**17,992**
Total 2017–18 (1)	-	26,110	0	26,110	13,977

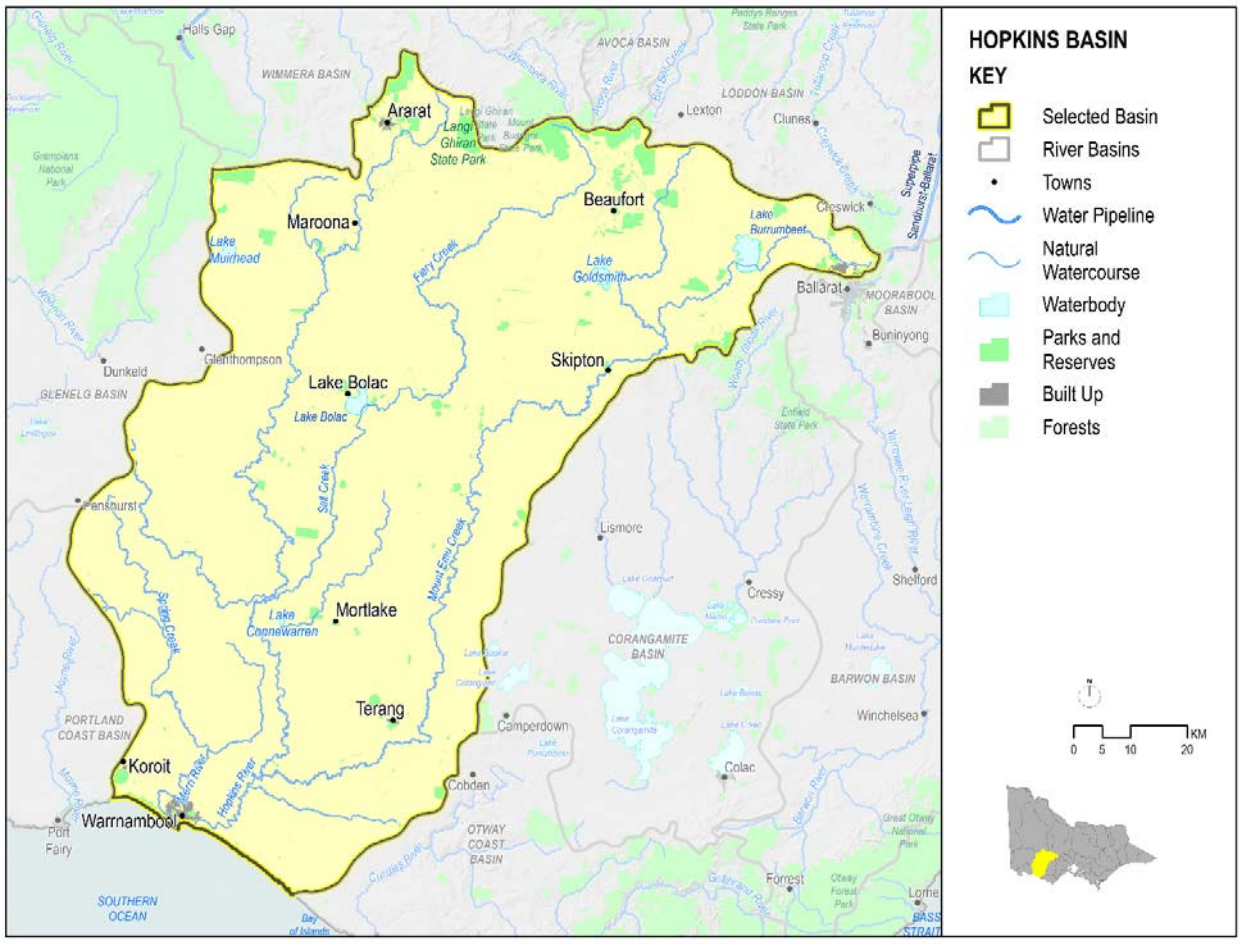
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

6.24 Hopkins basin

The Hopkins basin (Figure 6-45) is located in south-western Victoria. The two major rivers within the basin are the Merri River and Hopkins River.

Figure 6-45 Map of the Hopkins basin



6.24.1 Management arrangements

Management of water in the Hopkins basin is undertaken by various parties as shown in Table 6-154.

Table 6-154 Responsibilities for water resources management in the Hopkins basin

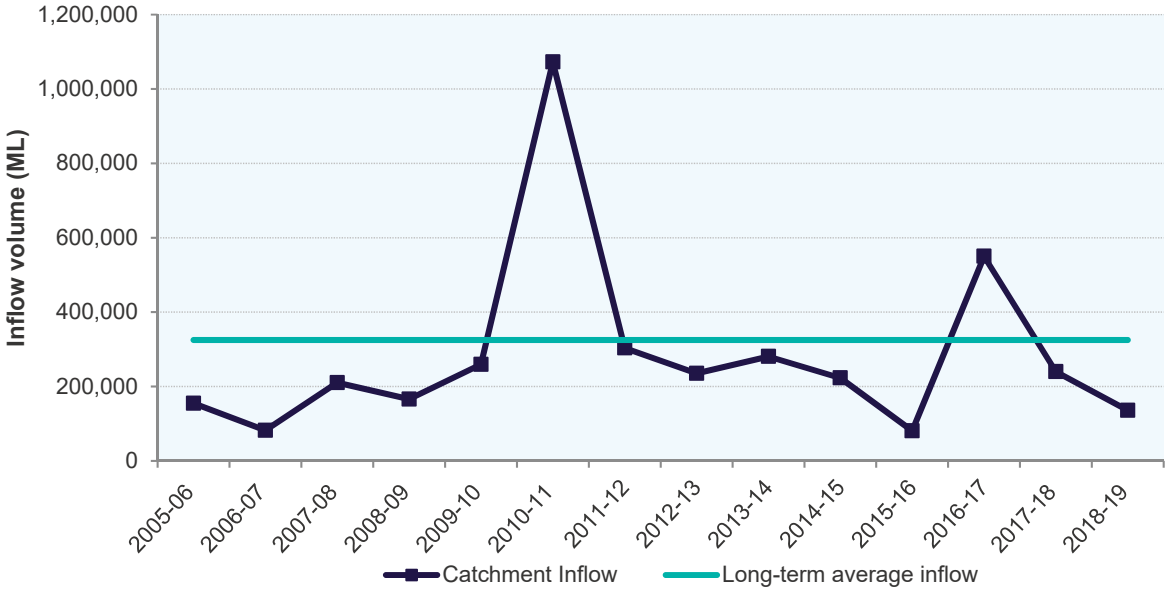
Authority	Management responsibilities
Southern Rural Water	• Manages groundwater and surface water licensed diversions (except Loddon Highlands WSPA, which is managed by Goulburn-Murray Water)
Wannon Water	• Supplies towns and cities in the south of the basin including Warrnambool
Grampians Wimmera Mallee Water	• Supplies towns and cities in the north of the basin including Ararat
Central Highlands Water	• Supplies towns in the north-east of the basin including Beaufort and Skipton
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the whole of the Hopkins basin

6.24.2 2018–19 water resource overview

Rainfall throughout the Hopkins basin in 2018–19 was between 80% and 100% of the long-term average.

Catchment inflows in 2018–19 were 42% of the long-term average annual volume of 325,100 ML, less than the inflows recorded in 2017–18, which were 74% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Figure 6-46 Catchment inflows in the Hopkins basin



Similar to the previous year, Brucknell Creek, the Hopkins and Merri rivers and Mount Emu Creek all began 2018–19 on a stage 1 roster. The roster remained in place for most of the year except in September 2018, when all streams were unrestricted. Stage 1 rosters were applied to all streams from October 2018, with most increasing through summer up to stages 2 and 4. Total bans were put in place on licensed diversions from Mount Emu and Brucknell creeks in February 2019. The ban on Brucknell Creek was in place for February 2019 only, but Mount Emu Creek's ban remained in place until the end of April 2019. All streams ended the year on a stage 1 roster.

There were no restrictions on urban water use in the Hopkins basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 5,722 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 6,267 ML diverted in the previous year.

6.24.2.1 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. Other important environmental assets in the basin include:

- the Hopkins River, a major waterway draining the eastern part of the region and entering the Southern Ocean at Warrnambool
- Hopkins estuary, the Merri River and Fiery Creek
- Brucknell Creek and Deep Creek, which provide important fish habitat for species including the Australian grayling and river blackfish
- Mt Emu Creek, which contains reaches with relatively intact remnant riparian vegetation and deep, permanent pools providing drought refuge for threatened species.

In 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.24.3 Water balance

The total volumes of water available and supplied from water resources in the Hopkins basin in 2018–19 are shown in Table 6-155.

Table 6-155 Water balance – Hopkins basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	2	135,766	239,748
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	0	0
Total inflows		**135,766**	**239,748**
Outflows			
Diversions			
Urban diversions		221	175
Licensed diversions from unregulated streams	4	2,401	2,354
Small catchment dams	5	3,099	3,738
Total diversions		***5,722***	***6,267***
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	5	2,825	3,051
In-stream infiltration to groundwater, flows to floodplain and evaporation	6	n/a	n/a
Total losses		***2,825***	***3,051***
Water passed at outlet of basin			
River outflows to the ocean		127,219	230,430
Total water passed at outlet of basin		***127,219***	***230,430***
Total outflows		**135,766**	**239,748**

6.24.3.1 Notes to the water balance

1. Storage

There are no major storages — storages greater than 1,000 ML — in the Hopkins basin.

2. Catchment inflow

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

The 2017–18 catchment inflow volume has been corrected from the previous accounts. An error was made with the unregulated diversion, which in turn caused an error in the catchment inflow amount.

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-156 lists the wastewater treatment plants in the Hopkins basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-156 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Ararat	598	593	98%	120	467	0	6	0	5
Beaufort	54	54	100%	0	54	0	0	0	0
Cardigan Village	29	29	100%	0	29	0	0	0	0
Mortlake	43	43	100%	6	37	0	0	0	0
Snake Valley	6	6	100%	0	6	0	0	0	0
Skipton	0	0	0%	0	0	0	0	0	0
Terang	197	197	100%	0	197	0	0	0	0
Warrnambool	5,694	80	0%	20	0	0	59	0	5,615
Willaura	22	5	23%	5	0	0	0	0	17
Total 2018–19	**6,643**	**1,007**	**14%**	**151**	**790**	**0**	**65**	**0**	**5,637**
Total 2017–18	6,466	1,044	15%	192	763	0	89	0	5,423

4. Licensed diversions from unregulated streams

The volume of diversions from unregulated streams reported for 2017–18 has been amended from the 2017–18 accounts, due to a change in the definition of unregulated licences, which chapter 6.1 explains.

5. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-157 provides information about small catchment dams in the basin.

Table 6-157 Estimated small catchment dam information for the Hopkins basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	27,942	2,463	2,572	5,035
Registered / licensed commercial and irrigation	8,146	636	253	889
Total 2018–19	**36,088**	**3,099**	**2,825**	**5,924**
Total 2017–18	36,088	3,738	3,051	6,788

6. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Hopkins basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses (see chapter 6.1.2).

6.24.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Hopkins – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (3,258 ML) was within the volume available for the year (17,999 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Hopkins basin provide the basis for how water is shared in the basin. Rights to water in the Hopkins basin are outlined in Table 6-158.

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 is sourced from the Wimmera.

Table 6-158 Entitlement volumes in the Hopkins basin

Water entitlement	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 (1)	9,176
Licensed small catchment dams – on-waterway (1)	2,219
Licensed small catchment dams – off-waterway (1)	5,927
Total (30 June 2019)	**17,951**
Total (30 June 2018) (1)	17,951

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-159 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-159 Available water and take for the Hopkins basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Beaufort	-	419	0	**419**	**221**
Skipton	-	210	0	**210**	**0**
Take and use licences – unregulated surface water	-	9,224	0	**9,224**	**2,401**
Licensed small catchment dams (1)	-	8,146	0	**8,146**	**636**
Total 2018–19	**-**	**17,999**	**0**	**17,999**	**3,258**
Total 2017–18 (1)	-	17,963	0	17,963	3,352

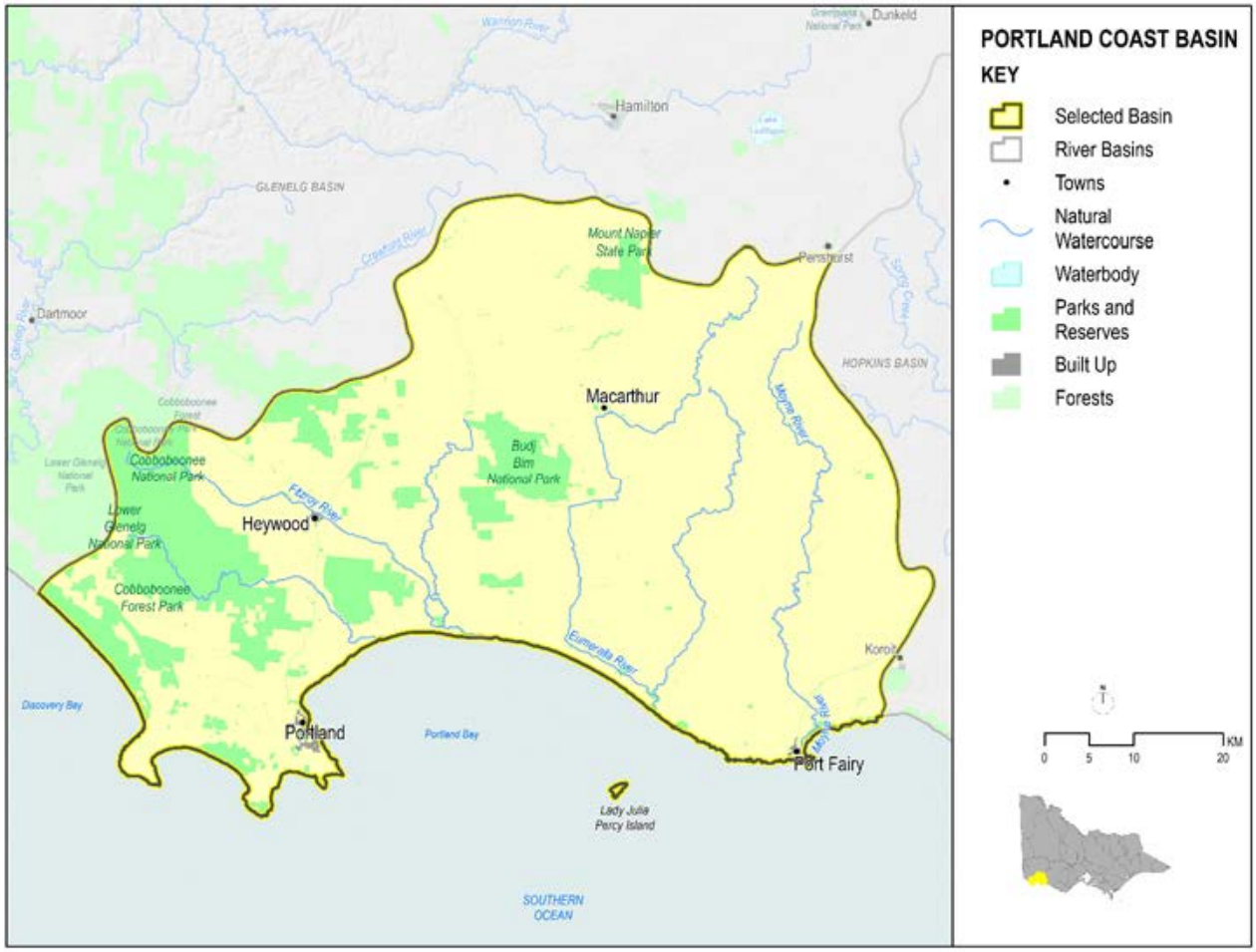
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

6.25 Portland Coast basin

The Portland Coast basin (Figure 6-47) is in south-western 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 Management arrangements

Management of water in the Portland Coast basin is undertaken by various parties as shown in Table 6-160.

Table 6-160 Responsibilities for water resources management in the Portland Coast basin

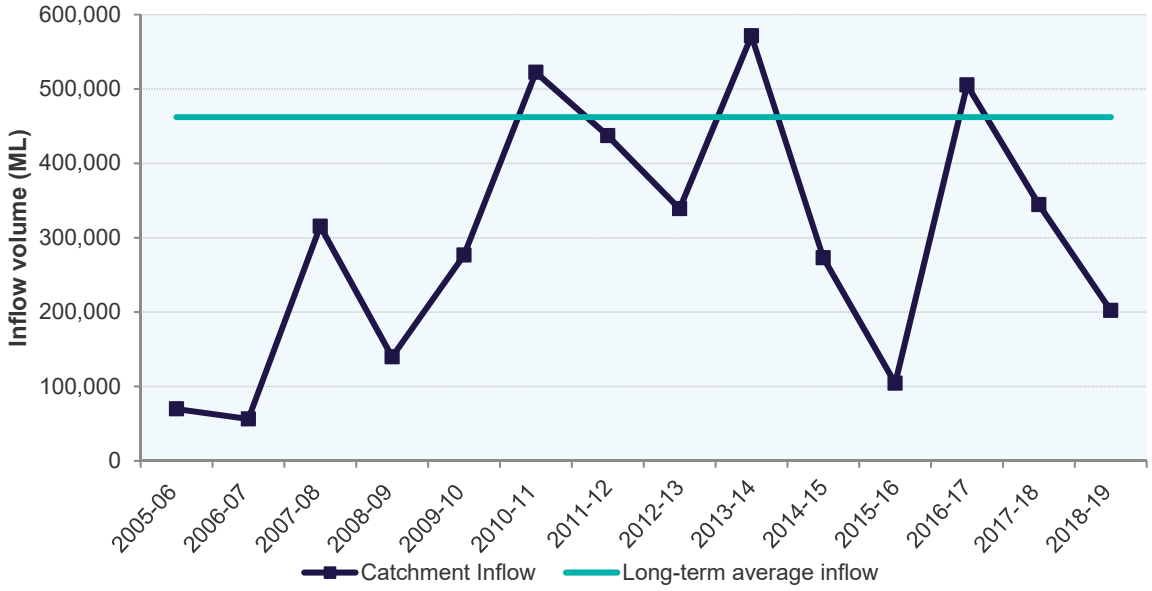
Authority	Management responsibilities
Southern Rural Water	• Manages licensed diversions
Wannon Water	• Supplies groundwater to Koroit, Port Fairy, Heywood and Portland
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the whole Portland Coast basin

6.25.2 2018–19 water resource overview

Rainfall throughout the Portland Coast basin in 2018–19 was between 80% and 100% of the long-term average.

Catchment inflows were 44% of the long-term average annual volume of 462,200 ML, lower than the inflows recorded in 2017–18, which were 75% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Figure 6-48 Catchment inflows in the Portland Coast basin



A ban on licensed diversions was implemented for the Fitzroy River in November 2019, followed by the Eumeralla, Moyne and Surry rivers in January 2019. Restrictions were in place until the end of April 2019. Licensed diversions were also banned from Darlots Creek in the 2018–19 summer, but only for the month of February.

There were no restrictions on urban water use in the Portland Coast basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 1,217 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 1,931 ML diverted in the previous year.

6.25.2.1 Water for the environment

Important environmental assets that rely on water for the environment in this basin include:

- Lake Condah and the Budj Bim National Heritage Landscape — a site inscribed on the UNESCO World Heritage List — which is a volcanic plain that encompasses the area from Budj Bim to the sea and which supports manna gum woodlands and many rare and threatened aquatic fauna including the Yarra pygmy perch
- the Fitzroy River – Darlots Creek system, where Darlots Creek flows south from Condah to the Fitzroy River at Tyrendarra and into the Southern Ocean via the Fitzroy River estuary. The area contains a number of threatened species.

Other important rivers in the basin include the Moyne and Surrey rivers and the Eumeralla / Shaw river system.

In 2018–19, water for the environment in the Portland Coast basin comprised:

- water in the basin not otherwise allocated for consumptive use: this water also provides social, recreational and cultural benefits
- 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.

6.25.3 Water balance

The total volumes of water available and supplied from water resources in the Portland Coast basin in 2018–19 are shown in Table 6-161.

Table 6-161 Water balance – Portland Coast basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	-	-
Volume in storage at end of year	1	-	-
Change in storage			
Inflows			
Catchment inflow	2	202,080	344,469
Rainfall on major storages	1	-	-
Treated wastewater discharged back to river	3	220	316

Total inflows		**202,300**	**344,785**
Outflows			
Diversions			
Licensed diversions from unregulated streams		0	0
Small catchment dams	4	1,217	1,931
Total diversions		***1,217***	**1,931**
Losses			
Evaporation losses from major storages	1	-	-
Evaporation from small catchment dams	4	1,019	1,181
In-stream infiltration to groundwater, flows to floodplain and evaporation	5	n/a	n/a
Total losses		***1,019***	***1,181***
Water passed at outlet of basin			
River outflows to the ocean		200,063	341,673
Total water passed at outlet of basin		***200,063***	***341,673***
Total outflows		**202,300**	**344,785**

6.25.3.1 Notes to the water balance

1. Storage

There are no major storages — storages greater than 1,000 ML — in the Portland Coast basin.

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-162 lists the wastewater treatment plants in the Portland Coast basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-162 Volume and use of recycled water in the Portland 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Heywood	345	125	36%	0	125	0	0	220	0
Port Fairy Domestic	628	0	0%	0	0	0	0	0	628
Port Fairy Industrial	145	0	0%	0	0	0	0	0	145
Portland	1,516	0	0%	0	0	0	0	0	1,516
Total 2018–19	**2,634**	**125**	**5%**	**0**	**125**	**0**	**0**	**220**	**2,289**
Total 2017–18	2,675	83	3%	0	83	0	0	316	2,277

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-163 provides information about small catchment dams in the basin.

Table 6-163 Estimated small catchment dam information for the Portland Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	6,594	1,137	989	2,126
Registered / licensed commercial and irrigation	497	81	31	111
Total 2018–19	**7,090**	**1,217**	**1,019**	**2,237**
Total 2017–18	7,090	1,931	1,181	3,113

5. In-stream losses

An assessment of in-stream infiltration to groundwater, flows to floodplain and evaporation is not made in the Portland Coast basin as there are no suitable models available, and the distribution of streamflow gauges across the basin makes it difficult to estimate in-stream losses, as chapter 6.1.2 explains.

6.25.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Portland – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (81 ML) was within the volume available for the year (1,507 ML).**

Entitlements in the Portland Coast basin provide the basis for how water is shared in the basin. Rights to water in the Portland Coast basin are outlined in Table 6-164.

Table 6-164 Entitlement volumes in the Portland Coast basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water (1)	1,011
Licensed small catchment dams – on-waterway (1)	67
Licensed small catchment dams – off-waterway (1)	429
Total (30 June 2019)	**1,507**
Total (30 June 2018) (1)	1,507

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-165 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-165 Available water and take for the Portland Coast basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	1,011	0	**1,011**	**0**
Licensed small catchment dams (1)	-	497	0	**497**	**81**
Total 2018–19	**-**	**1,507**	**0**	**1,507**	**81**
Total 2017–18 (1)	-	1,507	0	1,507	139

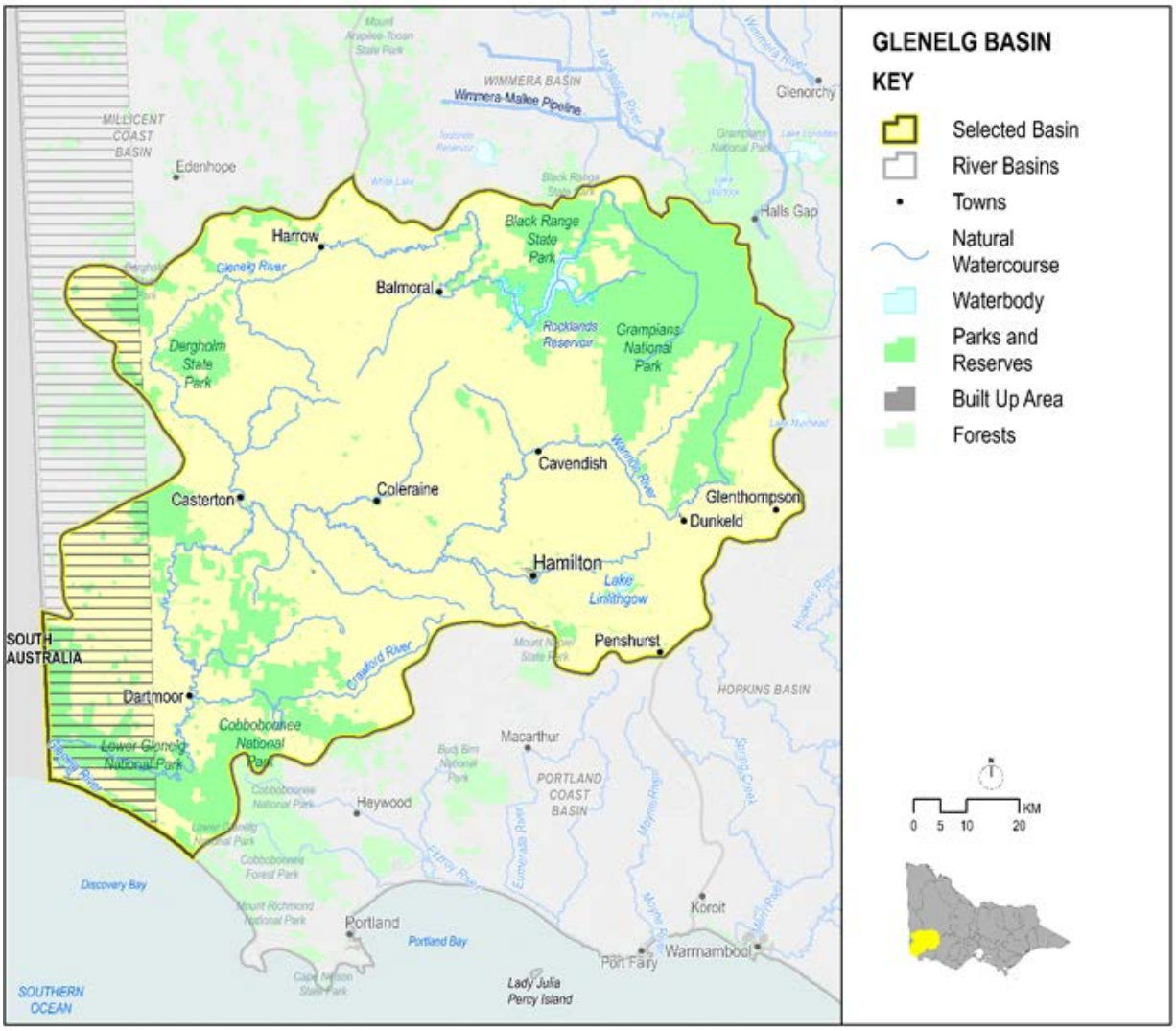
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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 Management arrangements

Management of water in the Glenelg basin is undertaken by various parties as shown in Table 6-166.

Table 6-166 Responsibilities for water resources management in the Glenelg basin

Authority	Management responsibilities
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
Wannon Water	• Supplies all other towns in the basin • Operates reservoirs in the Hamilton supply system
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the Glenelg basin

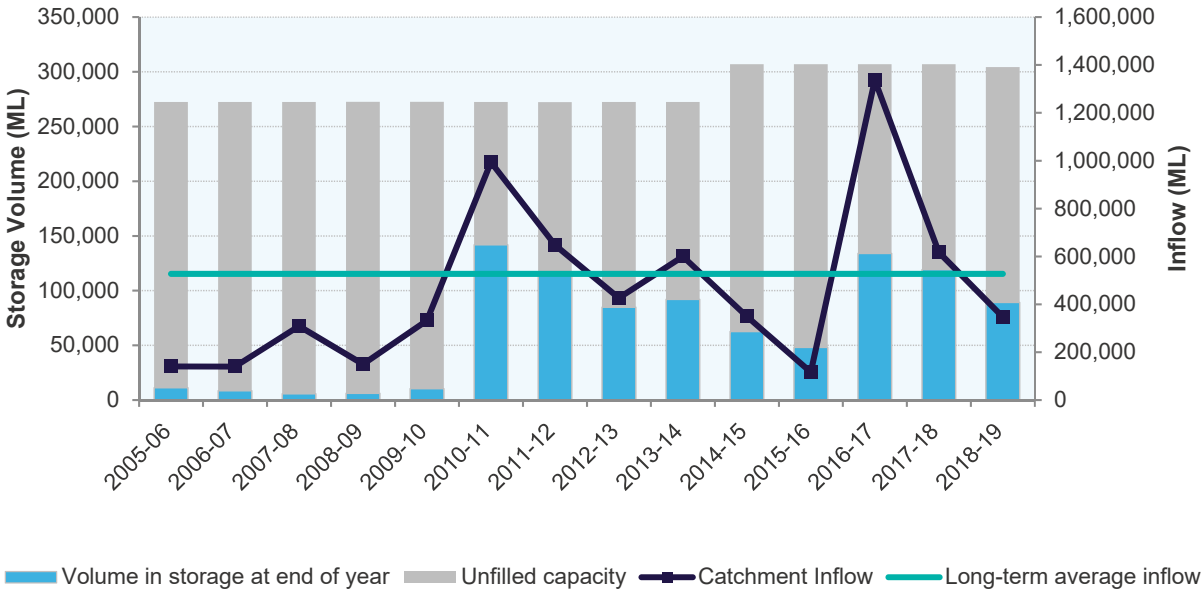
6.26.2 2018–19 water resource overview

Rainfall throughout the Glenelg basin in 2018–19 was between 80% and 100% of the long-term average.

Catchment inflows in the Glenelg basin in 2018–19 were 66% of the long-term average (527,300 ML), less than the inflows recorded in 2017–18, which were 117% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Storage levels in the Glenelg basin started 2018–19 at 39% of total capacity and ended at 29%.

Figure 6-50 Storage volumes and catchment inflows in the Glenelg basin



A ban on all licensed diversions was implemented on the Crawford, Grange Burn and Wannon rivers at various times throughout 2018–19, mostly during summer. A ban was put in place on the Crawford River in November 2018 and remained in place until May 2019. Licensed diversions were banned on the Wannon River from January to April 2019 and the Grange Burn River in February 2019. All streams were unrestricted from June 2019.

There were no restrictions on urban water use in the Glenelg basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 20,287 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was less than the 21,903 ML diverted in the previous year.

6.26.2.1 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)
- the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*), which has been recorded on the Glenelg River. This species is very dependent on flows and is listed as threatened under the *Flora and Fauna Guarantee Act 1988* and as critically endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*.

In 2018–19, 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 40,560 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 flows conditions as part of the environmental entitlement held by the VEWH
- water set aside for the environment through the operation of passing flow conditions on licensed diversions, particularly from the Crawford, Glenelg, Grange Burn and Wannon rivers

- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

In 2018–19, a total of 17,180 ML of environmental water was used in the Glenelg basin. This was all delivered in-stream for the Glenelg River. This volume includes 2,695 ML of passing flows through the system.

6.26.3 Water balance

The total volumes of water available and supplied from water resources in the Glenelg basin in 2018–19 are shown in Table 6-167.

Table 6-167 Water balance – Glenelg basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	119,162	132,036
Volume in storage at end of year	1	89,238	119,162
Change in storage		**(29,924)**	**(12,874)**
Inflows			
Catchment inflow	2	347,250	617,198
Rainfall on major storages	1	12,051	17,997
Treated wastewater discharged back to river	3	144	299
Total inflows		**359,445**	**635,494**
Outflows			
Diversions			
Urban diversions		1,619	1,876
Transfers to the Wimmera basin		12,606	12,828
Licensed diversions from unregulated streams		124	92
Small catchment dams	4	5,938	7,107
Total diversions		***20,287***	***21,903***
Losses			
Evaporation losses from major storages	1	22,805	22,909
Evaporation from small catchment dams	4	5,934	5,887
In-stream infiltration to groundwater, flows to floodplain and evaporation		48,751	71,506
Total losses		***77,490***	***100,303***
Water passed at outlet of basin			
River outflows to the ocean	5	291,592	526,162
Total water passed at outlet of basin		***291,592***	***526,162***
Total outflows		**389,369**	**648,368**

6.26.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Glenelg basin are included in the water balance. Table 6-168 shows how storage volumes changed during the year.

Table 6-168 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						
Konongwootong Reservoir	1,920	1,819	n/a	n/a	(17)	1,802
Moora Moora Reservoir	6,300	3,580	2,366	922	(2,304)	2,720
Rocklands Reservoir	296,000	113,763	9,685	21,883	(16,849)	84,716
Total 2018–19	**304,220**	**119,162**	**12,051**	**22,805**	**(19,170)**	**89,238**
Total 2017–18	304,220	132,036	17,997	22,909	(7,961)	119,162

Note
(1) Volumes shown are the maximum operating capacities of storages.

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-169 lists the wastewater treatment plants in the Glenelg basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Wannon Water operates all treatment plants within the Glenelg basin. Overall, 84% of wastewater was recycled in 2018–19, more than the percentage recycled in 2017–18.

Table 6-169 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Casterton	106	106	100%	0	106	0	0	0	0
Coleraine	40	40	100%	0	40	0	0	0	0
Dunkeld	15	15	100%	15	0	0	0	0	0
Hamilton	763	619	81%	18	601	0	0	143	0
Total 2018–19	**924**	**780**	**84%**	**33**	**747**	**0**	**0**	**143**	**0**
Total 2017–18	980	681	69%	76	605	0	0	299	0

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-170 provides information about small catchment dams in the basin.

Table 6-170 Estimated small catchment dam information for the Glenelg basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	32,525	5,467	5,724	11,191
Registered / licensed commercial and irrigation	3,084	471	210	681
Total 2018–19	**35,610**	**5,938**	**5,934**	**11,872**
Total 2017–18	35,610	7,107	5,887	12,994

5. Water passed at outlet of basin

The method used to calculate an estimate of outflows in the Glenelg basin in the 2018–19 accounts has been revised from the previous accounts: see chapter 6.1.2 for details. The new method uses streamflow data from a new gauged site, which replaces the previous two gauged sites used to estimate outflows. The previous method overstated the outflow amount and the update improves the estimate and provides a higher level of certainty in the outflow calculation. This has decreased the reported outflows to the ocean by 3% for 2018–19. The previous estimate would have resulted in outflows of 300,092 ML.

6.26.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Glenelg – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (2,214 ML) was within the volume available for the year (8,616 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlements in the Glenelg basin provide the basis for how water is shared in the basin. Rights to water in the Glenelg basin are outlined in Table 6-171.

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 6-183.

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 includes 3,300 ML for the Glenelg Compensation Flow. It also supplies entitlements held by Coliban Water, Wannon Water and the VEWH.

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 to water environmental assets.

Table 6-171 Entitlement volumes in the Glenelg basin

Water entitlement	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	974
Licensed small catchment dams – on-waterway (1)	66
Licensed small catchment dams – off-waterway (1)	3,019
Total (30 June 2019)	**8,612**
Total (30 June 2018) (1)	8,616

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-172 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-172 Available water and take for the Glenelg basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Coleraine, Casterton, Sandford	-	855	0	**855**	**75**
Dunkeld system	-	170	0	**170**	**0**
Glenthompson	-	94	0	**94**	**0**
Hamilton	-	3,435	0	**3,435**	**1,544**
Take and use licences – unregulated surface water	-	978	0	**978**	**124**
Licensed small catchment dams (1)	-	3,084	0	**3,084**	**471**
Total 2018–19	**-**	**8,616**	**0**	**8,616**	**2,214**
Total 2017–18 (1)	-	8,616	0	8,616	2,556

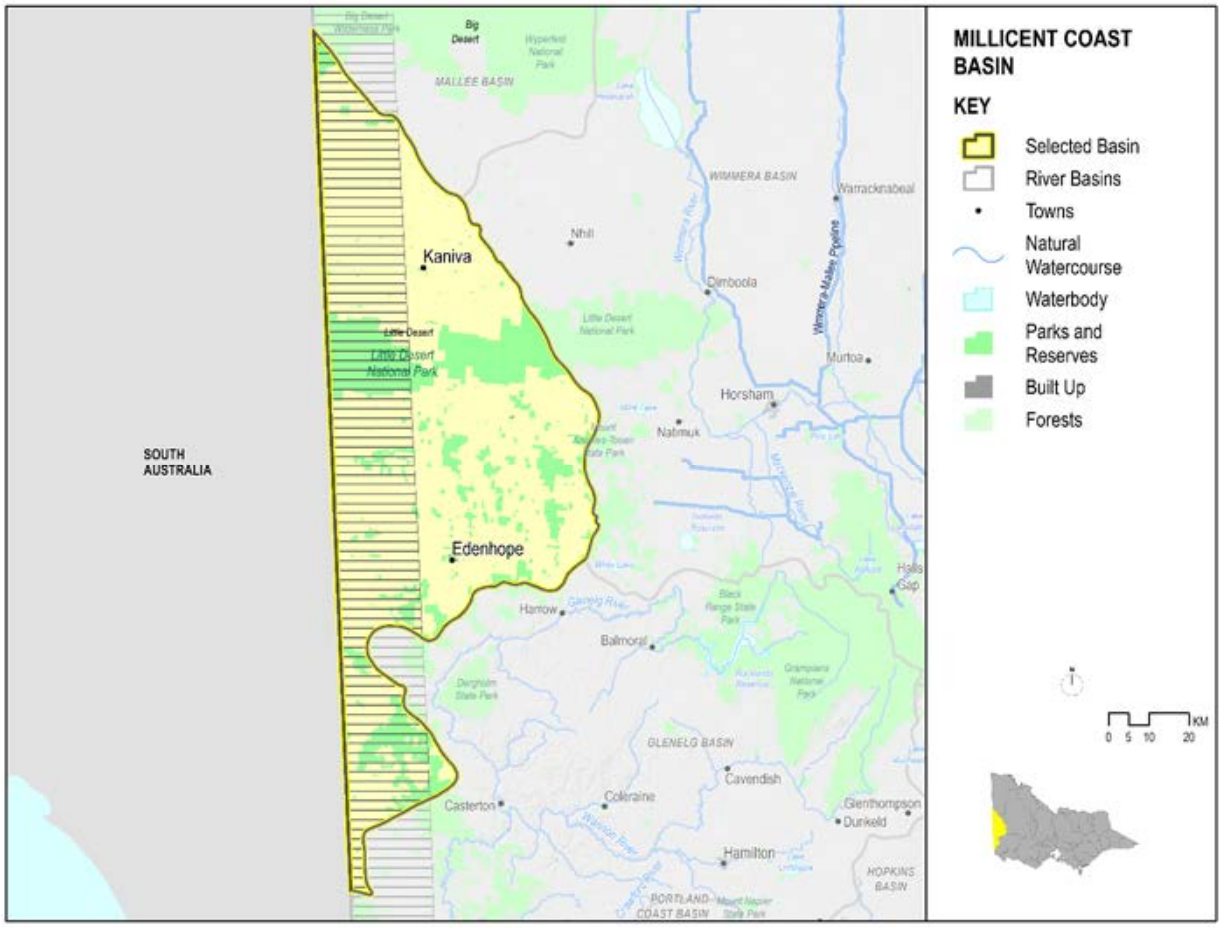
Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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



6.27.1 Management arrangements

Management of water in the Millicent Coast basin is undertaken by various parties as shown in Table 6-173.

Table 6-173 Responsibilities for water resources management in the Millicent Coast basin

Authority	Management responsibilities
Grampians Wimmera Mallee Water	• Manages licensed diversions in the Millicent Coast basin • Supplies all towns including Kaniva and Edenhope
Wimmera Catchment Management Authority	• Responsible for waterway and catchment management in the majority of the Millicent Coast basin
Glenelg Hopkins Catchment Management Authority	• Responsible for waterway and catchment management in the southern part of the Millicent Coast basin

6.27.2 2018–19 water resource overview

In 2018–19, rainfall in most of the Millicent Coast basin in 2018–19 was between 80% and 100% of the long-term average, except for a small area in the northern corner which received between 60% and 80% of the long-term average.

Groundwater taken from the West Wimmera GMA is the main source of water supply in the Millicent Coast basin. Chapter 7.6.1 has information about groundwater licences and use in this area.

Licensed diversions from unregulated streams were unrestricted throughout the year.

There were no restrictions on urban water use in the Millicent Coast basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

6.27.2.1 Water for the environment

The Millicent Coast basin contains numerous wetlands. 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 2018–19, water for the environment in the Millicent Coast basin comprised all water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

6.27.3 Water balance

Limited information is available for surface water availability and use, so a water balance has not been included for the Millicent Coast basin.

6.27.3.1 Notes to the resource position

Storages

There are no storages in the Millicent Coast basin.

Catchment inflow

There is no reliable streamflow data for the Millicent Coast basin. As such, an estimate of the volume of water leaving the basin was not made. As the Victorian Water Accounts estimate catchment inflow as a back-calculation from outflows, an assessment of the available water in the basin — catchment inflow — has not been made. Any surface water not diverted flows to South Australia.

Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-174 lists the wastewater treatment plants in the Millicent Coast basin.

Table 6-174 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Edenhope	56	10	17%	10	0	0	0	0	46
Kaniva North	2	0	0%	0	0	0	0	0	2
Kaniva South	12	0	0%	0	0	0	0	0	12
Serviceton	1	0	0%	0	0	0	0	0	1
Total 2018–19	**71**	**10**	**13%**	**10**	**0**	**0**	**0**	**0**	**61**
Total 2017–18	75	40	53%	40	0	0	0	0	36

Small catchment dams

The volume of water harvested, used and lost by small catchment dams (farm dams) is presented in Table 6-175.

Table 6-175 Estimated small catchment dam information for the Millicent Coast basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	4,656	209	568	776
Registered / licensed commercial and irrigation	5,071	158	80	238
Total 2018–19	**9,727**	**367**	**648**	**1,015**
Total 2017–18	9,727	689	993	1,681

In-stream losses

There is no suitable model available to make an estimate of in-stream losses, as there are no streamflow gauges in the Millicent Coast basin (see chapter 6.1.2).

6.27.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Millicent Coast – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted (163 ML) was within the volume available for the year (5,075 ML).**

Entitlements in the Millicent Coast basin provide the basis for how water is shared in the basin. Rights to water in the Millicent Coast basin are outlined in Table 6-176.

Table 6-176 Entitlement volumes in the Millicent Coast basin

Water entitlement	Annual entitlement volume (ML)
Take and use licences – unregulated surface water	4
Licensed small catchment dams – off-waterway (1)	5,071
Total (30 June 2019)	**5,075**
Total (30 June 2018) (1)	**5,075**

Note
(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and a separate category for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-177 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-177 Available water and take for the Millicent Coast basin

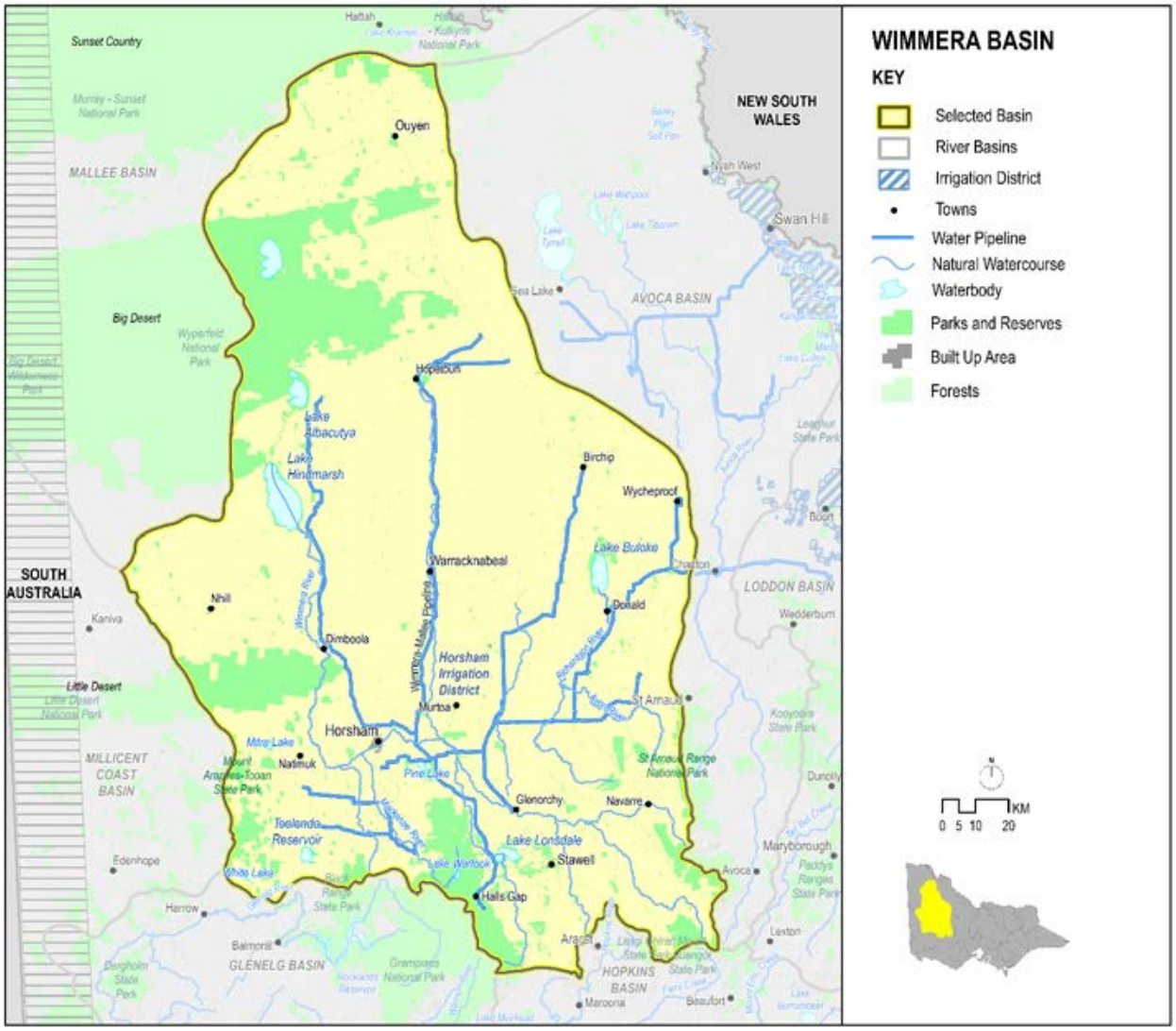
Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Take and use licences – unregulated surface water	-	4	0	**4**	**4**
Licensed small catchment dams (1)	-	5,071	0	**5,071**	**158**
Total 2018–19	**-**	**5,075**	**0**	**5,075**	**163**
Total 2017–18	-	5,075	0	5,075	463

Note
(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

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. The river 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 Management arrangements

Management of water in the Wimmera basin is undertaken by various parties as shown in Table 6-178.

Table 6-178 Responsibilities for water resources management in the Wimmera basin

Authority	Management responsibilities
Grampians Wimmera Mallee Water	• Manages the Wimmera Mallee supply system which delivers water to farms in the Wimmera basin (1) • Manages licensed diversions • Supplies most towns in the Wimmera basin • Provides bulk supply to some of Coliban Water's towns in the Loddon basin • Operates the Wimmera–Glenelg water headworks system
Central Highlands Water	• Supplies Landsborough and Navarre
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
Wimmera Catchment Management Authority	• Responsible for waterway and catchment management in the Wimmera River catchment
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the east of the basin, including the Avon and Richardson rivers

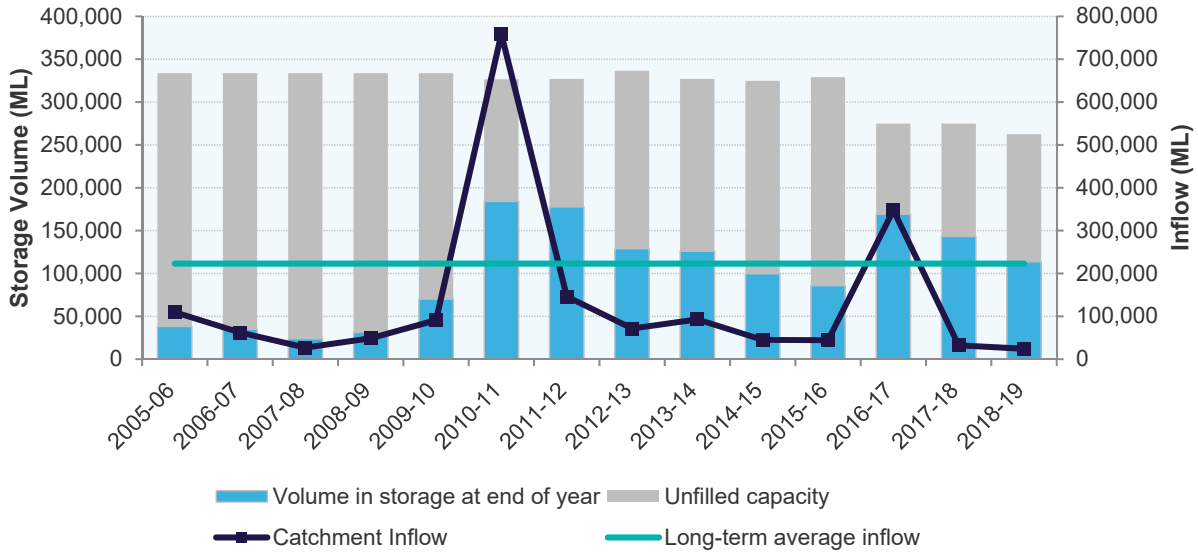
6.28.2 2018–19 water resource overview

Although the Wimmera basin was one of two basins (along with the Otway Coast basin) that received above-average rainfall in 2018–19 — in a small area in the middle of the basin over Warracknabeal (100% and 125% of the long-term average) — most of the basin received between 80% and 100%. Three areas received between 60% and 80% of above-average rainfall: one area in the north (from Lake Albacutya to the Wyperfeld National Park) and two areas in the south (near Horsham and Avoca). It was much drier in the north of Wyperfeld National Park, where rainfall was between 40% and 60% of the long-term average.

Catchment inflows in the Wimmera basin in 2018–19 were 11% of the long-term average (223,100 ML), less than the inflows recorded in 2017–18, which were 15% of the long-term average. The long-term average presented has been revised from the previous accounts: see chapter 6.1.2 for details.

Storage levels in the Wimmera basin started the year at 55% and ended the year at 43% of total capacity.

Figure 6-53 Storage volumes and catchment inflows in the Wimmera basin



The opening seasonal determination for the Wimmera Mallee Pipeline was announced on 6 July 2018 at 9%, and it increased to 55% by March 2019.

The Wimmera River was subject to a ban on all licensed diversions for the entirety of 2018–19. Licensed diversions for domestic and stock use were not banned.

There were no restrictions on urban water use in the Wimmera basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 23,242 ML of water was diverted for consumptive uses: town, domestic and stock, irrigation and commercial supply. This was more than the 19,310 ML diverted in the previous year.

6.28.2.1 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. Other important environmental assets include:

- the 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) in the MacKenzie River
- the Wimmera bottlebrush (*Melaleuca wimmerensis,* formerly known as *Callistemon wimmerensis*) which is listed as threatened under the *Flora and Fauna Guarantee Act 1988* (the FFG Act) and as critically endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*; this species depends on flows in the MacKenzie River for its survival and recruitment
- the lower Wimmera River, which is listed under the *Heritage Rivers Act 1992* 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 2018–19, water for the environment in the Wimmera basin comprised:

- the *Wimmera and Glenelg Rivers Environmental Entitlement 2010* held by the VEWH, comprising 40,560 ML of high-reliability entitlement shared with the Glenelg basin, 1,000 ML of entitlement for wetlands supplied from the

Wimmera Mallee Pipeline and 1,000 ML of unregulated flow in the Avon-Richardson Rivers to be used to maintain the weir pool at the Rich-Avon Weir

- 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 with the CEWH under Grampians Wimmera Mallee Water's bulk entitlement comprising 28,000 ML of low-reliability entitlement
- all other water in the basin not allocated for consumptive use: this water also provides social, recreational and cultural benefits.

A total of 15,798 ML of environmental water was used in the Wimmera basin in 2018–19; 147 ML of this was diverted off-stream, 431 ML was passing flows and the remainder was delivered in-stream.

6.28.3 Water balance

The total volumes of water available and supplied from water resources in the Wimmera basin in 2018–19 are shown in Table 6-179.

Table 6-179 Water balance – Wimmera basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year	1	143,242	169,205
Volume in storage at end of year	1	113,638	143,242
Change in storage		**(29,604)**	**(25,963)**
Inflows			
Catchment inflow	2	24,306	32,478
Rainfall on major storages	1	18,811	33,070
Transfer from Glenelg basin		12,606	12,828
Treated wastewater discharged back to river	3	0	0
Total inflows		**55,723**	**78,376**
Outflows			
Diversions			
Urban diversions and domestic and stock use		18,317	14,382
Diversions for irrigation		0	0
Licensed diversions from unregulated streams		422	422
Environmental water diversions		147	279
Supply to designated recreational lakes		2,369	2,091
Small catchment dams	4	1,986	2,136
Total diversions		***23,242***	***19,310***
Losses			
Evaporation losses from major storages	1	39,028	37,066
Evaporation from small catchment dams	4	2,661	2,757
In-stream infiltration to groundwater, flows to floodplain and evaporation		11,858	19,162
Total losses		***53,547***	***58,986***
Water passed at outlet of basin			
River outflows to Lake Buloke		4	49
River outflows to Lake Hindmarsh (measured at Tarranyurk)		8,534	25,995
Total water passed at outlet of basin		***8,538***	***26,044***
Total outflows		**85,327**	**104,339**

6.28.3.1 Notes to the water balance

1. Storage

Major on-stream storages in the Wimmera basin are included in the water balance.

Table 6-180 shows how storage volumes changed during the year.

Table 6-180 Storage volumes in the Wimmera 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						
Fyans Lake	18,460	12,691	1,870	4,326	2,661	12,896
Green Lake	5,350	2,842	n/a	n/a	(458)	2,384
Lake Bellfield	78,560	61,848	3,040	2,906	(8,114)	53,868
Lake Lonsdale	53,300	17,656	5,352	12,941	(144)	9,923
Taylors Lake	27,060	17,487	1,262	4,478	(4,821)	9,450
Toolondo Reservoir	50,530	15,926	2,360	9,269	4,623	13,640
Wartook Reservoir	29,300	14,792	4,927	5,108	(3,134)	11,477
Total 2018–19	**262,560**	**143,242**	**18,811**	**39,028**	**(9,387)**	**113,638**
Total 2017–18	274,743	169,205	33,070	37,066	(21,967)	143,242

2. Catchment inflow

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

3. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-181 lists the wastewater treatment plants in the Wimmera basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance.

Table 6-181 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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Birchip	46	30	65%	0	30	0	0	0	16
Dimboola	56	6	10%	0	6	0	0	0	50
Donald	106	77	72%	0	77	0	0	0	29
Halls Gap	116	90	78%	30	60	0	0	0	26
Hopetoun	25	0	0%	0	0	0	0	0	25
Horsham	1,060	900	85%	177	723	0	0	0	160
Jeparit	21	0	0%	0	0	0	0	0	21
Minyip	22	0	0%	0	0	0	0	0	22
Murtoa	39	7	17%	0	7	0	0	0	32
Natimuk	17	0	0%	0	0	0	0	0	17
Nhill	110	96	87%	0	96	0	0	0	14
Ouyen	74	27	37%	27	0	0	0	0	47
Rainbow	34	0	0%	0	0	0	0	0	34
Rupanyup	25	3	10%	0	3	0	0	0	22
Stawell	474	472	100%	218	254	0	0	0	2
Warracknabeal	173	91	52%	89	1	0	0	0	82
Wycheproof	49	49	100%	0	49	0	0	0	0
Total 2018–19	**2,447**	**1,848**	**75%**	**541**	**1,306**	**0**	**0**	**0**	**599**
Total 2017–18	2,436	1,455	60%	438	1,017	0	0	0	981

4. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance.

Table 6-182 provides information about small catchment dams in the basin.

Table 6-182 Estimated small catchment dam information for the Wimmera basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	29,535	1,474	2,377	3,851
Registered / licensed commercial and irrigation	7,436	512	284	796
Total 2018–19	**36,971**	**1,986**	**2,661**	**4,647**
Total 2017–18	36,971	2,136	2,757	4,893

6.28.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

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 and to supply 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. The entitlement volumes and diversions are presented in this Wimmera basin chapter and are not presented in the Glenelg basin chapter.

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.

Wimmera – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (51,472 ML) was within the volume available for the year (208,759 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements apart from:**
  - ✗ **water was taken from Lake Lonsdale to supply the CEWH, although this was not an authorised offtake point at the time. The Minister has since authorised offtake from Lake Lonsdale through the process set out in the bulk entitlement, to assist in the future delivery of water to the CEWH**
  - ✗ **no approved metering plan has been implemented for *Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012***
  - ✗ **no approved metering plan has been implemented for *Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010*.**

Entitlements in the Wimmera basin provide the basis for how water is shared in the basin. Rights to water in the Wimmera basin are outlined in Table 6-183.

Table 6-183 Entitlement volumes in the Wimmera basin

Water entitlement	Annual entitlement volume (ML)
Bulk Entitlement (Landsborough – Navarre) Conversion Order 2003	60
Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012 [1]	
Urban commitments – GWMWater	408
Bulk Entitlement (Willaura system – Wannon Water) Conversion Order 2012	58
Subtotal: Bulk Entitlement (Willaura, Elmhurst and Buangor systems – GWMWater) Conversion Order 2012	**466**
Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010 [2]	
Wimmera and Glenelg Rivers – GWMWater Wimmera Mallee Pipeline Product	44,720
Supply by agreement – CEWH	28,000
Glenelg compensation flow	3,300
Recreation [3]	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	
Wimmera and Glenelg Rivers Environmental Entitlement Wetland Product (4)	1,000
Wimmera and Glenelg Rivers Environmental Entitlement Wimmera Mallee Pipeline Product	40,560
Subtotal: Wimmera and Glenelg Rivers Environmental Entitlement 2010	**41,560**
Subtotal: Bulk Entitlement (Wimmera and Glenelg Rivers – GWMWater) Conversion Order 2010	**126,050**
Take and use licences – unregulated surface water (5)(6)	2,179
Licensed small catchment dams – off-waterway (6)	7,436
Total (30 June 2019)	**136,190**
Total (30 June 2018) (6)	136,247

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 the CEWH.

(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) The 1,000 ML for wetlands is 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.

(5) The total volume of licences in the Wimmera basin includes licences for irrigation as well as for domestic and stock purposes.

(6) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-184 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-184 Available water and take for the Wimmera basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Landsborough – Navarre	-	60	0	**60**	**0**
Willaura, Elmhurst and Buangor systems – GWMWater					
Urban commitments – GWMWater	-	408	0	**408**	**190**
Willaura system – Wannon Water	-	58	0	**58**	**33**
Diversion: Willaura, Elmhurst and Buangor systems – GWMWater					**223**
Wimmera and Glenelg Rivers – GWMWater					
GWMWater Wimmera Mallee Pipeline Product	89,829	24,592	(750)	**113,671**	**16,260**
Supply by agreement – CEWH (1)	7,676	0	0	**7,676**	**5,839**
Glenelg compensation flow	3,103	33	0	**3,136**	**1,130**
Recreation	1,866	0	750	**2,616**	**2,369**
Pipeline loss allowance	7,375	2,960	0	**10,335**	**410**
Wimmera and Glenelg Rivers – Coliban Water	333	165	0	**498**	**240**
Wimmera and Glenelg Rivers – Wannon Water	6,075	1,166	0	**7,241**	**55**
Wimmera and Glenelg Rivers Environmental Entitlement (2)	33,150	22,308	0	**55,458**	**24,013**
Diversion: Wimmera and Glenelg Rivers (3)					**50,314**
Take and use licences – unregulated surface water	-	427	0	**427**	**422**
Licensed small catchment dams (4)	-	7,175	0	**7,175**	**512**
Total 2018–19	**149,408**	**59,351**		**208,759**	**51,472**
Total 2017–18 (4)	144,003	83,782	0	227,785	45,099

Notes

(1) The Supply by Agreement – CEWH entitlement is 5,839 ML of environmental in-stream use. The in-stream use amount is not included in the water balance in Table 6-179, as it is not an actual diversion from the waterway.

(2) Use against this environmental entitlement included 23,866 ML of water delivered in-stream — 9,381 ML in the Wimmera basin and 14,485 ML in the Glenelg basin — and 147 ML of water delivered off-stream to the Wimmera Mallee wetlands. The 23,866 ML delivered in-stream in the Wimmera basin is not included in the water balance in Table 6-179 as it does not reflect an actual diversion from the waterway. There are also passing flows of 3,126 ML under this entitlement, which are not included in this table.

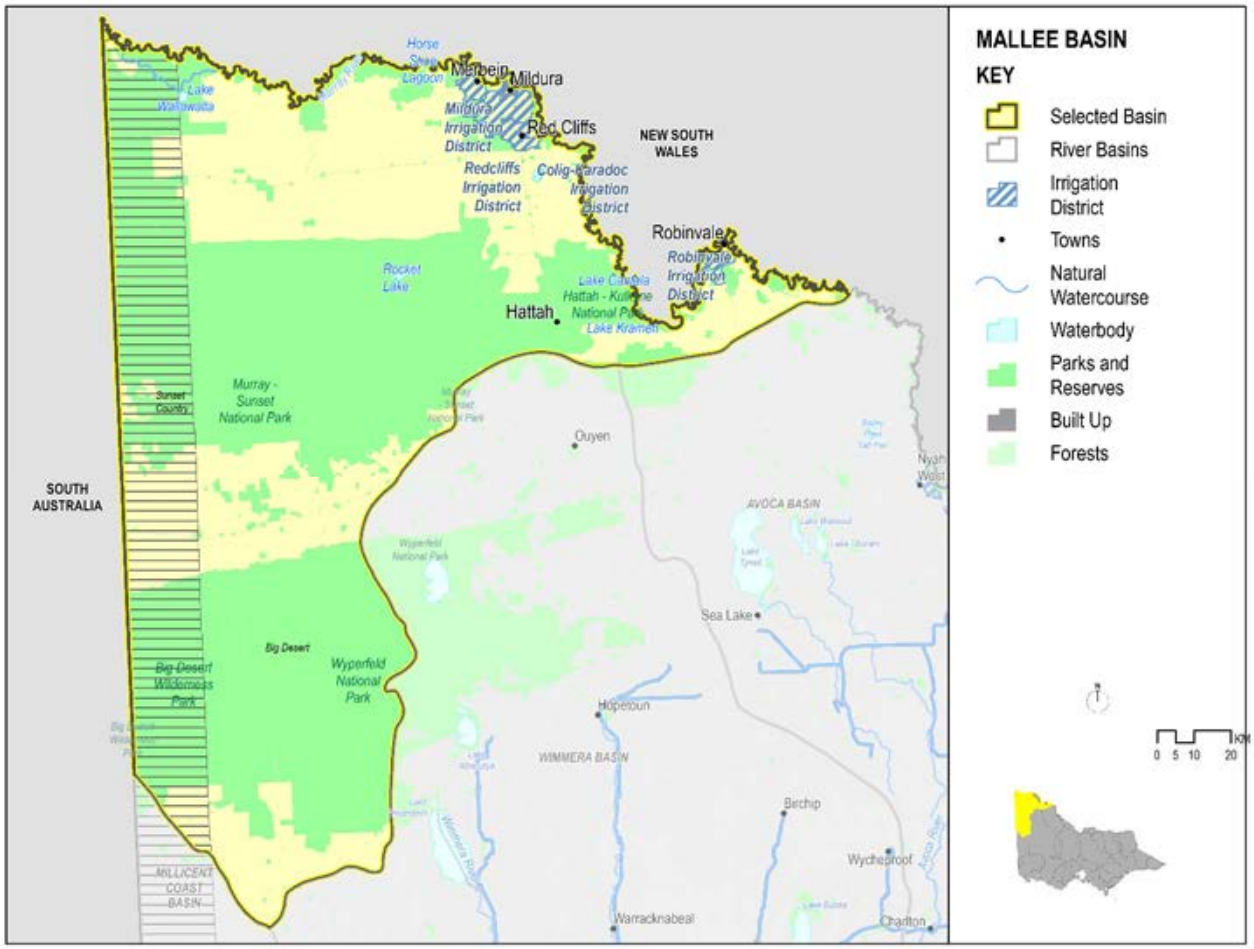
(3) The water use reported in this line item represents the bulk diversion to supply primary entitlements under the Wimmera and Glenelg rivers system source bulk entitlement. It includes environment deliveries in-stream (29,704 ML).

(4) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

6.29 Mallee basin

The Mallee basin (Figure 6-54) has few well-defined waterways. The Murray River forms the northern boundary of the basin, and 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



6.29.1 Management arrangements

Management of water in the Mallee basin is undertaken by various parties as shown in Table 6-185 .

Table 6-185 Responsibilities for water resources management in the Mallee basin

Authority	Management responsibilities
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
Mallee Catchment Management Authority	• Responsible for waterway and catchment management in the whole Mallee basin

6.29.2 2018–19 water resource overview

In 2018–19, the north of the Mallee basin received little rainfall: between 40% and 60% of long-term average rainfall along the border with New South Wales and South Australia and down to Hattah. Slightly more rainfall was received south of that area — between 60% and 80% — up to a small area in the south, which received between 80% and 100% of the long-term average.

Almost all surface water used in the Mallee basin is sourced from other basins.

There were no restrictions on urban water use in the Mallee basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

6.29.2.1 Water for the environment

In 2018–19, water for the environment in the Mallee basin comprised all water in the basin not allocated for consumptive use: this water also provided social, recreational and cultural benefits.

6.29.3 Water balance

Limited information is available for surface water availability and use, so a water balance has not been included for the Mallee basin.

Storage

There are no storages in the Mallee basin.

Catchment inflow

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 Murray basin surface water is reported 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.

Recycled water

There are no wastewater treatment plants within the Mallee basin.

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.

6.29.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Mallee – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume diverted in the Mallee basin is not estimated, due to lack of reliable information.**

Entitlements in the Mallee basin provide the basis for how water is shared in the basin. Rights to water in the Mallee basin are outlined in Table 6-186.

Table 6-186 Entitlement volumes in the Mallee basin

Water entitlement	Annual entitlement volume (ML)
Licensed small catchment dams – off-waterway (1)	10
Total (30 June 2019)	**10**
Total (30 June 2018) (1)	10

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19, the definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams has been included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-187 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-187 Available water and take for the Mallee basin

Water entitlement	Available water				Water taken (2)
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Licensed small catchment dams (1)	0	10	0	**10**	-
Total 2018–19	**0**	**10**	**0**	**10**	-
Total 2017–18 (1)	0	10	0	10	-

Notes

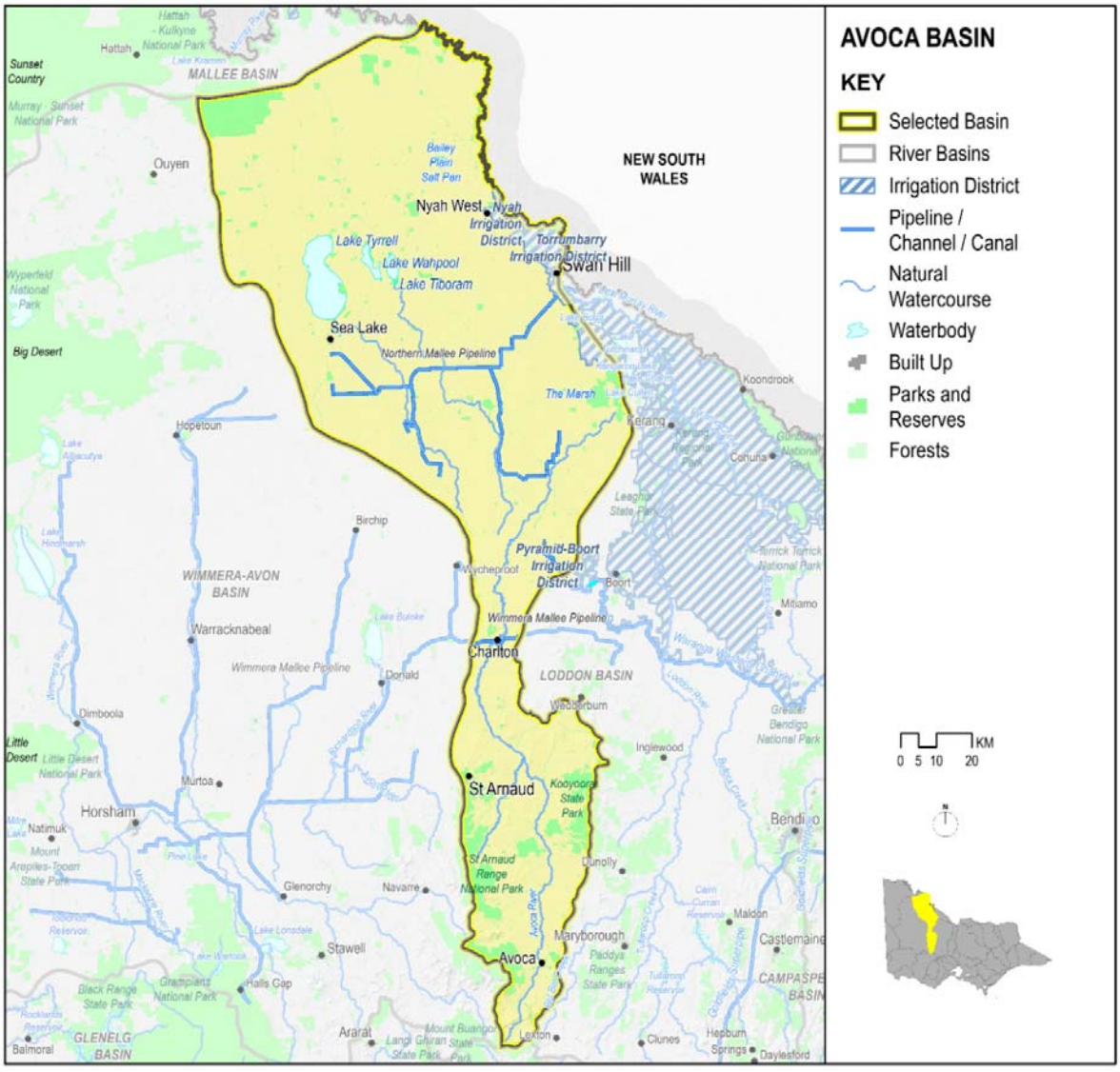
(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

(2) The volume of water taken from small catchment dams in the Mallee has not been estimated, due to lack of information for the 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. For the purposes of these accounts, the Avoca basin excludes Swan Hill and the Torrumbarry Irrigation Area, which are supplied from the Murray River.

Figure 6-55 Map of the Avoca basin



6.30.1 Management arrangements

Management of water in the Avoca basin is undertaken by various parties as shown in Table 6-188 .

Table 6-188 Responsibilities for water resources management in the Avoca basin

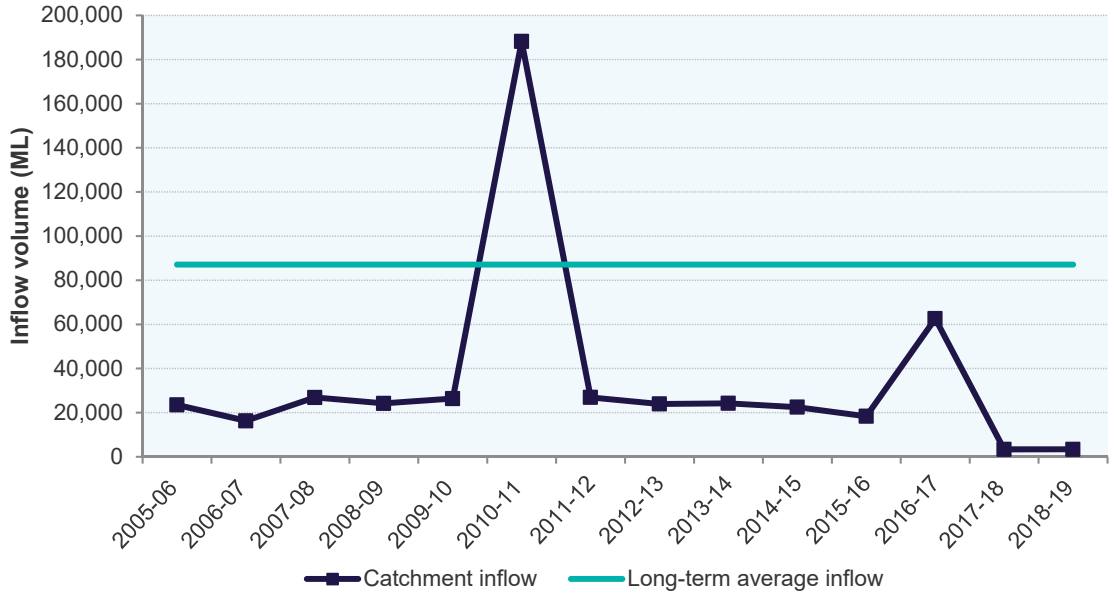
Authority	Management responsibilities
Central Highlands Water	• Supplies towns in the southern part of the Avoca basin including Avoca and Redbank
Grampians Wimmera Mallee Water	• Provides domestic and stock supplies to farms via the Wimmera Mallee Pipeline and the Northern Mallee Pipeline • Manages licensing • Supplies towns in the northern part of the Avoca basin including St Arnaud, Charlton, Sea Lake and Quambatook (water sourced from outside the Avoca basin)
Goulburn-Murray Water	• Supplies water from the Goulburn basin in bulk to Grampians Wimmera Mallee Water for Quambatook via the Normanville supply system
North Central Catchment Management Authority	• Responsible for waterway and catchment management in the Avoca basin

6.30.2 2018–19 water resource overview

Rainfall in the northern half of the Avoca basin in 2018–19 was mostly between 60% and 80% of the long-term average, except for the very north (from Lake Tyrrell to the border), which received between 40% and 60%. The southern half received between 80% and 100% of the long-term average rainfall, except for a small area near Avoca which received between 60% and 80%.

Catchment inflows in both the 2017–18 and 2018–19 water years were 4% of the long-term average annual volume of 87,100 ML. Similarly to the previous year, when no water reached the terminal lakes in the north of the basin, in 2018–19 only 2 ML of outflows were recorded.

Figure 6-56 Storage volumes and catchment inflows in the Avoca basin



All irrigation diversions from the Avoca River were banned for the entirety of 2018–19. Licensed diversions for domestic and stock use were not banned.

There were no restrictions on urban water use in the Avoca basin in 2018–19, with all towns in the basin remaining on permanent water-saving rules throughout the year.

In 2018–19, 989 ML of water was diverted for consumptive uses: town, domestic and stock and farm dam extractions. This was more than the 950 ML reported in the previous year.

6.30.2.1 Water for the environment

Environmental assets that rely on water in the Avoca basin include:

- the Avoca River, with red gums and a floodplain system in the lower Avoca and grassy woodland in the upper Avoca
- the lower Avoca grasslands, a unique, largely intact mosaic of floodplain associated with grassland and grassy woodland communities and significant flora and fauna values.

In 2018–19, 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: this water also provides social, recreational and cultural benefits.

6.30.3 Water balance

The total volumes of water available and supplied from water resources in the Avoca basin in 2018–19 are shown in Table 6-189.

Table 6-189 Water balance – Avoca basin

Water account component	Note	2018–19 (ML)	2017–18 (ML)
Major on-stream storage			
Volume in storage at start of year		-	-
Volume in storage at end of year		-	-
Change in storage		**-**	**-**
Inflows			
Catchment inflow	1	3,397	3,366
Rainfall on major storages		-	-
Treated wastewater discharged back to river	2	0	0
Total inflows		**3,397**	**3,366**
Outflows			
Diversions			
Urban diversions		30	47
Licensed diversions from unregulated streams		48	42
Small catchment dams	3	911	861
Total diversions		***989***	***950***
Losses			
Evaporation losses from major storages		-	-
Evaporation from small catchment dams	3	1,193	1,066
In-stream infiltration to groundwater, flows to floodplain and evaporation		1,214	1,350
Total losses		***2,406***	***2,416***
Water passed at outlet of basin			
Avoca River flow at Sandhill Lake Road (outflow to terminal lakes)		2	0
Avoca River overflow from the terminal lakes to the Kerang Lakes		0	0
Total water passed at outlet of basin		***2***	***0***
Total outflows		**3,397**	**3,366**

6.30.3.1 Notes to the water balance

1. Catchment inflow

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

2. Recycled water

Water recycled at wastewater treatment plants can be used to supplement water available in the basin. Table 6-190 lists the wastewater treatment plants in the Avoca basin. Water discharged to the environment from treatment plants is included as an inflow to the water balance. In 2018–19, no water was discharged to the environment in the Avoca basin.

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 ocean or other discharges (ML)
				Urban and industrial	Agriculture	Beneficial allocation	Within plant process		
Avoca	36	36	100%	0	36	0	0	0	0
Charlton	50	0	0%	0	0	0	0	0	50
Sea Lake	35	0	0%	0	0	0	0	0	35
St Arnaud	139	115	83%	40	75	0	0	0	24
Total 2018–19	**260**	**151**	**58%**	**40**	**111**	**0**	**0**	**0**	**109**
Total 2017–18	258	132	51%	40	92	0	0	0	125

3. Small catchment dams

Water harvested and used by small catchment dams (farm dams) is included in the water balance. Table 6-191 provides information about small catchment dams in the basin.

Table 6-191 Estimated small catchment dam information for the Avoca basin

Type of small catchment dam	Capacity (ML)	Usage (ML)	Evaporation loss (ML)	Total water harvested (ML)
Domestic and stock (not licensed)	9,483	496	956	1,452
Registered / licensed commercial and irrigation	5,183	415	236	651
Total 2018–19	**14,667**	**911**	**1,193**	**2,104**
Total 2017–18	14,667	861	1,066	1,927

6.30.4 Compliance against entitlements

Compliance against water entitlements is reported for this basin in three areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Avoca – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume diverted (493 ML) was within the volume available for the year (8,150 ML).**
- ✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
- ✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

Entitlement volumes provide the basis for how water is shared in the basin. Rights to water in the basin are outlined in Table 6-192.

Table 6-192 Entitlement volumes in the Avoca basin

Water entitlement	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 (1)	2,566
Licensed small catchment dams – off-waterway (1)	5,183
Total (30 June 2019)	**8,028**
Total (30 June 2018) (1)	8,150

Note

(1) Reporting for unregulated entitlement volume has changed in 2018–19. The definition of 'take and use licences – unregulated surface water' was amended and separate categories for small catchment dams included. The prior-year entitlement volume has been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

Table 6-193 shows the amount available to be taken by entitlement holders and the amount they have taken during the water year.

Table 6-193 Available water and take for the Avoca basin

Water entitlement	Available water				Water taken
	Opening carryover	Allocation issued	Net trade in / (out)	Total available water	
Amphitheatre	-	25	0	**25**	**8**
Avoca	-	233	0	**233**	**22**
Redbank	-	20	0	**20**	**0**
Take and use licences – unregulated surface water	-	2,689	0	**2,689**	**48**
Licensed small catchment dams (1)	-	5,183	0	**5,183**	**415**
Total 2018–19	**-**	**8,150**	**0**	**8,150**	**493**
Total 2017–18 (1)	-	8,150	0	8,150	518

Note

(1) Water taken from licensed small catchment dams has been reported in this table for the first time in 2018–19. The prior-year totals have been adjusted from the 2017–18 accounts to reflect this change, which chapter 6.1 explains.

7. Groundwater catchment accounts

7.1 Overview

7.1.1 Introduction

This chapter presents water accounts by groundwater catchment.

The groundwater catchment accounts are compiled from information obtained from:

- the Victorian Water Register
- the Victorian Water Measurement Information System
- data from water corporations and major users of water
- management plans, groundwater catchment statements, annual reports and related documents.

7.1.2 Groundwater resources

In 2012, the Victorian Government developed a framework for the management and reporting of groundwater resources (as explained in chapter 1.3.2). The framework has three levels for managing and reporting on groundwater. In decreasing order of size, they are:

- groundwater management basins
- groundwater catchments
- groundwater management units (GMUs).

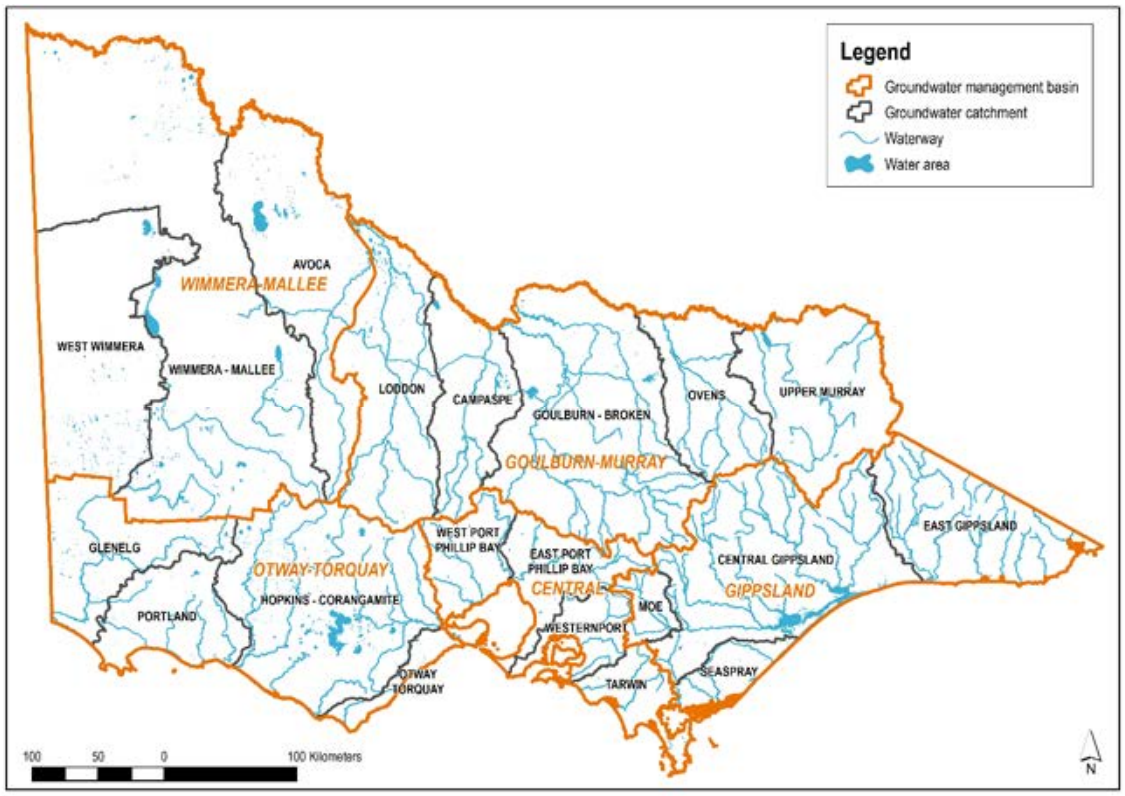
There are five groundwater management basins in Victoria. These are partly based on our understanding of groundwater geological basins, but they are also aligned with water corporation administrative boundaries.

For management and reporting purposes, each groundwater management basin has several groundwater catchments, shown in Figure 7-1. There are 20 groundwater catchments in total. A groundwater catchment approximates the surface water basin, with adjustments based on our knowledge and assumptions about groundwater flow divides.

The Victorian groundwater management basins and their catchments are:

- the **Goulburn–Murray management basin** in the north and north-east, which covers the Loddon, Campaspe, Goulburn–Broken, Ovens and Upper Murray groundwater catchments
- the **Gippsland management basin** in the south-east, which covers the East Gippsland, Central Gippsland, Moe and Seaspray groundwater catchments
- the **Central management basin** in the south, which covers the West Port Phillip Bay, East Port Phillip Bay, Westernport and Tarwin groundwater catchments
- the **Otway–Torquay management basin** in the south-west, which covers the Glenelg, Portland, Hopkins–Corangamite and Otway–Torquay groundwater catchments
- the **Wimmera–Mallee management basin** in the north-west, which covers the Wimmera–Mallee, West Wimmera and Avoca groundwater catchments.

Figure 7-1 Groundwater management basins and catchments



The smaller management units — GMUs — within groundwater catchments are classified as water supply protection areas (WSPAs) and groundwater management areas (GMAs). Areas outside these units were previously referred to as unincorporated areas (UAs).

Generally, a groundwater catchment includes several GMUs where the geographical boundaries of the GMU are contained within and/or aligned with the groundwater catchment boundaries. There are a few exceptions (such as the South West Limestone GMA, Central Victorian Mineral Springs GMA and Shepparton Irrigation Region GMA, which straddle several groundwater catchments) (explained in chapters 7.5.2, 7.5.3 and 7.5.4 respectively).

Licensing is the fundamental basis for managing groundwater access and use. The total volume of groundwater that may be licensed in a GMU is determined by the permissible consumptive volume (PCV). PCVs are declared by the Minister for Water through an order published in the *Victoria Government Gazette*. Management arrangements are set out in statutory groundwater management plans or local management plans and groundwater catchment statements. These are developed in consultation with local stakeholders including water users, environmental group representatives, Traditional Owners and government agencies.

Chapter 1.1.2 has more information about groundwater resources in Victoria, and chapter 1.3.2 includes more information about the management of groundwater resources.

7.1.3 Groundwater catchment reporting — method

Information about groundwater in 2018–19 is presented in this chapter for each of the 20 groundwater catchments. The structure of the Victorian Water Accounts groundwater chapter has been changed this year, and there are now three sections within each groundwater catchment sub-chapter. They are:

- management arrangements
- 2018–19 groundwater resources overview
- groundwater use and compliance.

7.1.3.1 Management arrangements

This section summarises the management arrangements and GMUs in the groundwater catchment.

7.1.3.2 2018–19 groundwater resources overview

This section provides a snapshot of the resource condition in the groundwater catchment for 2018–19 by summarising groundwater level trends, restrictions and water use.

7.1.3.3 Groundwater use and compliance

Licensed groundwater volumes and use

This table shows the total volume of water that was available to be extracted during the water year and the associated licensed use in GMUs and outside management units. Total water available represents the amount allocated to active licences during the year (including any adjustment where restrictions are in place) plus any carryover from the previous year and the net effect of trade into or out of a GMU. It is different to the PCV in that it represents the amount available to active licence holders in each individual year, rather than the overall maximum PCV per GMU.

Urban use is reported by town name and represents the volume of take and use licences (and one bulk entitlement in the Otway–Torquay groundwater catchment) held by urban water corporations to supply towns within their service area and the total volume of water that could be extracted for the water year plus all licensed use.

Domestic and stock use is estimated based on the number of domestic and stock bores in each GMU. There is further explanation below about the method used to make this estimation.

The components of the table — carryover, licensed volume allocated, net trade, total water available and water extracted – are described below.

Carryover: this item represents any water carried over from 2017–18 that could be taken in 2018–19. Carryover is only available where the Minister has made a declaration under section 62A of the *Water Act 1989.*

Licensed volume allocated[3]: this item represents the volume of water able to be taken and used under licences during the water year. It comprises the entitlement volume, less any volume if restrictions are in force for the season.

The allocated total can be different to the entitlement volume at the end of the water year because:

- a restriction on water use might be in place in the GMU. For example, in 2018–19 take and use licence holders in the Deutgam WSPA were restricted to 50% of their licence volume: that is, for every 100 ML in their licence, they could use or trade 50 ML of water
- licences may have been cancelled or temporarily traded during the year, so the allocation volume presented may be greater than the entitlement volume as at the end of the water year. For example, temporary trade of licences can occur between GMUs in Victoria: this would affect the allocation volume issued to licences in GMUs within the basin during the year.

Net trade: this item represents the volume of water that has been traded in for use within the GMU, less water traded out of the GMU.

Total water available: this item represents the volume of water that was available under licences to be taken in 2018–19. It is the sum of the first three components: carryover, licensed volume allocated and the net of the in/out trade of water.

Water taken: this item represents the volume of water used during the year under the entitlement.

Estimated domestic and stock use

An estimation of the volume of groundwater extracted for domestic and stock use is made per GMU each year. This use is permitted under section 8 of the *Water Act 1989*, which grants private rights to take water for domestic and stock 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 item: it has been accounted for in the total licensed groundwater use item.

Estimated domestic and stock use has been calculated based on an assumption of 2 ML per bore per year in groundwater areas managed by Goulburn-Murray Water and GWMWater 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, and Stratford GMA, which was estimated at 2 ML per bore per year).

The number of domestic and stock bores recorded for each GMU includes all bores registered in the Water Measurement Information System (WMIS) that are less than 30 years old, as this is the expected life of a bore.

Table 7-1 shows that in 2018–19, the number of reported domestic and stock bores decreased by 9,226 bores from the previous year. These bores were all created in WMIS during the 1987–88 water year, and as they are now more than 30 years old, they have dropped off the list of active domestic and stock bores. While the bores were entered into WMIS during that year, they were not actually all constructed in that year: rather, a large backlog of data entry into the system was completed in 1987–88. Therefore, the large decrease has not actually occurred this year: it has likely been decreasing to this point over the past three to five years (and possibility longer).

[3] Under the *Water Act 1989* licences may be restricted. Licences do not receive an allocation.

Table 7-1 Number of domestic and stock bores decreased

Groundwater catchment	Decrease in reported number of domestic and stock bores
Avoca	30
Campaspe	403
Central Gippsland	646
East Gippsland	22
East Port Phillip Bay	361
Glenelg	877
Goulburn–Broken	503
Hopkins–Corangamite	1,048
Loddon	386
Moe	50
Otway Torquay	2
Ovens	718
Portland	2,718
Seaspray	49
Tarwin	139
Upper Murray	97
West Port Phillip Bay	117
West Wimmera	262
Westernport	552
Wimmera–Mallee	246
Total	**9,226**

Bore depths (where recorded) have been taken into account to ensure that domestic and stock bores are assigned appropriately. To account for domestic and stock bores, where this information is available bores are first assigned to a GMU based on their spatial location and the depth of the bore. Where spatial and/or depth locations are not available, the bores are assigned to outside the GMU: that is, to areas previously known as unincorporated areas.

Compliance

Compliance against groundwater entitlements is reported in these accounts in two areas:

- **entitlement issued:** the volume of entitlements (not applicable for domestic and stock water use) issued in a GMU (either a WSPA or GMA) does not exceed PCV
- **water taken:** the volume of water taken under entitlements during the year does not exceed the water available made available to licence holders.

The exception is the Otway–Torquay groundwater catchment, where compliance is also reported for whether entitlement holders complied with all provisions in their bulk entitlement orders.

7.1.4 Groundwater management unit compliance reporting for 2018–19

A summary of licensed groundwater use against available water and the PCV for 2018–19 is presented in the table below for each GMU.

Overall key compliance points
✓ **The total volume of water used in each GMU was within the volume available for the year.**
✓ **The licensed entitlement volume for each GMU were within the gazetted PCV for all GMUs.** • **The licence volume in the Stratford GMA exceeds the PCV because the licences held by the Latrobe Valley coal mines, are identified by aquifers which do not align to GMU boundaries, however the total licensed volume is attributed to Stratford GMA.**

Table 7-2 Licensed and available groundwater volumes

Groundwater management unit	Entitlement volume		Water available and taken under licences 2018-19					Compliance		
	PCV	Licensed entitlement (ML)	Carryover	Water allocated	Net trade	Total water available	Water taken (ML)	% of PCV	% of available water	Licence volume available under PCV (ML)
	A	B	C	D	E	F =C+D+E	G	H =G/A	I =G/B	J =A-B
Goulburn–Murray Water										
Water supply protection areas										
Katunga	60,577	60,203	-	61,298	0	**61,298**	**41,104**	**68%**	**67%**	**374**
Loddon Highlands [1]	20,697	20,502	2,978	19,774	0	**22,752**	**9,097**	**44%**	**40%**	**195**
Lower Campaspe Valley	55,875	55,860	13,408	55,763	(100)	**69,071**	**50,259**	**90%**	**73%**	**15**
Upper Ovens River [2]	n/a	3,618	-	3,657	(291)	**3,366**	**1,001**	**n/a**	**30%**	**n/a**
Groundwater management areas										
Barnawartha	2,100	375	-	375	0	**375**	**8**	**0%**	**2%**	**1,725**
Broken	3,732	2,844	-	2,844	0	**2,844**	**621**	**17%**	**22%**	**888**
Central Victorian Mineral Springs	6,024	5,037	-	5,053	0	**5,053**	**1,090**	**18%**	**22%**	**987**
Eildon	1,496	603	-	603	0	**603**	**216**	**14%**	**36%**	**894**
Kiewa	3,852	3,117	-	3,119	0	**3,119**	**356**	**9%**	**11%**	**735**
Lower Ovens	25,200	19,875	-	19,905	0	**19,905**	**8,285**	**33%**	**42%**	**5,325**
Mid Goulburn	12,470	12,470	2,486	12,470	0	**14,956**	**4,766**	**38%**	**32%**	**0**
Mid Loddon	34,037	33,927	8,902	33,927		**42,829**	**30,310**	**89%**	**71%**	**110**
Shepparton Irrigation Region [3] [4]	n/a	185,321	-	188,511	0	**188,511**	**93,828**	**n/a**	**50%**	**n/a**
Strathbogie	1,660	1,427	-	1,427	0	**1,427**	**529**	**32%**	**37%**	**233**
Upper Goulburn	8,568	6,107	-	6,107	0	**6,107**	**935**	**11%**	**15%**	**2,461**
Upper Murray	7,674	3,532	-	3,534	0	**3,534**	**421**	**5%**	**12%**	**4,142**
West Goulburn	n/a	3,066	272	3,066	100	**3,438**	**1,747**	**n/a**	**51%**	**n/a**
Outside management units										
Goulburn–Murray Water	n/a	13,031	-	13,081	0	**13,081**	**3,771**	**n/a**	**29%**	**n/a**
GWMWater										
Groundwater management areas										
Murrayville	11,005	9,755	1,237	9,576	0	**10,813**	**6,368**	**58%**	**59%**	**1,250**
West Wimmera [5] [6]	57,409	53,598	10,821	49,485	0	**60,306**	**26,722**	**47%**	**44%**	**3,811**
Outside management units										
Grampians Wimmera Mallee Water	n/a	9,327	-	9,327	0	**9,327**	**2,116**	**n/a**	**23%**	**n/a**
Southern Rural Water										
Water supply protection areas										
Condah	7,475	7,470	-	7,470	0	**7,470**	**3,478**	**47%**	**47%**	**5**
Deutgam [7]	5,100	5,082	-	2,541	0	**2,541**	**796**	**16%**	**31%**	**18**
Glenelg	33,262	16,092	-	17,260	0	**17,260**	**5,923**	**18%**	**34%**	**17,170**
Koo-Wee-Rup	12,915	12,575	-	12,730	()	**12,730**	**3,964**	**31%**	**31%**	**340**
Sale	21,238	21,203	-	21,153	(50)	**21,103**	**17,867**	**84%**	**85%**	**35**
Warrion	14,086	14,075	-	14,079	0	**14,079**	**3,854**	**27%**	**27%**	**11**
Yarram	25,690	25,688	-	25,689	0	**25,689**	**16,557**	**64%**	**64%**	**2**
Groundwater management areas										
Bungaree	5,334	5,293	-	5,293	0	**5,293**	**3,245**	**61%**	**61%**	**41**
Cardigan	3,967	3,889	-	3,889	0	**3,889**	**925**	**23%**	**24%**	**78**
Colongulac	4,695	4,404	-	4,406	0	**4,406**	**1,576**	**34%**	**36%**	**291**
Corinella	2,550	662	-	662	0	**662**	**63**	**2%**	**10%**	**1,888**
Cut Paw Paw	3,650	511	-	511	0	**511**	**0**	**0%**	**0%**	**3,139**

Denison [8]	18,502	18,499	-	18,722	0	**18,722**	**11,864**	**64%**	**63%**	**3**
Frankston	3,200	2,212	-	2,212	0	**2,212**	**183**	**6%**	**8%**	**988**
Gellibrand [9]	n/a	0	-	0	0	**0**	**0**	**n/a**	**n/a**	**n/a**
Gerangamete [10]	20,239	20,238	-	20,238	0	**20,238**	**121**	**1%**	**1%**	**1**
Giffard	5,689	5,689	-	5,689	0	**5,689**	**5,548**	**98%**	**98%**	**1**
Glenormiston	2,698	2,636	-	2,636	0	**2,636**	**1,211**	**45%**	**46%**	**62**
Jan Juc [11]	14,250	14,250	-	14,250	0	**14,250**	**201**	**1%**	**1%**	**0**
Lancefield	1,485	1,378	-	1,378	0	**1,378**	**282**	**19%**	**20%**	**108**
Leongatha	6,500	1,803	-	1,803	0	**1,803**	**149**	**2%**	**8%**	**4,697**
Merrimu	451	10	-	34	0	**34**	**0**	**0%**	**0%**	**441**
Moe	8,200	3,885	-	3,885	(30)	**3,855**	**785**	**10%**	**20%**	**4,315**
Moorabbin	2,700	2,624	-	2,624	0	**2,624**	**1,228**	**45%**	**47%**	**76**
Nepean [6]	6,110	6,110	-	6,050	0	**6,050**	**2,856**	**47%**	**47%**	**1**
Newlingrook	1,977	1,958	-	1,958	0	**1,958**	**55**	**3%**	**3%**	**20**
Orbost	1,217	1,217	-	1,217	0	**1,217**	**545**	**45%**	**45%**	**1**
Paaratte [12]	4,606	3,212	-	3,212	0	**3,212**	**339**	**7%**	**11%**	**1,394**
Portland	7,795	7,794	-	7,794	0	**7,794**	**2,561**	**33%**	**33%**	**1**
Rosedale [5] [13]	22,372	22,322	-	23,828	0	**23,828**	**10,276**	**46%**	**43%**	**50**
South West Limestone [14]	n/a	81,194	23,214	81,196	0	**104,411**	**36,281**	**n/a**	**35%**	**n/a**
Stratford [5] [12] [15]	27,686	37,084	-	37,084	0	**37,084**	**23,054**	**83%**	**62%**	**0**
Tarwin	1,300	58	-	58	0	**58**	**17**	**1%**	**29%**	**1,242**
Wa De Lock [5] [8]	30,795	29,125	-	29,125		**29,125**	**10,259**	**33%**	**35%**	**1,670**
Wandin Yallock	3,027	3,025	-	3,025	0	**3,025**	**728**	**24%**	**24%**	**2**
Wy Yung [5]	7,463	7,462	-	7,462	0	**7,462**	**1,546**	**21%**	**21%**	**1**
Outside management units										
Southern Rural Water	n/a	71,320	-	72,279	80	**72,359**	**14,629**	**n/a**	**20%**	**n/a**
Total 2018–19	**650,600**	**965,641**	**63,318**	**966,341**	**(291)**	**1,029,369**	**466,514**	**72%**	**45%**	**51,835**
Total 2017–18	650,361	967,100	-	n/a	n/a	967,100	394,401	61%	41%	52,134

Notes

(1) Extractions from the Newlyn trading zone in the Loddon Highlands WSPA were restricted to 75% allocation.

(2) The Minister approved the revocation of the PCV on 3 March 2013.

(3) 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.

(4) Groundwater use in the Shepparton Irrigation Region GMA is estimated at the end of each season using a method which considers annual use by a subset of Shepparton Irrigation Region GMA licensed groundwater users that are metered, the volume of metered groundwater use in the Katunga Water Supply Protection Area, and spring rainfall.

(5) 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.

(6) Extractions from Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% allocation.

(7) Extractions from Deutgam WSPA were restricted to 50% allocation.

(8) The volume of use in Denison and Wa De Lock GMA includes metered extractions for salinity control (Denison WSPA 672ML and Wa De Lock GMA 778 ML).

(9) The Gellibrand PCV of 0 ML was gazetted at the end of 2018–19.

(10) The PCV for the Gerangamete GMA was previously 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. The PCV was decreased to 239 ML on 26 June 2019 after Barwon Water did not renew its licence. The entitlement volume includes the 20,000 ML licence, as the licence expired on 30 June 2019.

(11) 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 14,250 ML includes 4,250 ML and the maximum annual bulk entitlement extraction volume of 10,000 ML.

(12) The Paaratte GMA PCV was amended on 23rd April 2018 to 4,606 ML or 4,606 ML plus additional volume that may be taken under a section 51 licence for taking and use of groundwater for a single pumping test or Managed Aquifer Recharge scheme. Licensed entitlements must not exceed 4,692 ML.

(13) The use volume reported in Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 884 ML and Stratford GMA 22,944 ML).

(14) The PCV for the South West Limestone GMA has not been gazetted. The entitlements and use relate to the area defined in the South West Limestone Groundwater Management Area Plan No. LEGL./15-199. The South West Limestone GMA includes the area of the former Nullawarre WSPA, Yangery WSPA, Hawkesdale GMA and Heywood GMA, and the areas outside the former GMUs but included within the South West Limestone GMA area. Abolition of the Nullawarre and Yangery WSPAs was approved on 24 October 2014 and published in the Victoria Government Gazette on 30 October 2014. The PCVs for the four GMUs have not been revoked and still apply. PCV volumes are Nullawarre 22,741 ML, Yangery 14,352 ML, Hawkesdale 16,161 ML and Heywood 8,500 ML.

(15) The licence volume in the Stratford GMA exceeds the PCV because the licences held by the Latrobe Valley coal mines, are identified by aquifers which do not align to GMU boundaries. However, the total licensed volume is attributed to Stratford GMU.

7.2 Goulburn–Murray groundwater management basin

The Goulburn–Murray groundwater management basin is located in north-east Victoria. It borders the Gippsland management basin to the south-east, the Central and Otway–Torquay management basins to the south and the Wimmera–Mallee management basin to the west.

The hydrogeology of the region can be broadly subdivided into two distinct geological areas: the 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 bedrock, which is comprised of sedimentary fractured rock. Bedrock 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, unless a fracture in the rock is intercepted.

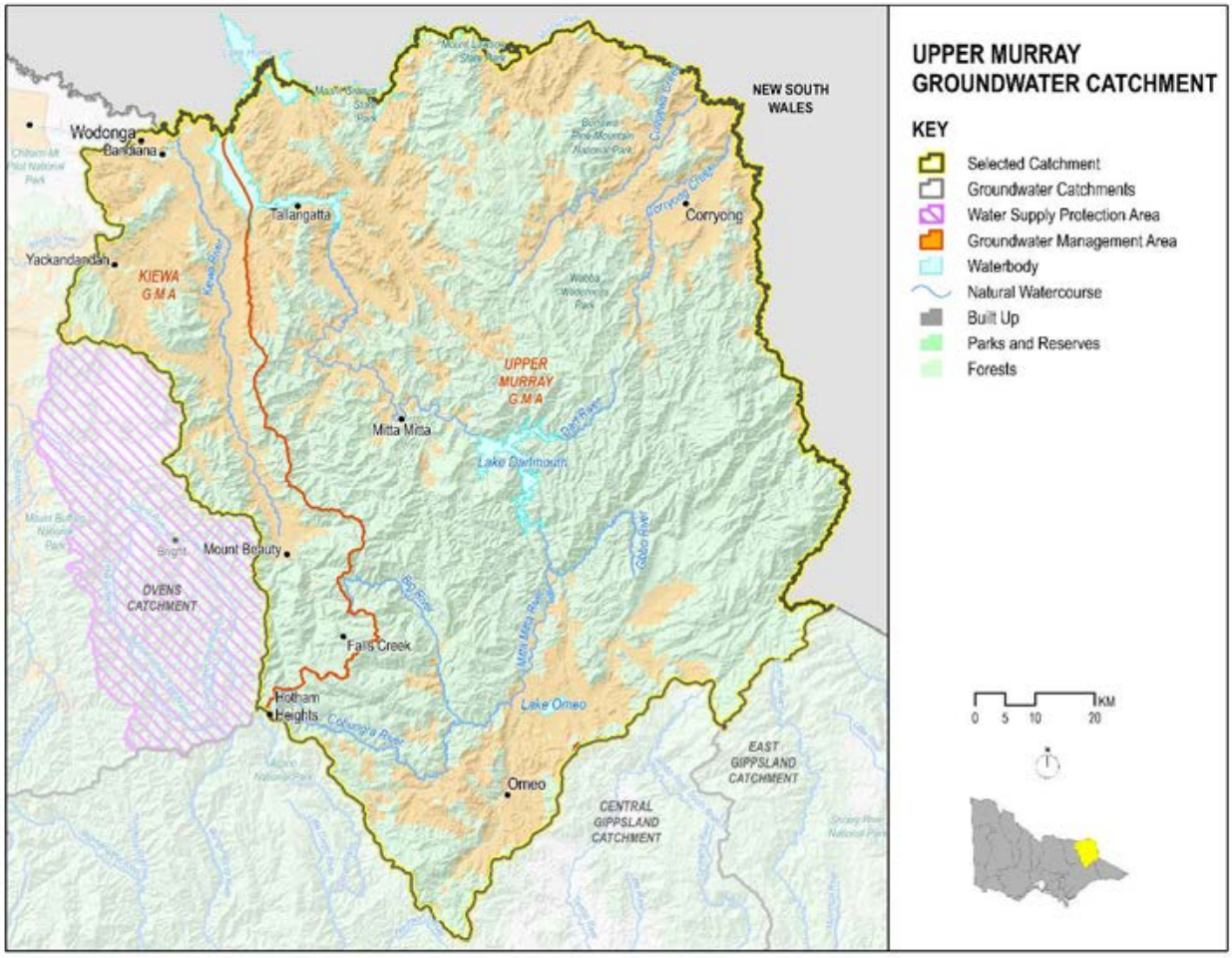
In the north, the plain of the Goulburn–Murray groundwater management basin gradually thickens into several geological layers:

- the Upper Tertiary Quaternary Aquifer 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 Upper Tertiary Quaternary Aquifer 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 bedrock, which comprises sedimentary fractured rock.

7.2.1 Upper Murray groundwater catchment

The Upper Murray groundwater catchment is located in north-east Victoria (Figure 7-2). 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 7-2 Map of the Upper Murray groundwater catchment



7.2.1.1 Management arrangements

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, and it administers domestic and stock use. 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 and a small part of the Upper Ovens River WSPA, which is mostly contained in the Ovens groundwater catchment. Groundwater resources supply licence entitlements, domestic and stock use and licensed use to the town of Dinner Plain.

7.2.1.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-3. The trends were classified as declining from July to December 2018 and mostly stable for 2019.

Table 7-3 Upper Murray groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Upper Ovens River	Declining	Declining	Stable	**Stable**	**Stable**
Groundwater management area					
Kiewa	Declining	Declining	Declining	**Stable**	**Stable**
Upper Murray	Declining	Declining	Stable	**Stable**	**Stable**

In 2018–19, 1,515 ML of water was extracted for consumptive use, which was slightly less than the 1,762 ML extracted in the previous year. Of this volume, 53 ML was extracted for urban use and 738 ML was estimated to have been used for domestic and stock purposes.

7.2.1.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-4, including licensed groundwater entitlements (for urban and non-urban use) and domestic and stock bores. Groundwater is used to provide the urban water supply to Dinner Plain. 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.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-4 Licensed groundwater volumes and use in the Upper Murray groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Kiewa GMA	Licensed use (non-urban)	3,117	0	3,119	0	**3,119**	**356**
	Domestic & stock	-	-	-	-	-	**420**
Upper Murray GMA	Licensed use (non-urban)	3,412	0	3,414	0	**3,414**	**368**
	Dinner Plains urban	120	0	120	0	**120**	**53**
	Domestic & stock	-	-	-	-	-	**318**
Upper Murray total 2018–19		**6,649**	**0**	**6,653**	**0**	**6,653**	**1,515**
Upper Murray total 2017–18		6,597	n/a	n/a	n/a	n/a	1,762

Compliance against water entitlements is reported in this groundwater catchment in two areas:

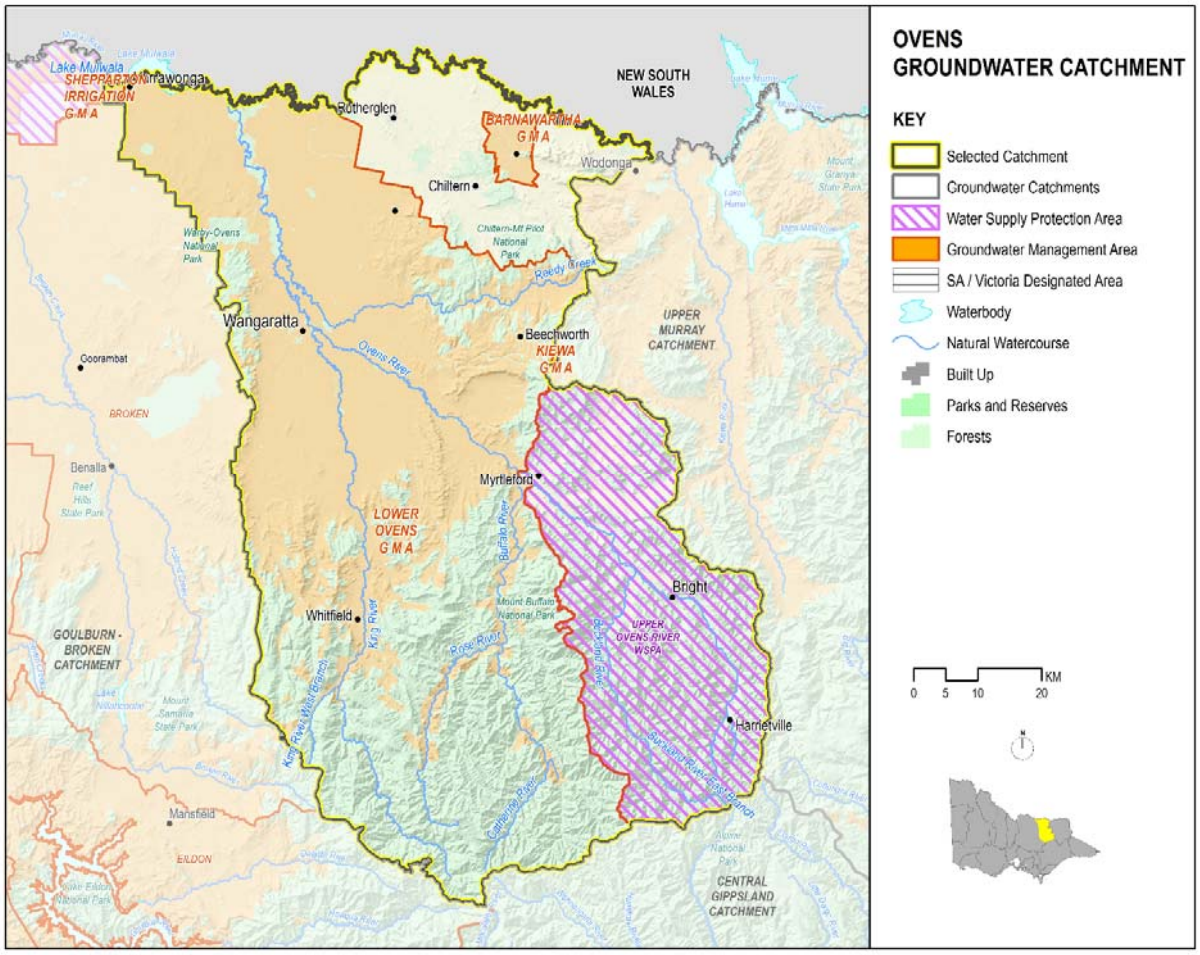
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Upper Murray – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (1,515 ML) was within the volume available for the year (6,653 ML).**

7.2.2 Ovens groundwater catchment

The Ovens groundwater catchment is in northern Victoria (Figure 7-3). It extends from the Great Dividing Range in the south to the Murray River in the north.

Figure 7-3 Map of the Ovens groundwater catchment



7.2.2.1 Management arrangements

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, bore construction and surface water diversions, and it administers domestic and stock use. 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 and Upper Ovens River WSPA. The *Upper Ovens River 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 four other towns in the area.

7.2.2.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-5. In 2018–19, the Upper Ovens River WSPA and Lower Ovens GMA trends were classified as declining from July to December 2018 and mostly stable for the remainder of the year (except for Lower Ovens, which ended the year with a declining trend). Barnawartha GMA was stable for most of the year, with a declining trend in the March 2019 quarter.

Table 7-5 Ovens groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Upper Ovens River	Declining	Declining	Stable	**Stable**	**Stable**
Groundwater management area					
Barnawartha	Stable	Stable	Declining	**Stable**	**Stable**
Lower Ovens	Declining	Declining	Stable	**Declining**	**Stable**

Note
(1) The Upper Ovens River WSPA is partly contained within the Upper Murray groundwater catchment.

In 2018–19, 13,266 ML of water was extracted for consumptive use, which was more than the 11,526 ML extracted in the previous year. Of this volume, 252 ML was extracted for urban use and 2,392 ML was estimated to have been used for domestic and stock purposes.

7.2.2.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-6. Groundwater in the Ovens groundwater catchment is an available urban water supply option for Barnawartha and a backup urban water supply for Bright, Chiltern, Springhurst and Wangaratta. Several 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 7-6.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-6 Licensed groundwater volumes and use in the Ovens groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Barnawartha GMA	Licensed use (non-urban)	82	-	82	0	**82**	**8**
	Barnawartha urban	293	-	293	0	**293**	**0**
	Domestic & stock	-	-	-	-	-	**50**
Lower Ovens GMA	Licensed use (non-urban)	19,175	-	19,205	0	**19,205**	**8,034**
	Springhurst urban	20	-	20	0	**20**	**0**
	Wangaratta urban	680	-	680	0	**680**	**252**
	Domestic & stock	-	-	-	-	-	**1,842**
Upper Ovens River WSPA	Licensed use (non-urban)	3,543	-	3,583	(223)	**3,360**	**1,001**
	Bright urban	75	-	74	(68)	**6**	**0**
	Domestic & stock	-	-	-	-	-	**292**
Outside management area	Licensed use (non-urban)	2,415	-	2,417	0	**2,417**	**1,581**
	Chiltern urban	25	-	25	0	**25**	**0**
	Domestic & stock	-	-	-	-	-	**208**
Ovens total 2018–19		**26,308**	**n/a**	**26,379**	**(291)**	**26,088**	**13,266**
Ovens total 2017–18		26,224	n/a	n/a	n/a	n/a	11,526

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Ovens – Key compliance points

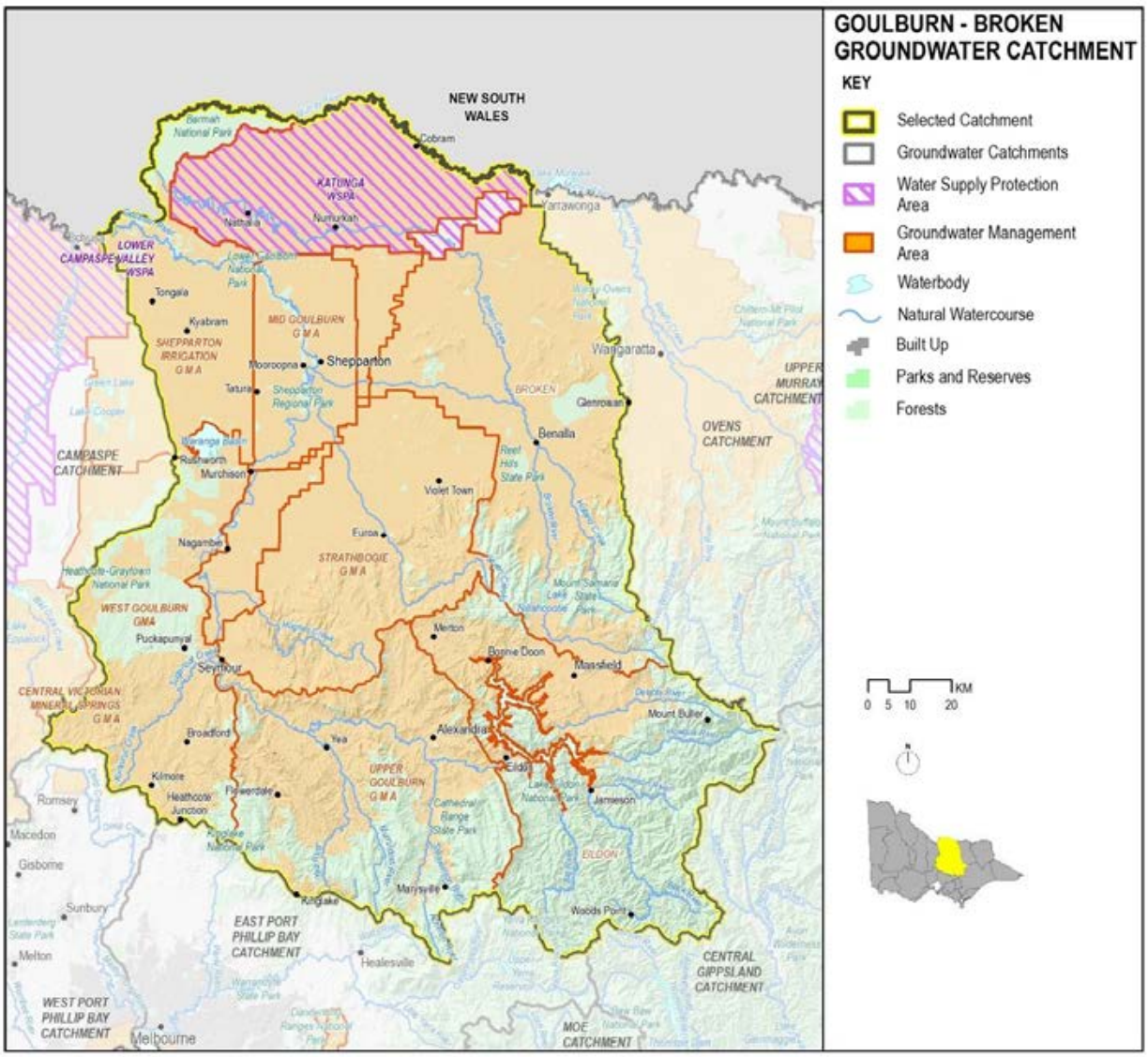
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (13,266 ML) was within the volume available for the year (26,088 ML).**

7.2.3 Goulburn–Broken groundwater catchment

The Goulburn–Broken groundwater catchment is in northern Victoria (Figure 7-4). 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 7-4 Map of the Goulburn–Broken groundwater catchment



7.2.3.1 Management arrangements

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, bore construction and surface water diversions, and it administers domestic and stock use. 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 includes the Mid Goulburn GMA, most of the Shepparton Irrigation Region GMA (which also extends into the Campaspe groundwater catchment), the Strathbogie GMA, the Upper Goulburn GMA, the Broken GMA, the Eildon GMA, the West Goulburn GMA and the Katunga WSPA. The local management plan for the West Goulburn GMA was approved and published on 28 July 2017.

Groundwater resources supply irrigation, domestic and stock use and urban use in Goorambat, Katunga and Strathmerton.

7.2.3.2 2018–19 groundwater resources overview

There were no restrictions on licensed use in Katunga WSPA for the whole of 2018–19.

Groundwater level trends for 2018–19 are shown in Table 7-7. The trends varied from declining to stable across the GMUs within the Goulburn–Broken groundwater catchment, with most ending 2018–19 with a declining trend, except the Broken and Strathbogie GMAs.

Although there are no observation bores currently monitoring groundwater levels in the Eildon GMA, historical records indicate that groundwater levels in both aquifers of this GMA are generally within 5 m of the ground surface and fluctuate in response to rainfall. Goulburn-Murray Water reported that rainfall in the Eildon GMA in 2018–19 was below average.

Table 7-7 Goulburn–Broken groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Katunga	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Broken	Stable	Stable	Stable	**Stable**	**Stable**
Mid Goulburn	Declining	Declining	Declining	**Declining**	**Declining**
Shepparton Irrigation Region (1)	Declining	Declining	Declining	**Declining**	**Stable**
Strathbogie	Stable	Stable	Stable	**Stable**	**Stable**
Upper Goulburn	Declining	Declining	Declining	**Declining**	**Stable**
West Goulburn (2)	Stable	Stable	Stable	**Declining**	**Stable**

Notes
(1) The Shepparton Irrigation Region GMA is partly contained within the Campaspe groundwater catchment.
(2) The West Goulburn GMA is partly contained within the Campaspe groundwater catchment.

In 2018–19, 142,276 ML of water was extracted for consumptive use, more than the 116,081 ML extracted in the previous year. Of this volume, 42 ML was extracted for urban use and 6,598 ML was estimated to have been used for domestic and stock purposes.

7.2.3.2 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-8. Several 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 7-8. Groundwater is used to provide urban water supply to Goorambat, Katunga and Strathmerton.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-8 Licensed groundwater volumes and use in the Goulburn–Broken groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Broken GMA	Licensed use (non-urban)	2,820	-	2,820	0	**2,820**	**621**
	Goorambat urban	24	-	24	0	**24**	**0**
	Domestic & stock	-	-	-	-	-	**606**
Eildon GMA	Licensed use (non-urban)	603	-	603	0	**603**	**216**
	Domestic & stock	-	-	-	-	-	**542**
Katunga WSPA	Licensed use (non-urban)	59,363	-	60,023	650	**60,673**	**41,062**
	Katunga urban	110	-	110	0	**110**	**42**
	Strathmerton urban	730	-	730	(650)	**80**	**0**
	Domestic & stock	-	-	-	-	-	**1,420**
Mid Goulburn GMA	Licensed use (non-urban)	12,470	2,486	12,470	0	**14,956**	**4,766**
	Domestic & stock	-	-	-	-	-	**230**
Shepparton Irrigation Region GMA (1)	Licensed use (non-urban)	169,095	-	172,168	0	**172,168**	**85,613**
	Domestic & stock	-	-	-	-	-	**1,960**
Strathbogie GMA	Licensed use (non-urban)	1,427	-	1,427	0	**1,427**	**529**
	Domestic & stock	-	-	-	-	-	**408**
Upper Goulburn GMA	Licensed use (non-urban)	6,107	-	6,107	0	**6,107**	**935**
	Domestic & stock	-	-	-	-	-	**978**
West Goulburn GMA	Licensed use (non-urban)	2,814	272	2,814	100	**3,186**	**1,747**
	Domestic & stock	-	-	-	-	-	**30**
Outside management area	Licensed use (non-urban)	209	-	209	0	**209**	**147**
	Domestic & stock	-	-	-	-	-	**424**
Goulburn–Broken total 2018–19		**255,772**	**2,758**	**259,505**	**100**	**262,363**	**142,276**
Goulburn–Broken total 2017–18		258,744	n/a	n/a	n/a	n/a	116,081

Note
(1) The Shepparton Irrigation Region GMA extends into the Campaspe groundwater catchment; an additional 16,294 ML of entitlement volume is reported in the Campaspe catchment account (Table 7-10). The total entitlement volume for the GMA as at 30 June 2019 was 185,320 ML.

Groundwater use in the Shepparton Irrigation Region GMA is estimated at the end of each season using a method which considers annual use by a subset of Shepparton Irrigation Region GMA licensed groundwater users that are metered, the volume of metered groundwater use in the Katunga WSPA and spring rainfall. This volume has been split between the Campaspe and Goulburn–Broken groundwater catchments as a proportion of the entitlement volume.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

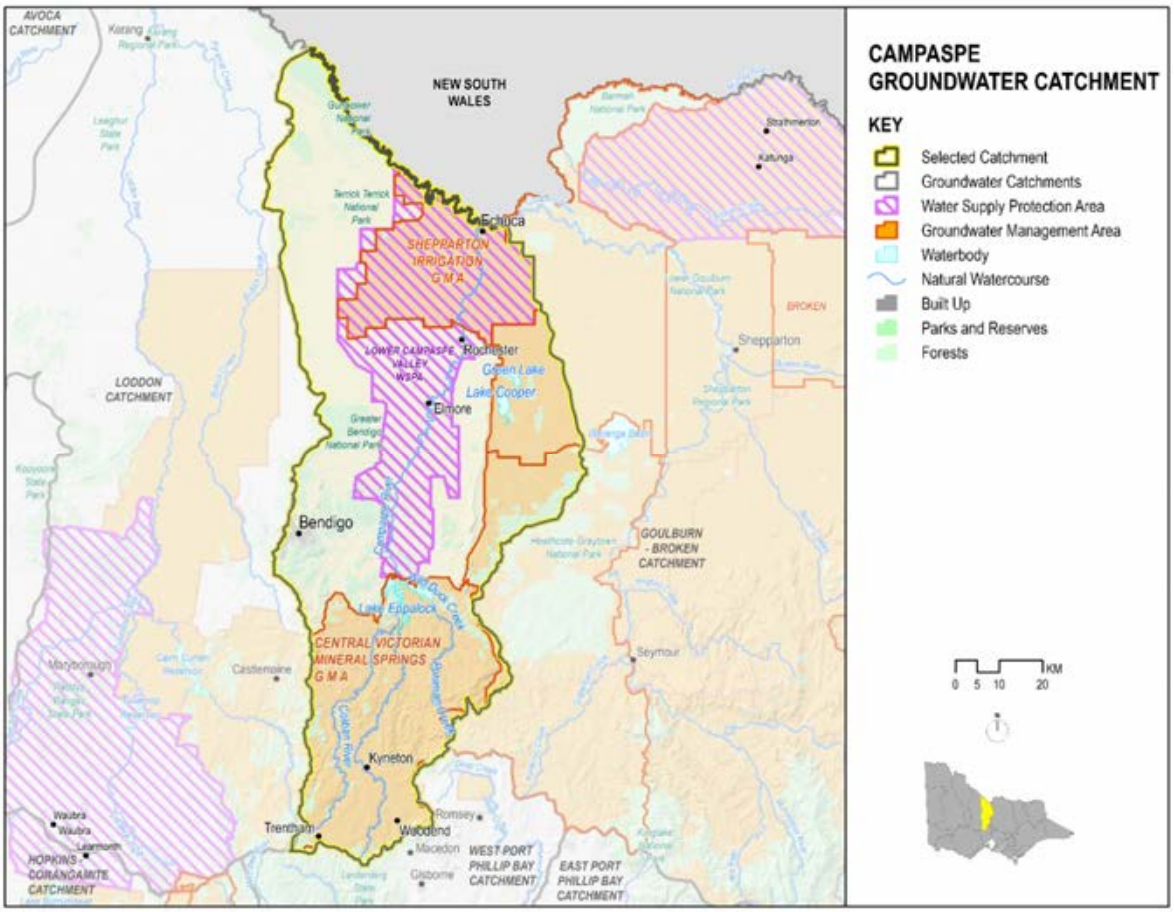
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Goulburn–Broken – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (142,276 ML) was within the volume available for the year (262,363 ML).**

7.2.4 Campaspe groundwater catchment

The Campaspe groundwater catchment is in northern Victoria (Figure 7-5). The catchment extends from the Great Dividing Range at Woodend and Trentham in the south to the Murray River near Echuca in the north.

Figure 7-5 Map of the Campaspe groundwater catchment



7.2.4.1 Management arrangements

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, bore construction and surface water diversions, and it administers domestic and stock use. 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.

The Campaspe groundwater catchment includes the Lower Campaspe Valley WSPA, part of the Shepparton Irrigation Region and West Goulburn GMA (which extend into the Goulburn–Broken catchment) and part of the Central Victorian Mineral Springs GMA (which extends into the Loddon catchment). Groundwater resources supply irrigation, domestic and stock use and the towns of Elmore and Trentham.

7.2.4.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-9. The trends varied from declining to stable across the GMUs within the Campaspe groundwater catchment. Although the Lower Campaspe Valley WSPA and Shepparton Irrigation Region GMA levels were declining in 2018–19, the Central Victorian Mineral Springs GMA and West Goulburn GMA trends were categorised as stable for much of the year.

Table 7-9 Campaspe groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Lower Campaspe Valley	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Central Victorian Mineral Springs (1)	Stable	Stable	Stable	**Stable**	**Stable**
Shepparton Irrigation Region (2)	Declining	Declining	Declining	**Declining**	**Declining**
West Goulburn GMA (3)	Stable	Stable	Stable	**Declining**	**Stable**

Notes

(1) The Central Victorian Mineral Springs GMA is partly contained within the Loddon groundwater catchment.
(2) The Shepparton Irrigation Region GMA is partly contained within the Goulburn–Broken groundwater catchment.
(3) The West Goulburn GMA is partly contained within the Goulburn–Broken groundwater catchment.

In 2018–19, 62,979 ML of water was extracted for consumptive use, which was more than the 49,292 ML extracted in the previous year. Of this volume, 155 ML was extracted for urban use and 2,762 ML was estimated to have been used for domestic and stock purposes.

7.2.4.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-10. Several 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. In the Campaspe catchment, groundwater is an option for urban water supply to Elmore and Trentham.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-10 Licensed groundwater volumes and use in the Campaspe groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Central Victorian Mineral Springs GMA (1)	Licensed use (non-urban)	2,215	-	2,230	0	**2,230**	**479**
	Trentham urban	48	-	48	0	**48**	**10**
	Domestic and stock use	-	-	-	-	-	**1,392**
Lower Campaspe Valley WSPA	Licensed use (non-urban)	55,576	13,337	55,479	(100)	**68,716**	**50,114**
	Elmore urban	284	71	284	0	**355**	**145**
	Domestic and stock use	-	-	-	-	-	**668**
Shepparton Irrigation Region GMA (2)	Licensed use (non-urban)	16,225	-	16,342	0	**16,342**	**8,215**
	Domestic and stock use	-	-	-	-	-	**200**
West Goulburn GMA	Licensed use (non-urban)	252	-	252	0	**252**	**0**
	Domestic and stock use	-	-	-	-	-	**4**
Outside management area	Licensed use (non-urban)	3,954	-	3,972	0	**3,972**	**1,255**
	Domestic and stock use	-	-	-	-	-	**498**
Campaspe total 2018–19		**78,555**	**13,408**	**78,607**	**(100)**	**91,915**	**62,979**
Campaspe total 2017–18		79,321	n/a	n/a	n/a	n/a	49,292

Notes

(1) The Central Victorian Mineral Springs GMA extends into the Loddon groundwater catchment, and an additional 2,774 ML of entitlement volume is reported in the Loddon catchment account (Table 7-12). The total entitlement volume for the Central Victorian Mineral Springs GMA as at 30 June 2019 was 5,037 ML.

(2) The Shepparton Irrigation Region GMA extends into the Goulbourn-Broken groundwater catchment, and an additional 169,095 ML of entitlement volume is reported in the Goulburn–Broken catchment account (Table 7-8). The total entitlement volume for the Shepparton Irrigation Region GMA as at 30 June 2019 was 185,320 ML.

(3) Groundwater use in the Shepparton Irrigation Region GMA is estimated at the end of each season using a method which considers annual use by a subset of Shepparton Irrigation Region GMA licensed groundwater users that are metered, the volume of metered groundwater use in the Katunga Water Supply Protection Area and spring rainfall. This volume has been split between the Campaspe and Goulburn–Broken catchments as a proportion of the entitlement volume.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Campaspe – Key compliance points

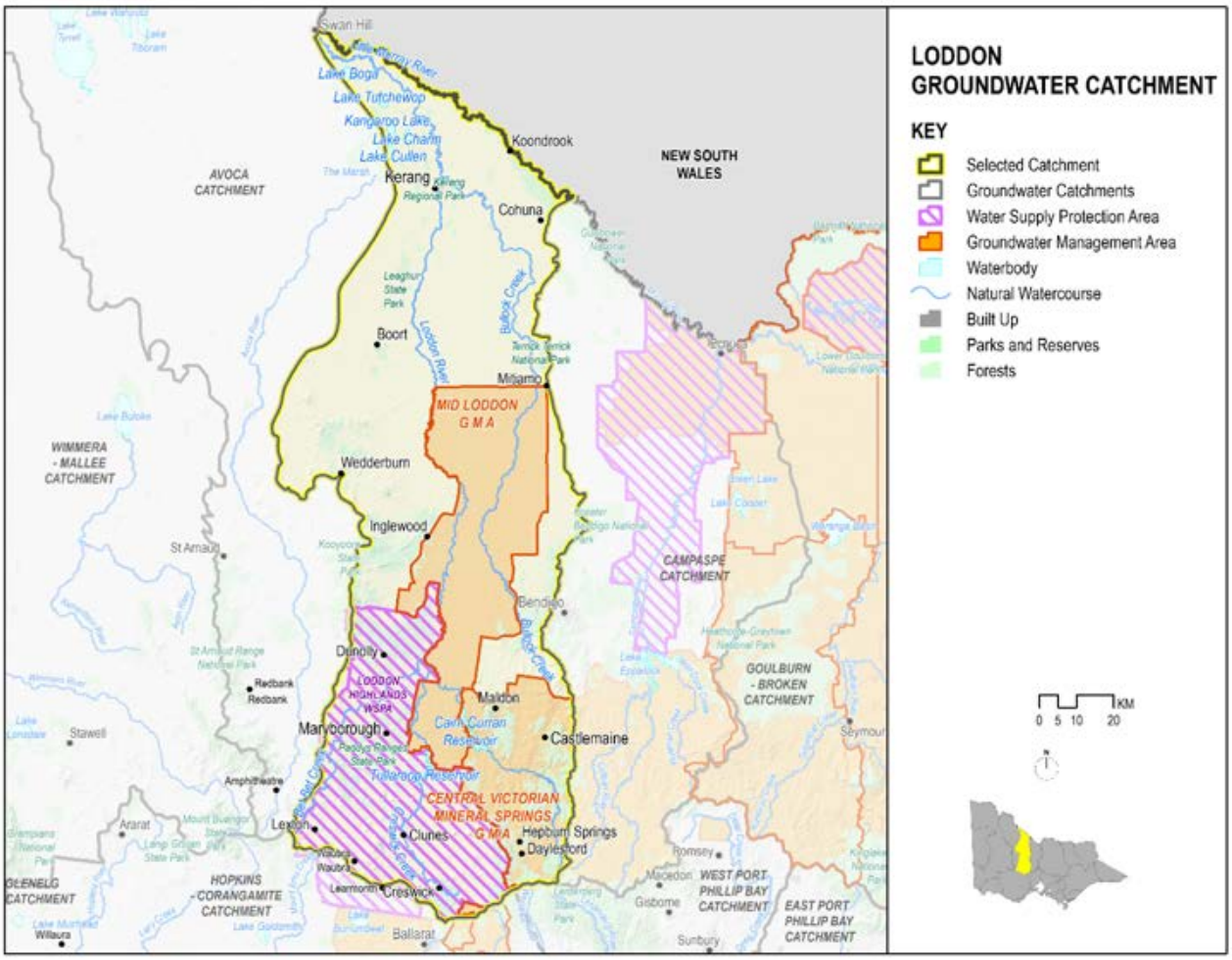
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (62,979 ML) was within the volume available for the year (91,915 ML).**

7.2.5 Loddon groundwater catchment

The Loddon groundwater catchment is in northern Victoria (Figure 7-6). 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 7-6 Map of the Loddon groundwater catchment



7.2.5.1 Management arrangements

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, bore construction and surface water diversions, and it administers domestic and stock use. 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 includes all the Mid Loddon GMA, most of Loddon Highlands WSPA (which currently extends into the Hopkins–Corangamite catchment) and part of the Central Victorian Mineral Springs GMA (which currently extends into the Campaspe catchment). Groundwater resources supply licence entitlements, domestic and stock use and six towns in the area.

7.2.5.2 2018–19 groundwater resources overview

In the Loddon Highlands WSPA, licensed diversions from all zones except Newlyn were able to take 100% of their entitlement volume. Licensed diversions from the Newlyn Zone were restricted to 75% of entitlement volume.

Groundwater level trends for 2018–19 are shown in Table 7-11. The trends were mostly categorised as declining throughout the Loddon groundwater catchment, except for the Central Victorian Mineral Springs GMA which was categorised as stable for the whole year.

Table 7-11 Loddon groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Loddon Highlands	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Mid Loddon	Declining	Declining	Declining	**Declining**	**Declining**
Central Victorian Mineral Springs (1)	Stable	Stable	Stable	**Stable**	**Stable**

Note
(1) The Central Victorian Mineral Springs GMA is partly contained within the Campaspe groundwater catchment.

In 2018–19, 42,930 ML of water was extracted for consumptive use, which was more than the 35,668 ML extracted in the previous year. Of this volume, 1,064 ML was extracted for urban use and 2,132 ML was estimated to have been used for domestic and stock purposes.

7.2.5.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-12. In the Loddon groundwater catchment, all management zones in the Loddon Highlands WSPA had an allocation of 100%, except for the Newlyn Zone, which had an allocation of 75% in 2018–19. Several groundwater licences also incorporate domestic and stock use: in these cases, the use from these bores is reported in the licensed volume in Table 7-12. Groundwater is an urban water supply option for six towns within the catchment.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-12 Licensed groundwater volumes and use in the Loddon groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Central Victorian Mineral Springs GMA	Licensed use (non-urban)	2,501	0	2,507	0	**2,507**	**511**
	Daylesford urban	273	0	268	0	**268**	**90**
	Domestic & stock	-	-	-	-	-	**840**
Loddon Highlands WSPA	Licensed use (non-urban)	18,822	2,650	17,675	70	**20,396**	**8,153**
	Avoca urban	250	38	250	0	**288**	**187**
	Clunes urban	350	53	350	0	**403**	**233**
	Forest Hill urban	350	53	263	0	**315**	**155**
	Learmonth urban	98	15	100	(2)	**113**	**49**
	Maryborough urban	565	161	1,071	(70)	**1,161**	**291**
	Waubra urban	65	10	65	0	**75**	**30**
	Domestic & stock	-	-	-	-	-	**748**
Mid Loddon GMA	Licensed use (non-urban)	33,927	8,902	33,927		**42,829**	**30,310**
	Domestic & stock	-	-	-	-	-	**322**
Outside management area	Licensed use (non-urban)	6,505	0	6,535	0	**6,535**	**790**
	Domestic & stock	-	-	-	-	-	**222**
Loddon total 2018–19		**63,706**	**11,880**	**63,011**	**(2)**	**74,888**	**42,930**
Loddon total 2017–18		62,695	n/a	n/a	n/a	n/a	35,668

Note
(1) The Central Victorian Mineral Springs GMA extends into the Campaspe groundwater catchment, and an additional 2,263 ML of entitlement volume is reported in the Campaspe catchment account (Table 7-10). The total entitlement volume for the Central Victorian Mineral Springs GMA as at 30 June 2019 was 5,037 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Loddon – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (42,930 ML) was within the volume available for the year (74,888 ML).**

7.3 Gippsland groundwater management basin

The Gippsland groundwater management 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 groundwater management 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.

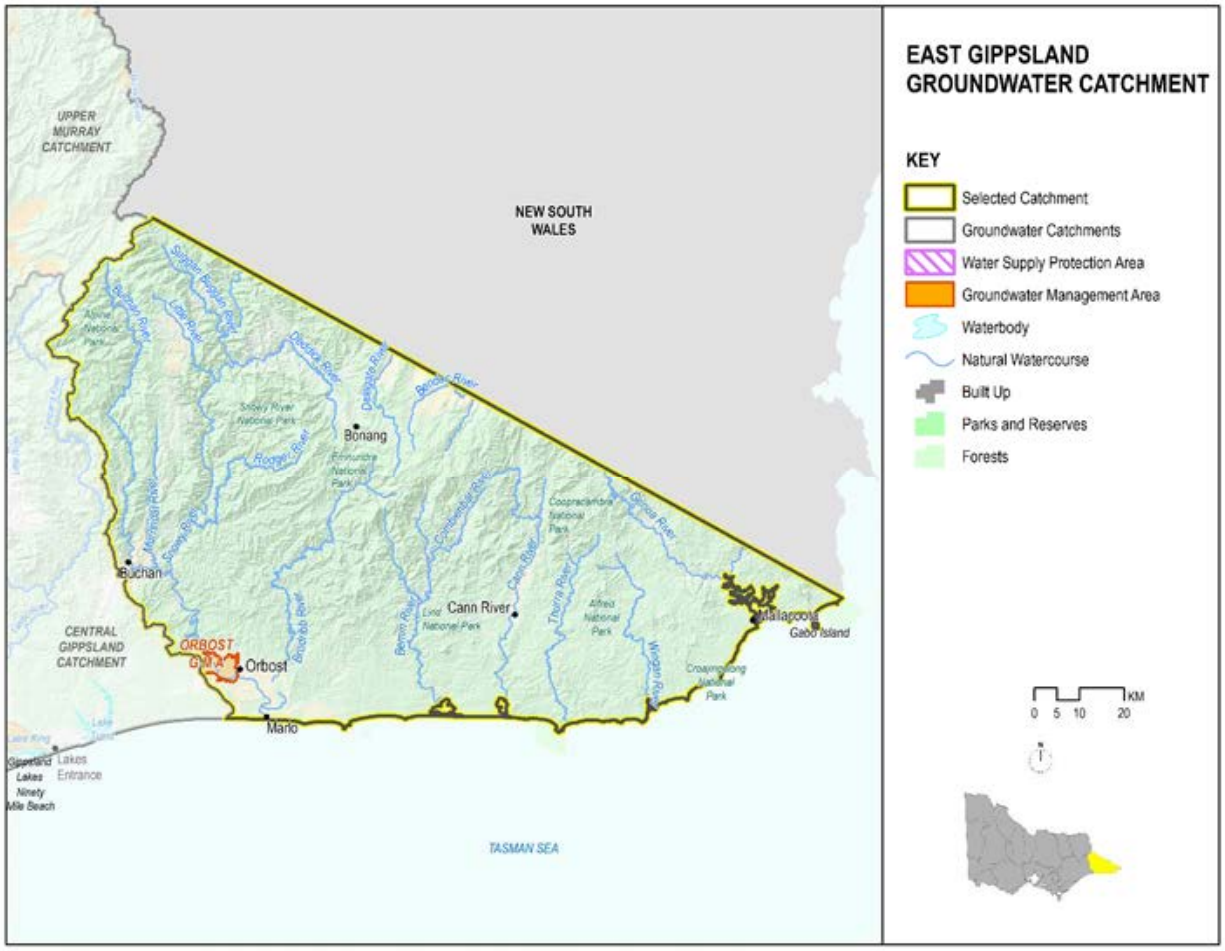
Middle aquifers cover a large part of the Gippsland groundwater management basin from Moe to Bairnsdale. They comprise thick seams of sand aquifers separated by aquitards. The aquitards are generally clay or coal seams in the north-west of the Gippsland groundwater region, and limestone in the east and centre of the region. Recharge occurs from leakage through the overlying and surrounding sediments, and discharge is to the limestone aquitards to the east of the region and along the coast.

Lower aquifers extend across the Gippsland groundwater management 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 bedrock. Where the lower aquifers occur at or near the surface, they receive direct recharge from rainfall and river leakage: in the deeper areas of the 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 7-7) is located in the Gippsland groundwater management basin in eastern Victoria. Neighbouring groundwater catchments are Central Gippsland to the west and Upper Murray to the north-west.

Figure 7-7 Map of the East Gippsland groundwater catchment



7.3.1.1 Management arrangements

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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The East Gippsland groundwater catchment contains the Orbost GMA. Groundwater supplies irrigation, domestic and stock use and Mallacoota.

7.3.1.2 2018–19 groundwater resources overview

The groundwater level trend for 2018–19 is shown in Table 7-13. The Orbost GMA was categorised as declining throughout 2018–19.

Table 7-13 East Gippsland groundwater level trend

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
Orbost	Declining	Declining	Declining	**Declining**	**Declining**

In 2018–19, 942 ML of water was extracted for consumptive use, which was more than the 804 ML extracted in the previous year. Of this volume, 113 ML was extracted for urban use and 77 ML was estimated to have been used for domestic and stock purposes.

7.3.1.3 Groundwater use and compliance

All groundwater extracted for consumptive use in 2018–19 from GMUs are shown in Table 7-14. 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 7-14. Within the East Gippsland catchment, groundwater is available for urban water supply to Mallacoota.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-14 Licensed groundwater volumes and use in the East Gippsland groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Orbost GMA	Licensed use (non-urban)	1,217	0	1,217	0	**1,217**	**545**
	Domestic and stock use	-	-	-	-	-	**5**
Outside management area	Licensed use (non-urban)	624	0	696	83	**779**	**214**
	Mallacoota urban	220	0	220	0	**220**	**113**
	Domestic and stock use	-	-	-	-	-	**66**
East Gippsland total 2018–19		**2,061**	**0**	**2,132**	**83**	**2,215**	**942**
East Gippsland total 2017–18		2,105	n/a	n/a	n/a	n/a	804

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

East Gippsland – Key compliance points

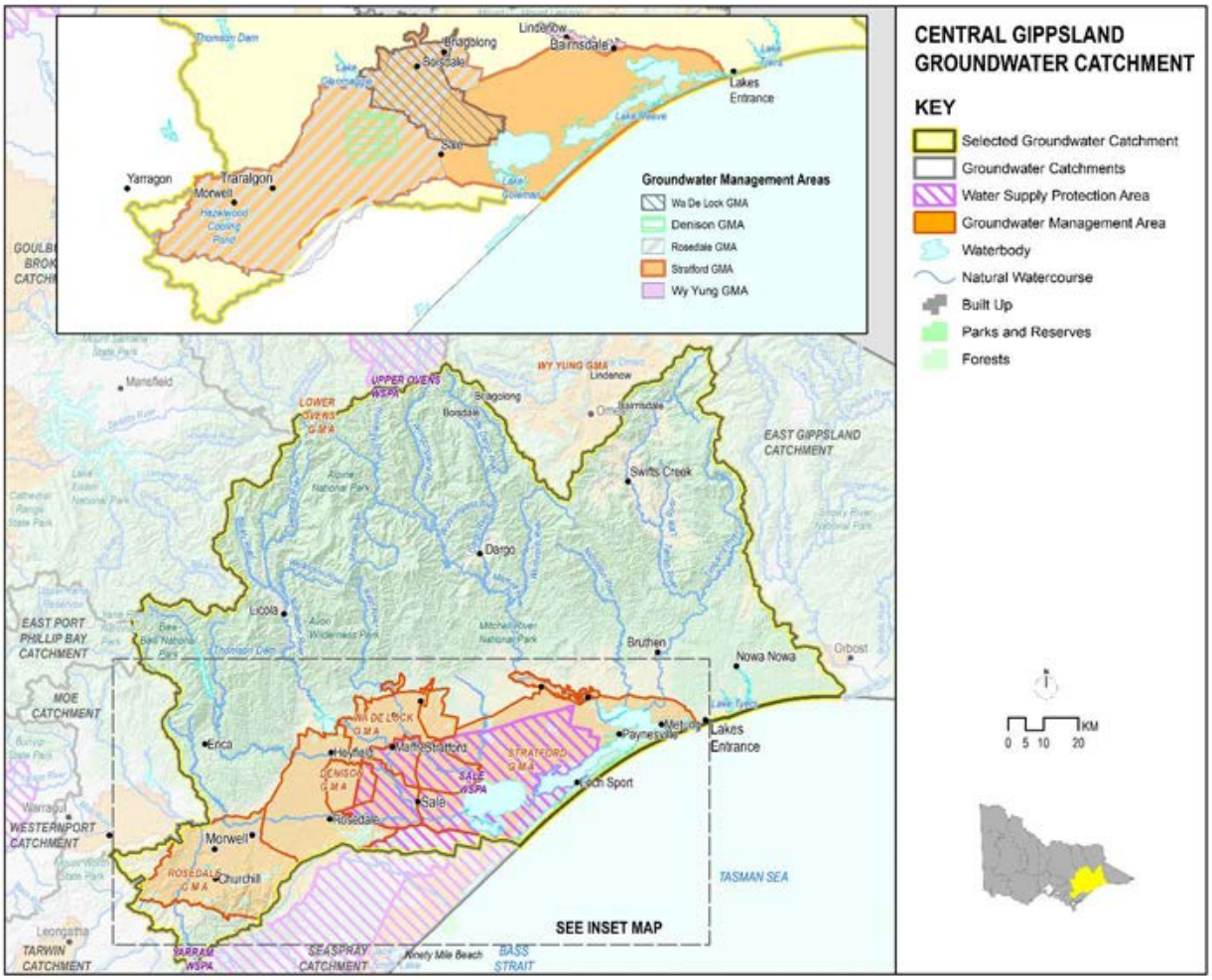
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (942 ML) was within the volume available for the year (2,215 ML).**

7.3.2 Central Gippsland groundwater catchment

The Central Gippsland groundwater catchment (Figure 7-8) is located in the Gippsland groundwater management basin in eastern Victoria and encompasses the major systems of the Gippsland Lakes. Neighbouring groundwater catchments are Goulburn–Broken and Moe to the north-west and west, Ovens and Upper Murray to the north, Tarwin and Seaspray to the south-west and south and East Gippsland to the east.

Figure 7-8 Map of the Central Gippsland groundwater catchment



7.3.2.1 Management arrangements

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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Central Gippsland groundwater catchment contains the Rosedale GMA, Wa De Lock GMA, Denison GMA, Sale WSPA and Wy Yung GMA. 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.

7.3.2.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-15. The trends were mostly declining across all GMUs except Sale WSPA, which had stable levels from January to July 2019.

Table 7-15 Central Gippsland groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Sale	Declining	Declining	Stable	**Stable**	**Stable**
Yarram (1)	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Moe	Declining	Declining	Declining	**Declining**	**Declining**
Rosedale (2)	Declining	Declining	Declining	**Declining**	**Declining**
Stratford (2)	Declining	Declining	Declining	**Declining**	**Declining**
Wa De Lock	Declining	Declining	Declining	**Declining**	**Declining**
Wy Yung	Declining	Declining	Declining	**Declining**	**Stable**

Notes
(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.
(2) Rosedale and Stratford GMAs include the dewatering activities from the Loy Yang and Morwell coal mines.

In 2018–19, 85,806 ML of water was extracted for consumptive uses, which was less than the 74,648 ML extracted in the previous year. Of this volume, 2,061 ML was extracted for urban use and 1,848 ML was estimated to have been used for domestic and stock purposes.

7.3.2.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-16. 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. Groundwater is used to provide urban water supply for Boisdale, Briagolong, Lindenow and Sale.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-16 Licensed groundwater volumes and use in the Central Gippsland groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Denison GMA (1)	Licensed use (non-urban)	18,499	-	18,722	0	**18,722**	**11,864**
	Domestic and stock use	-	-	-	-	-	**114**
Moe GMA (2)	Licensed use (non-urban)	33	-	33	0	**33**	**10**
	Domestic and stock use	-	-	-	-	-	**0**
Rosedale GMA (3)	Licensed use (non-urban)	22,322	-	23,828	0	**23,828**	**10,276**
	Domestic and stock use	-	-	-	-	-	**114**
Sale WSPA	Licensed use (non-urban)	17,723	-	17,673	930	**18,603**	**15,897**
	Sale urban	3,480	-	3,480	(980)	**2,500**	**1,970**
	Domestic and stock use	-	-	-	-	-	**371**
Stratford GMA (3) (4)	Licensed use (non-urban)	36,722	-	36,722	(3)	**36,719**	**22,945**
	Domestic and stock use (6)	-	-	-	-	-	**24**
Wa De Lock GMA (1)	Licensed use (non-urban)	28,929	-	28,929		**28,929**	**10,169**
	Boisdale urban	37	-	37	0	**37**	**0**
	Briagolong urban	160	-	160	0	**160**	**91**
	Domestic and stock use	-	-	-	-	-	**404**
Wy Yung GMA	Licensed use (non-urban)	7,462	-	7,462	0	**7,462**	**1,546**
	Domestic and stock use	-	-	-	-	-	**11**
Yarram WSPA (5)	Licensed use (non-urban)	6,889	-	6,897	0	**6,897**	**4,956**
	Domestic and stock use	-	-	-	-	-	**104**
Outside management area	Licensed use (non-urban)	19,723	-	20,054	(33)	**20,021**	**4,235**
	Lindenow urban	171	-	171	0	**171**	**0**
	Domestic and stock use	-	-	-	-	-	**708**
Central Gippsland total 2018–19		**162,149**	**-**	**164,166**	**(86)**	**164,080**	**85,806**
Central Gippsland total 2017–18		162,172	n/a	n/a	n/a	162,172	74,648

Notes
(1) The volumes of use in Denison and Wa De Lock GMAs include metered extractions for salinity control (Denison WSPA 672 ML and Wa De Lock GMA 778 ML).
(2) The Moe GMA extends into the Moe groundwater catchment, and an additional 3,852 ML of entitlement volume is reported in the Moe catchment account (Table 7-20). The total entitlement volume for the Moe GMA as at 30 June 2019 was 3,885 ML.
(3) The use volume reported in the Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 884 ML and Stratford GMA 22,945 ML).
(4) The Stratford GMA extends into the Seaspray groundwater catchment, and an additional 362 ML of entitlement volume is reported in the Seaspray catchment account (Table 7-18). The total entitlement volume for the Stratford WSPA as at 30 June 2019 was 37,084 ML.

(5) The Yarram WSPA extends into the Seaspray groundwater catchment, and an additional 18,799 ML of entitlement volume is reported in the Seaspray catchment account (Table 7-18). The total entitlement volume for the Yarram WSPA as at 30 June 2019 was 25,687 ML.
(6) Estimated domestic and stock use for Stratford GMA is calculated using a factor of 2 ML per bore.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

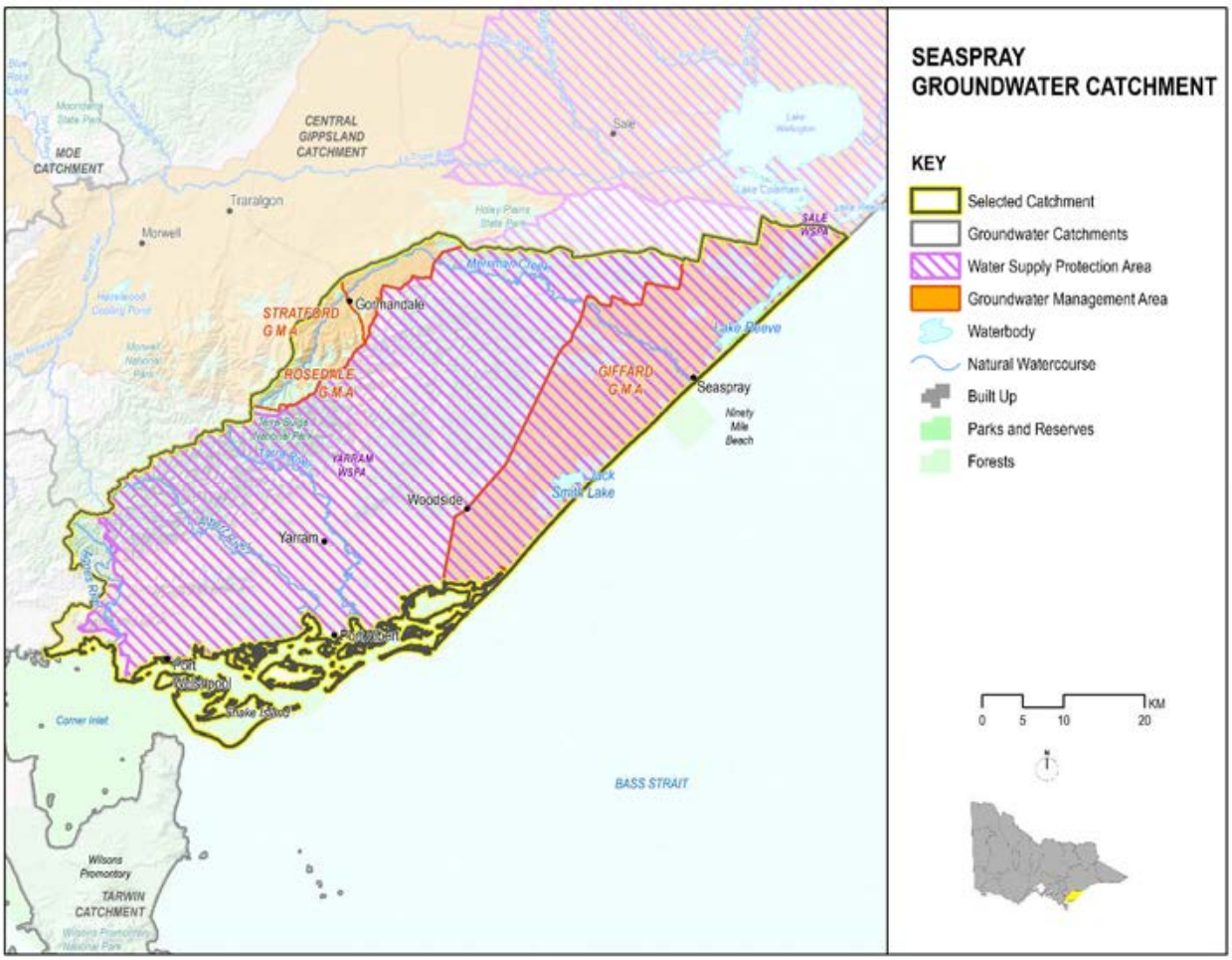
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Central Gippsland – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (85,806 ML) was within the volume available for the year (164,080 ML).**

7.3.3 Seaspray groundwater catchment

The Seaspray groundwater catchment (Figure 7-9) is located in the Gippsland groundwater management basin in Victoria's south-east. Neighbouring groundwater catchments are Central Gippsland to the north and Tarwin to the west.

Figure 7-9 Map of the Seaspray groundwater catchment



7.3.3.1 Management arrangements

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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The catchment contains the Giffard GMA, most of the Yarram WSPA (which also extends into the Central Gippsland catchment) and part of the Stratford GMA. Groundwater resources supply licence entitlements, domestic and stock use and urban water to Yarram. Groundwater use in the Seaspray catchment is predominantly for irrigation.

7.3.3.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-17. The trends were categorised as declining for all GMUs in 2018–19.

Table 7-17 Seaspray groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Yarram (1)	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Giffard	Declining	Declining	Declining	**Declining**	**Declining**
Stratford (2)	Declining	Declining	Declining	**Declining**	**Declining**

Notes
(1) Yarram WSPA water levels are influenced by offshore oil and gas extraction.
(2) Stratford include the dewatering activities from the Loy Yang and Morwell coal mines.

In 2018–19, 17,994 ML of water was extracted for consumptive uses, which was more than the 13,543 ML extracted in the previous year. Of this volume, 159 ML was extracted for urban use and 467 ML was estimated to have been used for domestic and stock purposes.

7.3.3.2 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-18. 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 7-18. Groundwater supplies are available for Yarram.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-18 Licensed groundwater volumes and use in the Seaspray groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Giffard GMA	Licensed use (non-urban)	5,689	0	5,689	0	**5,689**	**5,548**
	Domestic & stock	-	-	-	-	-	**114**
Stratford GMA (1)	Licensed use (non-urban)	362	0	362	3	**365**	**109**
	Domestic & stock	-	-	-	-	-	**0**
Yarram WSPA (2)	Licensed use (non-urban)	18,585	0	18,578	0	**18,578**	**11,443**
	Yarram urban	214	0	214	0	**214**	**159**
	Domestic & stock	-	-	-	-	-	**240**
Outside management area	Licensed use (non-urban)	1,018	0	1,018	0	**1,018**	**270**
	Domestic & stock	-	-	-	-	-	**113**
Seaspray total 2018–19		**25,867**	**0**	**25,861**	**3**	**25,864**	**17,994**
Seaspray total 2017–18		25,741	n/a	n/a	n/a	n/a	13,543

Notes

(1) The Stratford GMA extends into the Central Gippsland groundwater catchment, and an additional 36,722 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-16). The total entitlement volume for the Stratford WSPA as at 30 June 2019 was 37,084 ML.

(2) The Yarram WSPA extends into the Central Gippsland groundwater catchment, and an additional 6,889 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-16). The total entitlement volume for the Yarram WSPA as at 30 June 2019 was 25,687 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Seaspray – Key compliance points

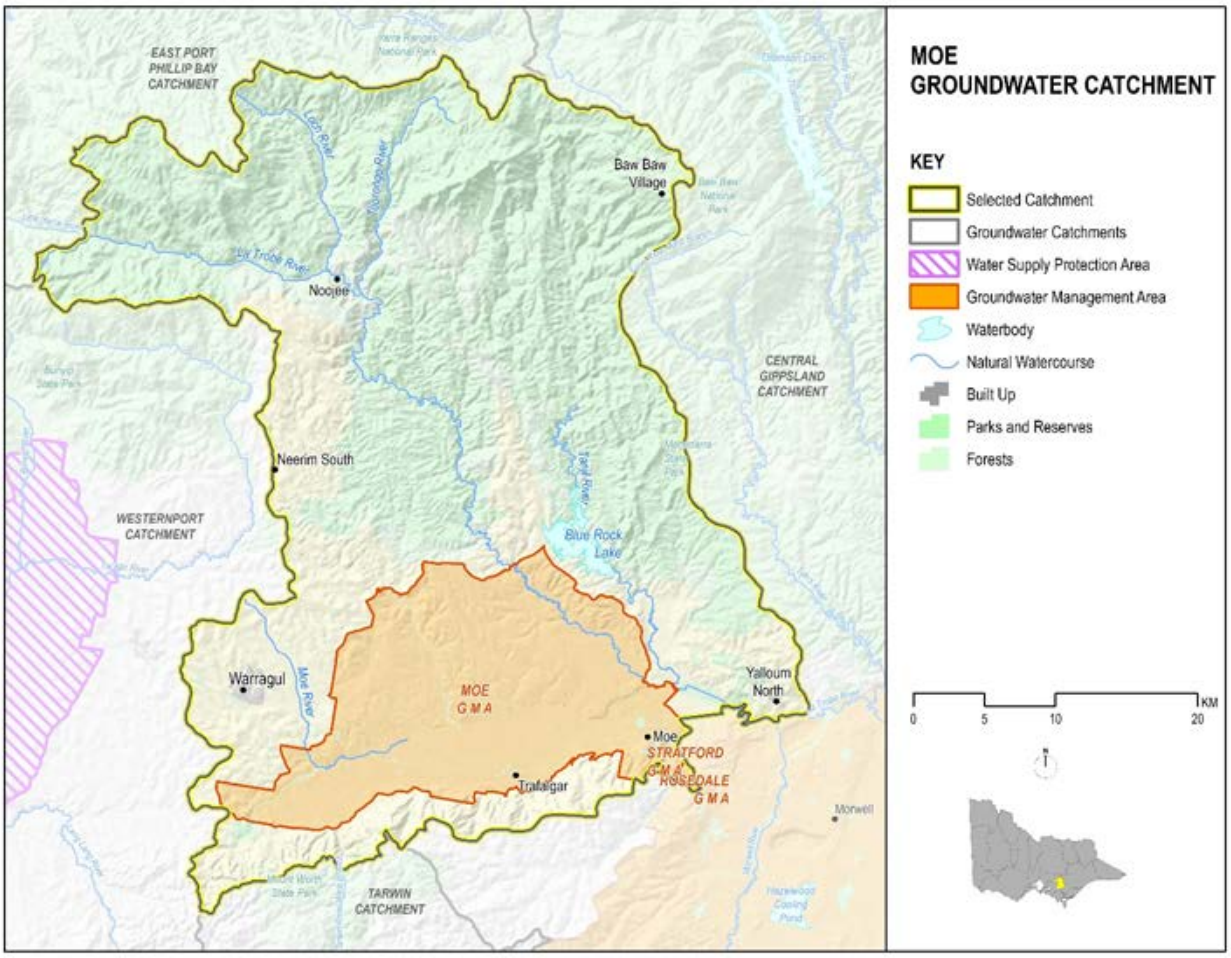
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (17,994 ML) was within the volume available for the year (25,864 ML).**

7.3.4 Moe groundwater catchment

The Moe groundwater catchment (Figure 7-10) is located in the Gippsland groundwater management basin in eastern Victoria. 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 7-10 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Moe groundwater catchment contains the Moe GMA. 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.

7.3.4.2 2018–19 groundwater resources overview

The groundwater level trend for 2018–19 is shown in Table 7-19. The trend was categorised as declining throughout the year.

Table 7-19 Moe groundwater level trend

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
Moe	Declining	Declining	Declining	**Declining**	**Declining**

In 2018–19, 1,358 ML of water was extracted for consumptive uses, which was less than the 1,612 ML extracted in the previous year. Of this volume, 234 ML was estimated to have been used for domestic and stock purposes. There was no urban use in 2018–19.

7.3.4.2 Groundwater entitlements and use

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown 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 7-20. Groundwater supplies are available for Yarragon.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-20 Licensed groundwater volumes and use in the Moe groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Moe GMA	Licensed use (non-urban)	3,752	0	3,752	(30)	**3,722**	**775**
	Yarragon urban	100	-	100	0	**100**	**0**
	Domestic & stock	-	-	-	-	-	**123**
Outside management area	Licensed use (non-urban)	1,358	0	1,358	30	**1,388**	**349**
	Domestic & stock	-	-	-	-	-	**111**
Moe total 2018–19		**5,210**	**0**	**5,210**	**0**	**5,210**	**1,358**
Moe total 2017–18		5,213	n/a	n/a	n/a	n/a	1,612

Note

(1) The Moe GMA extends into the Central Gippsland groundwater catchment, and an additional 33 ML of entitlement volume is reported in the Central Gippsland catchment account (Table 7-16). The total entitlement volume for the Moe GMA as at 30 June 2019 was 3,885 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Moe – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (1,358 ML) was within the volume available for the year (5,210 ML).**

7.4 Central groundwater management basin

The Central groundwater management basin comprise the Port Phillip, Westernport and Tarwin groundwater management 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 region are Tarwin, Westernport, East Port Phillip Bay and West Port Phillip Bay.

The upper aquifers of the Central groundwater management basin 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 floodplains 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.

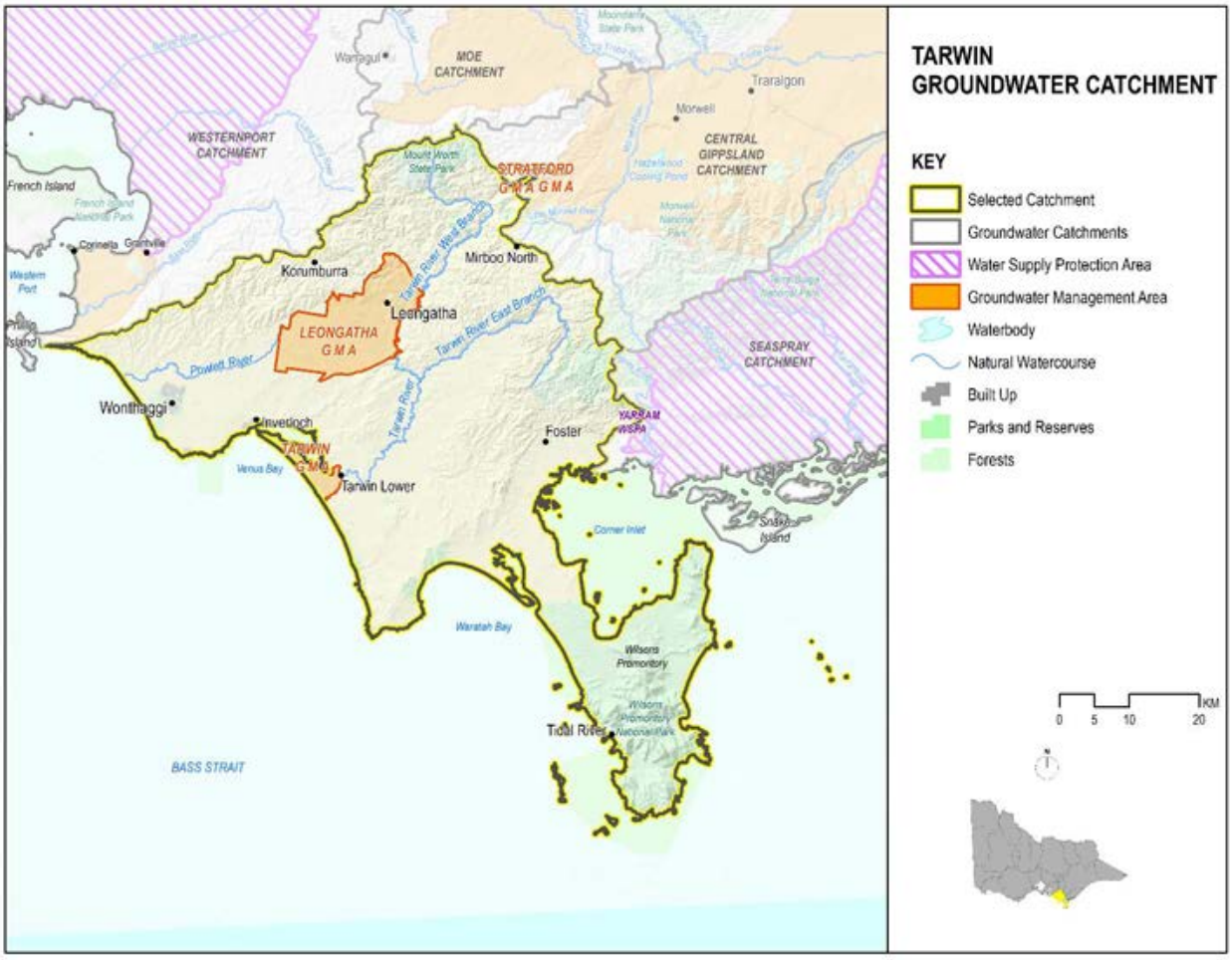
The middle aquifers of the Central groundwater management basin cover a large part of the area. They are made up of several formations, which are connected and act as one aquifer in each region. These aquifers vary in composition and include fine sands, coarse sand and gravel, clay and limestone. These 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 management basin. 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 bedrock 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 bedrock 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 bedrock are at the surface; elsewhere, recharge occurs as leakage.

7.4.1 Tarwin groundwater catchment

The Tarwin groundwater catchment is located in south-east Victoria (Figure 7-11). 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 7-11 Map of the Tarwin groundwater catchment



7.4.1.1 Management arrangements

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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Tarwin groundwater catchment contains the Leongatha GMA and Tarwin GMA. Groundwater resources supply licence entitlements, domestic and stock use and Leongatha.

7.4.1.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-21. The trends were mostly stable during the year for Tarwin GMA and mostly declining for Leongatha GMA.

Table 7-21 Tarwin groundwater level trends in the Tarwin groundwater catchment

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
Leongatha	Declining	Declining	Declining	**Stable**	**Stable**
Tarwin	Stable	Stable	Declining	**Stable**	**Stable**

In 2018–19, 1,163 ML of water was extracted for consumptive uses, which was less than the 1,354 ML extracted in the previous year. Of this volume, 928 ML was estimated to have been used for domestic and stock purposes. There was no urban use in 2018–19.

7.4.1.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-22. 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. Groundwater supply is available for Leongatha.

Groundwater use decreased slightly in 2018–19, compared to 2017–18.

Table 7-22 Licensed groundwater volumes and use in the Tarwin groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Leongatha GMA	Licensed use (non-urban)	1,088	0	1,088	0	**1,088**	**149**
	Leongatha urban	715	0	715	0	**715**	**0**
	Domestic & stock	-	-	-	-	-	**51**
Tarwin GMA	Licensed use (non-urban)	58	0	58	0	**58**	**17**
	Domestic & stock	-	-	-	-	-	**572**
Outside management area	Licensed use (non-urban)	344	0	344	0	**344**	**71**
	Domestic & stock	-	-	-	-	-	**305**
Tarwin total 2018–19		**2,206**	**0**	**2,206**	**0**	**2,206**	**1,163**
Tarwin total 2017–18		2,205	n/a	n/a	n/a	n/a	1,354

Compliance against water entitlements is reported in this groundwater catchment in two areas:

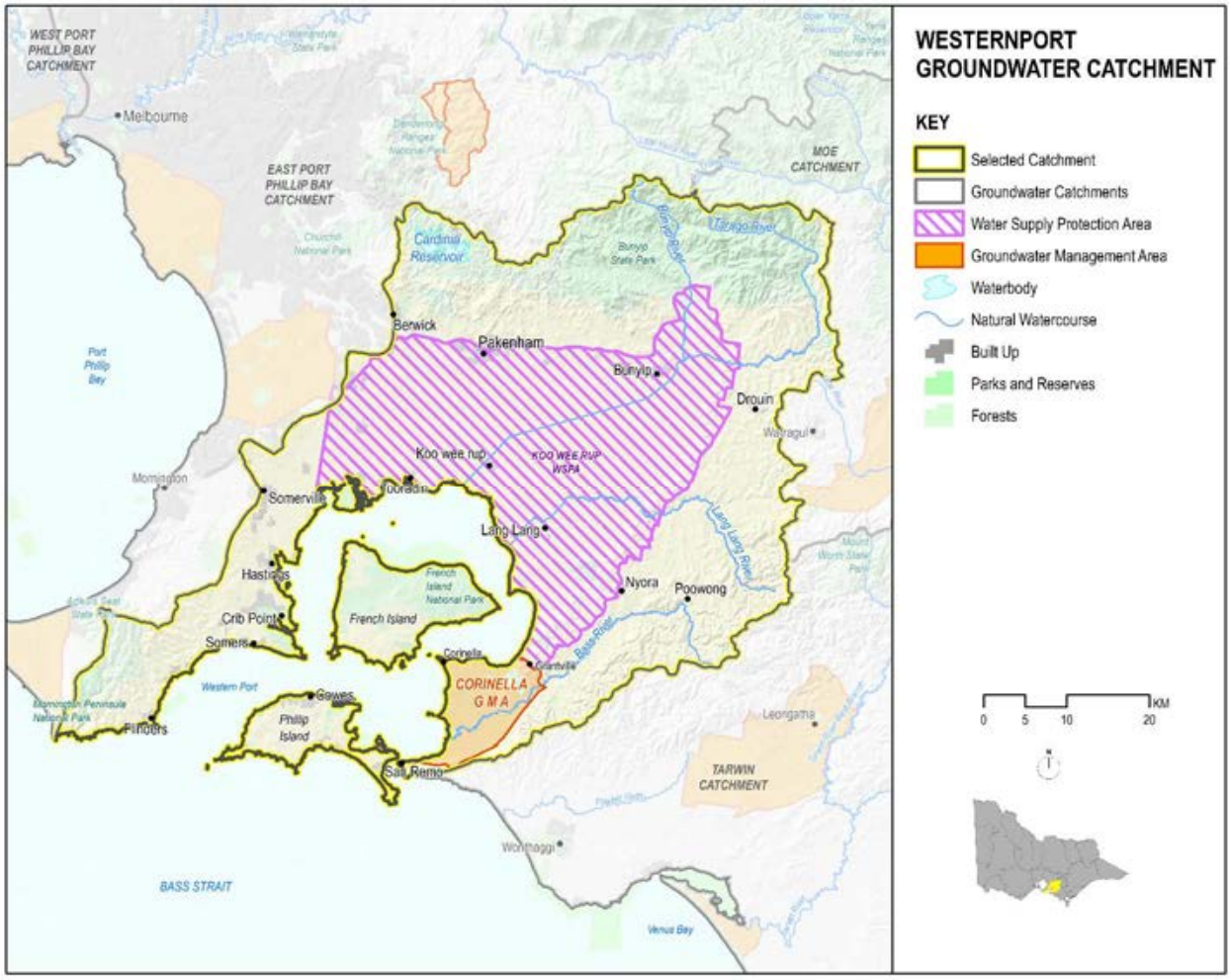
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Tarwin – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (1,163 ML) was within the volume available for the year (2,206 ML).**

7.4.2 Westernport groundwater catchment

The Westernport groundwater catchment is located in southern Victoria (Figure 7-12). Neighbouring groundwater catchments are East Port Phillip Bay to the west, Moe to the north-east and Tarwin to the south-east.

Figure 7-12 Map of the Westernport groundwater catchment



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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Westernport groundwater catchment contains the Corinella GMA and most of the Koo Wee Rup WSPA (which extends into the East Port Phillip Bay groundwater catchment). Groundwater resources supply licence entitlements, domestic and stock use and the towns of Corinella, Grantville and Lang Lang.

7.4.2.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-23. The trends were categorised as declining throughout the groundwater catchment.

Table 7-23 Westernport groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Corinella	Declining	Declining	Declining	**Declining**	**Declining**

In 2018–19, 6,001 ML of water was extracted for consumptive uses, which was more than the 6,303 ML extracted in the previous year. Of this volume, 1,290 ML was estimated to have been used for domestic and stock purposes. There was no urban use in 2018–19.

7.4.2.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-24. 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 7-24. Groundwater is available as an urban water supply to Corinella and Grantville as well as Lang Lang.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-24 Licensed groundwater volumes and use in the Westernport groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Corinella GMA	Licensed use (non-urban)	172	-	172	0	**172**	**63**
	Corinella / Grantville urban	490	-	490	0	**490**	**0**
	Domestic & stock	-	-	-	-	-	**62**
Koo Wee Rup WSPA	Licensed use (non-urban)	12,345	-	12,500	100	**12,600**	**3,964**
	Lang Lang urban	119	-	119	(100)	**19**	**0**
	Domestic & stock	-	-	-	-	-	**701**
Outside management area	Licensed use (non-urban)	4,288	-	4,511	0	**4,511**	**686**
	Domestic & stock	-	-	-	-	-	**527**
Westernport total 2018–19		**17,414**	**-**	**17,793**	**0**	**17,793**	**6,001**
Westernport total 2017–18		17,673	n/a	n/a	n/a	n/a	6,303

Note

(1) The Koo Wee Rup WSPA extends into the East Port Phillip Bay groundwater catchment, and an additional 111 ML of entitlement volume is reported in the East Port Phillip Bay catchment account (Table 7-26). The total entitlement volume for the Koo Wee Rup WSPA as at 30 June 2019 was 12,575 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Westernport – Key compliance points

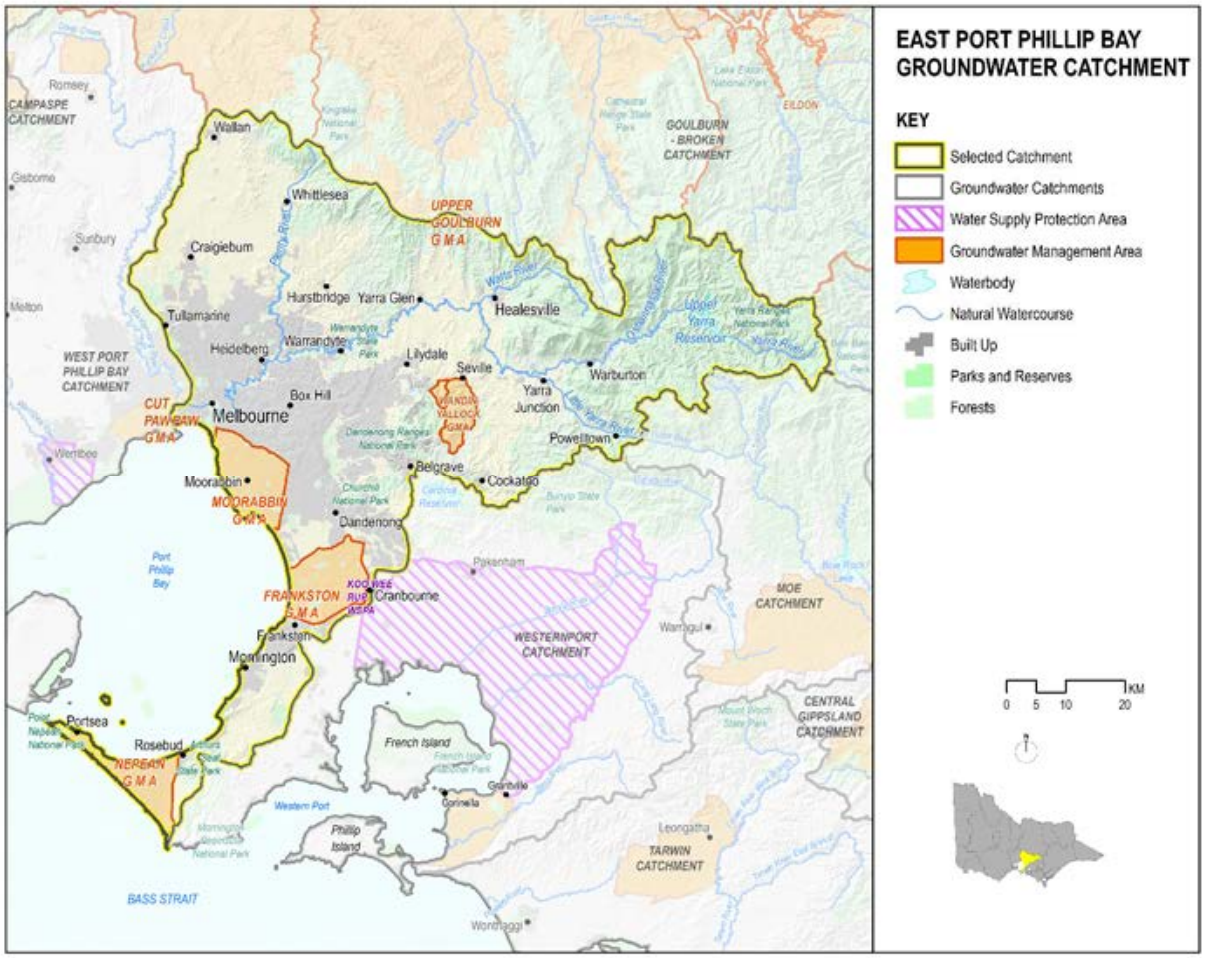
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (6,001 ML) was within the volume available for the year (17,793 ML).**

7.4.3 East Port Phillip Bay groundwater catchment

The East Port Phillip Bay groundwater catchment is located in southern Victoria (Figure 7-13). Neighbouring groundwater catchments are West Port Phillip Bay to the west, Goulburn–Broken to the north and Westernport and Moe to the east.

Figure 7-13 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

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 the Wandin Yallock GMA.

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.

7.4.3.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-25. The trends were declining for all of the GMUs except Nepean GMA, which was categorised as stable for the whole year.

Table 7-25 East Port Phillip Bay groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Koo Wee Rup	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Frankston	Declining	Declining	Declining	**Declining**	**Declining**
Moorabbin	Declining	Declining	Declining	**Declining**	**Stable**
Nepean	Stable	Stable	Stable	**Stable**	**Stable**
Wandin Yallock	Declining	Declining	Declining	**Declining**	**Stable**

In 2018–19, 10,603 ML of water was extracted for consumptive use, which was more than the 10,324 ML extracted in the previous year. Of this volume, 3,416 ML was estimated to have been used for domestic and stock purposes. There are no urban use licences in the East Port Phillip Bay groundwater catchment.

7.4.3.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown 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 7-26.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-26 Licensed groundwater volumes and use in the East Port Phillip Bay groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Frankston GMA	Licensed use (non-urban)	2,212	0	2,212	0	**2,212**	**183**
	Domestic & stock	-	-	-	-	-	**54**
Koo Wee Rup WSPA	Licensed use (non-urban)	111	0	111	0	**111**	**0**
	Domestic & stock	-	-	-	-	-	**0**
Moorabbin GMA	Licensed use (non-urban)	2,624	0	2,624	0	**2,624**	**1,228**
	Domestic & stock	-	-	-	-	-	**254**
Nepean GMA	Licensed use (non-urban)	6,110	0	6,050	0	**6,050**	**2,856**
	Domestic & stock	-	-	-	-	-	**1,579**
Wandin Yallock WSPA	Licensed use (non-urban)	3,025	0	3,025	0	**3,025**	**728**
	Domestic & stock	-	-	-	-	-	**62**
Outside management area	Licensed use (non-urban)	13,916	0	13,946	0	**13,946**	**2,193**
	Domestic & stock	-	-	-	-	-	**1,467**
East Port Phillip Bay total 2018–19		**27,998**	**0**	**27,968**	**0**	**27,968**	**10,603**
East Port Phillip Bay total 2017–18		26,922	n/a	n/a	n/a	n/a	10,324

Notes

(1) The Koo Wee Rup WSPA extends into the Westernport groundwater catchment, and an additional 12,464 ML of entitlement volume is reported in the Westernport catchment account (Table 7-24). The total entitlement volume for the Koo Wee Rup WSPA as at 30 June 2019 was 12,575 ML.

(2) Estimated stock and domestic use in Nepean GMA is calculated using a factor 1 ML per bore.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

East Port Phillip Bay – Key compliance points

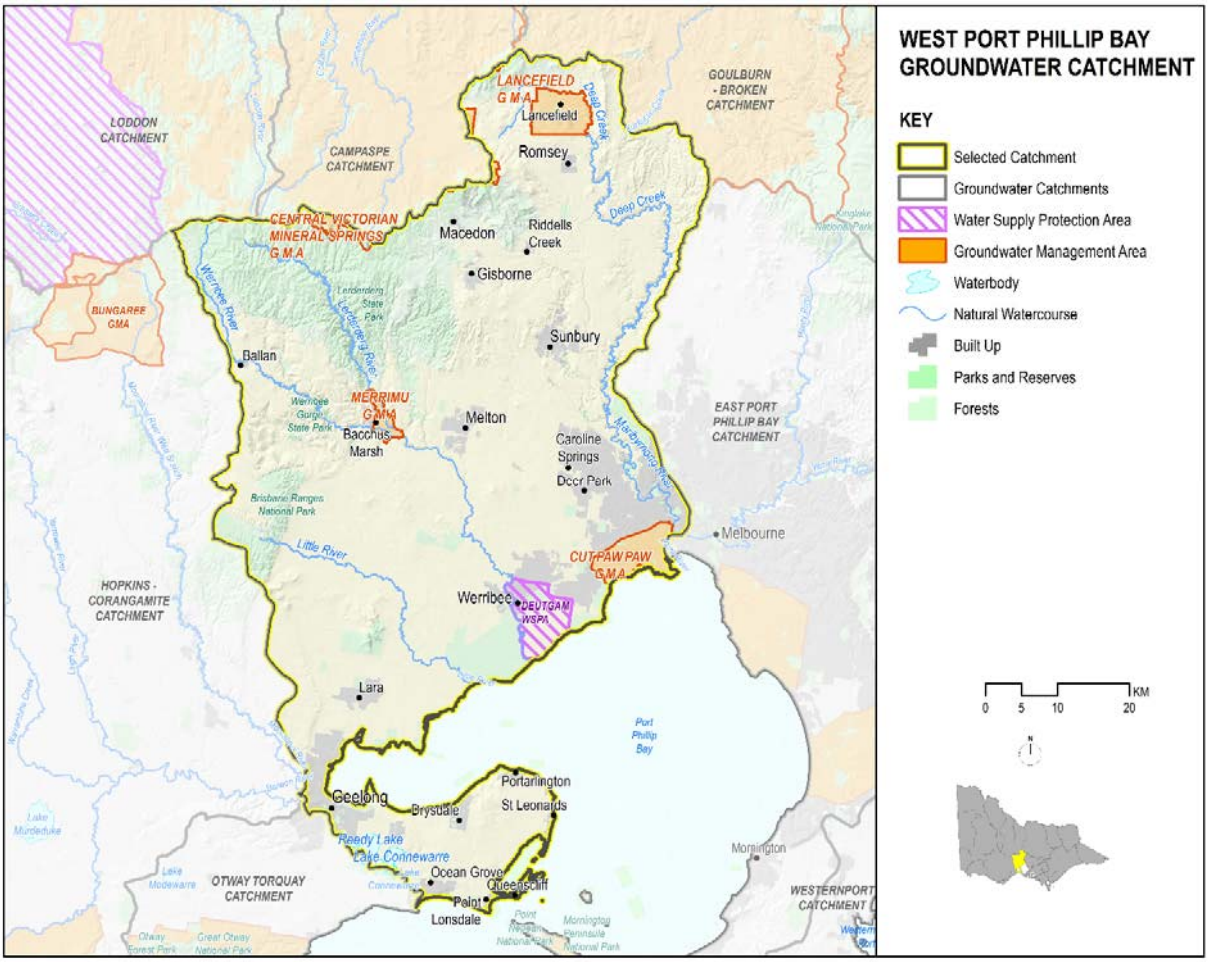
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (10,603 ML) was within the volume available for the year (27,968 ML).**

7.4.4 West Port Phillip Bay groundwater catchment

The West Port Phillip Bay groundwater catchment is located in southern Victoria (Figure 7-14). 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 7-14 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The catchment contains the Cut Paw Paw GMA, Lancefield GMA, Merrimu GMA and Deutgam WSPA. 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.

7.4.4.2 2018–19 groundwater resources overview

Deutgam WSPA had a seasonal allocation of 50% in 2018–19.

Groundwater level trends for 2018–19 are shown in Table 7-27. The trends were categorised between declining and rising. The Deutgam WSPA and Merrimu GMA were categorised as declining for the year and Lancefield had a mostly rising trend throughout the year. Observation bores were not available to determine a trend in the Cut Paw Paw GMA.

Table 7-27 West Port Phillip Bay groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Deutgam	Declining	Declining	Declining	**Declining**	**Declining**
Groundwater management area					
Lancefield	Rising	Rising	Stable	**Rising**	**Stable**
Merrimu	Declining	Declining	Declining	**Declining**	**Stable**

In 2018–19, 4,535 ML of water was extracted for consumptive uses, which was more than the 4,531 ML extracted in the previous year. Of this volume, 58 ML was extracted for urban use and 1,715 ML was estimated to have been used for domestic and stock purposes.

7.4.4.3 Groundwater use and compliance

All groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-28. 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 7-26. Within the West Port Phillip Bay groundwater catchment, groundwater is an urban water supply option for Blackwood, Lancefield and Romsey.

Deutgam WSPA had a seasonal allocation of 50% in 2018–19.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-28 Licensed groundwater volumes and use in the West Port Phillip Bay groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Cut Paw Paw GMA	Licensed use (non-urban)	511	0	511	0	**511**	**0**
	Domestic & stock	-	-	-	-	-	**5**
Deutgam WSPA	Licensed use (non-urban)	5,082	0	2,541	0	**2,541**	**796**
	Domestic & stock	-	-	-	-	-	**53**
Lancefield GMA	Licensed use (non-urban)	1,084	0	1,084	0	**1,084**	**282**
	Lancefield urban	294	0	294	0	**294**	**0**
	Domestic & stock	-	-	-	-	-	**71**
Merrimu GMA	Licensed use (non-urban)	10	0	34	0	**34**	**0**
	Domestic & stock	-	-	-	-	-	**15**
Outside management area	Licensed use (non-urban)	10,462	0	10,621	0	**10,621**	**1,687**
	Blackwood urban	50	0	50	0	**50**	**6**
	Romsey urban	600	0	600	0	**600**	**52**
	Domestic & stock	-	-	-	-	-	**1,571**
West Port Phillip Bay total 2018–19		**18,093**	**0**	**15,734**	**0**	**15,734**	**4,535**
West Port Phillip Bay total 2017–18		17,797	n/a	n/a	n/a	n/a	4,531

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

West Port Phillip Bay – Key compliance points

- ✓ **There was no net increase in the total entitlement volume from the previous year.**
- ✓ **The total volume extracted (4,535 ML) was within the volume available for the year (15,734 ML).**

7.5 Otway–Torquay groundwater management basin

The Otway–Torquay groundwater management 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 management basin and the Wimmera–Mallee groundwater management basin to the north and the Central management basin to the east.

The upper aquifers of the Otway–Torquay groundwater management basin are found extensively across the south-west of the region 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 region, 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.

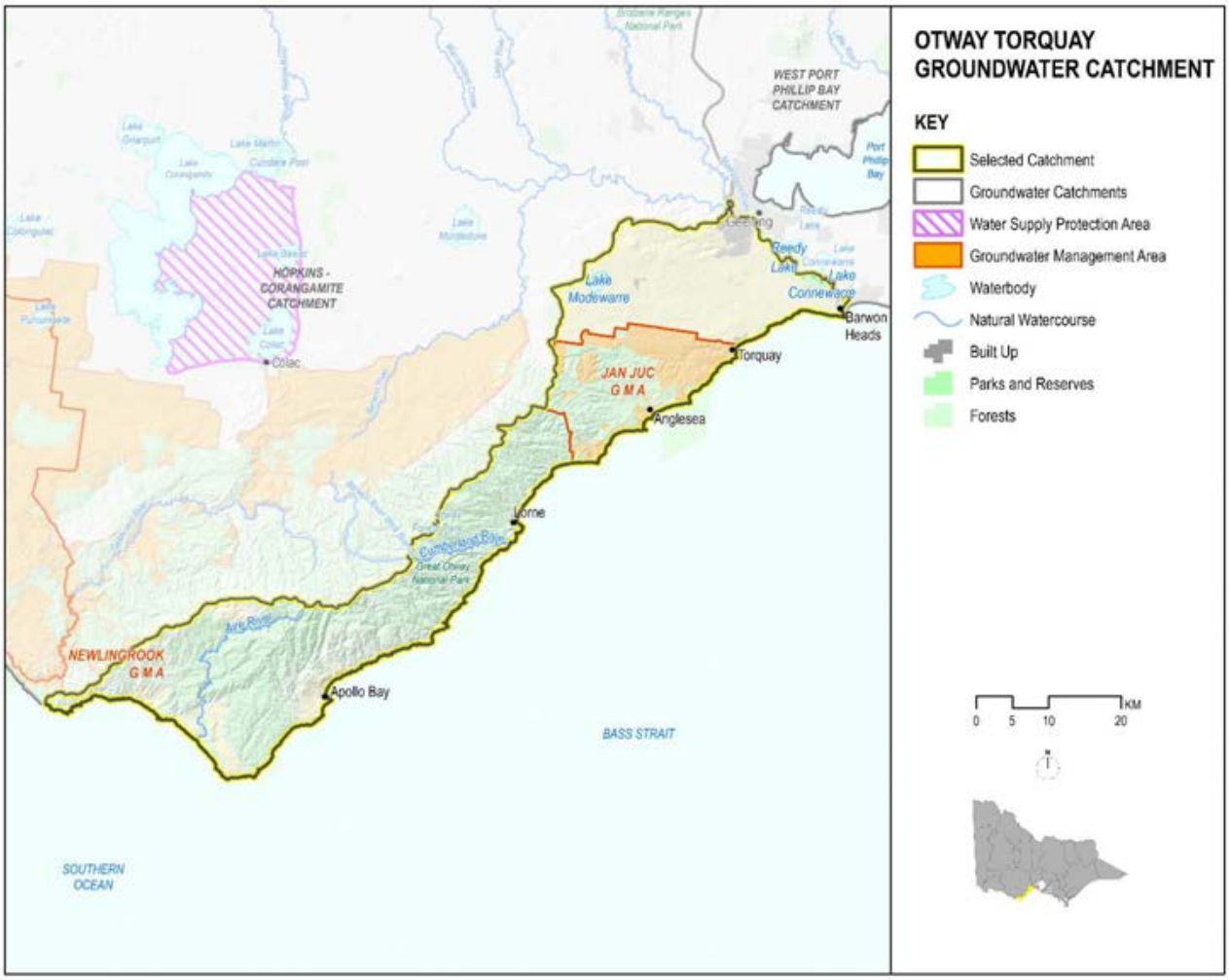
Most of the lower middle aquifer is confined by overlying layers and below by thick marl aquitards; the exception is the region along its northern reaches where it connects to the lower aquifers. The lower middle aquifer relies on upward and downward leakage from adjacent formations for recharge. Discharge 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 management basin, stretching from the South Australian border south of the Grampians across to Port Phillip Bay. In many parts of the management basin, they are overlain by hundreds of metres of sediment, but in the region'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 bedrock comprised mainly of siltstone, which reaches the surface around the management basin margin to form the Grampians, the Otway Ranges and the Central Highlands.

7.5.1 Otway–Torquay groundwater catchment

The Otway–Torquay groundwater catchment (Figure 7-15) is located in the Otway–Torquay groundwater management basin in south-west Victoria. 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 7-15 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Otway–Torquay catchment contains the Jan Juc GMA. Groundwater resources supply licence entitlements and domestic and stock use and Geelong.

7.5.1.2 2018–19 groundwater resources overview

The groundwater level trend for 2018–19 is shown in Table 7-29. The trend for Jan Juc GMA was categorised as rising for the whole of 2018–19.

Table 7-29 Otway–Torquay groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
Jan Juc	Rising	Rising	Rising	**Rising**	**Declining**

In 2018–19, 246 ML of water was extracted for consumptive uses: irrigation and commercial supply. This was more than the 57 ML extracted in the previous year. Of this volume, 46 ML was estimated to have been used for domestic and stock purposes. There was no urban use in 2018–19.

7.5.1.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-30. 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 7-30. In the Otway–Torquay groundwater catchment, groundwater is used for urban water supply for greater Geelong.

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, Anglesea, Torquay and Lorne. No groundwater was extracted under this bulk entitlement in 2018–19.

Barwon Water also holds 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 7-32.

Groundwater use increased slightly in 2018–19, compared to 2017–18.

Table 7-30 Licensed groundwater volumes and use in the Otway–Torquay groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Jan Juc GMA	Licensed use (non-urban)	4,250	0	4,250	0	**4,250**	**201**
	Greater Geelong (Anglesea Bore Field) urban (1)	10,000	0	10,000	0	**10,000**	**0**
	Domestic & stock	-	-	-	-	-	**5**
Outside management area	Licensed use (non-urban)	153	0	160	0	**160**	
	Domestic & stock	-	-	-	-	-	**41**
Otway–Torquay total 2018–19		**14,403**	**0**	**14,410**	**0**	**14,410**	**246**
Otway–Torquay total 2017–18		14,345	n/a	n/a	n/a	n/a	57

Note

(1) Greater Geelong is supplied under a bulk entitlement, which applies to Zone 2 Lower Eastern View formation. The volume is based on a five-year total of 35,000 ML with a maximum annual extraction of 10,000 ML. The only use in the last eight years was 4,019 ML in 2011–12; each year since then, no use has been recorded.

Compliance against water entitlements is reported in this groundwater catchment in three areas:

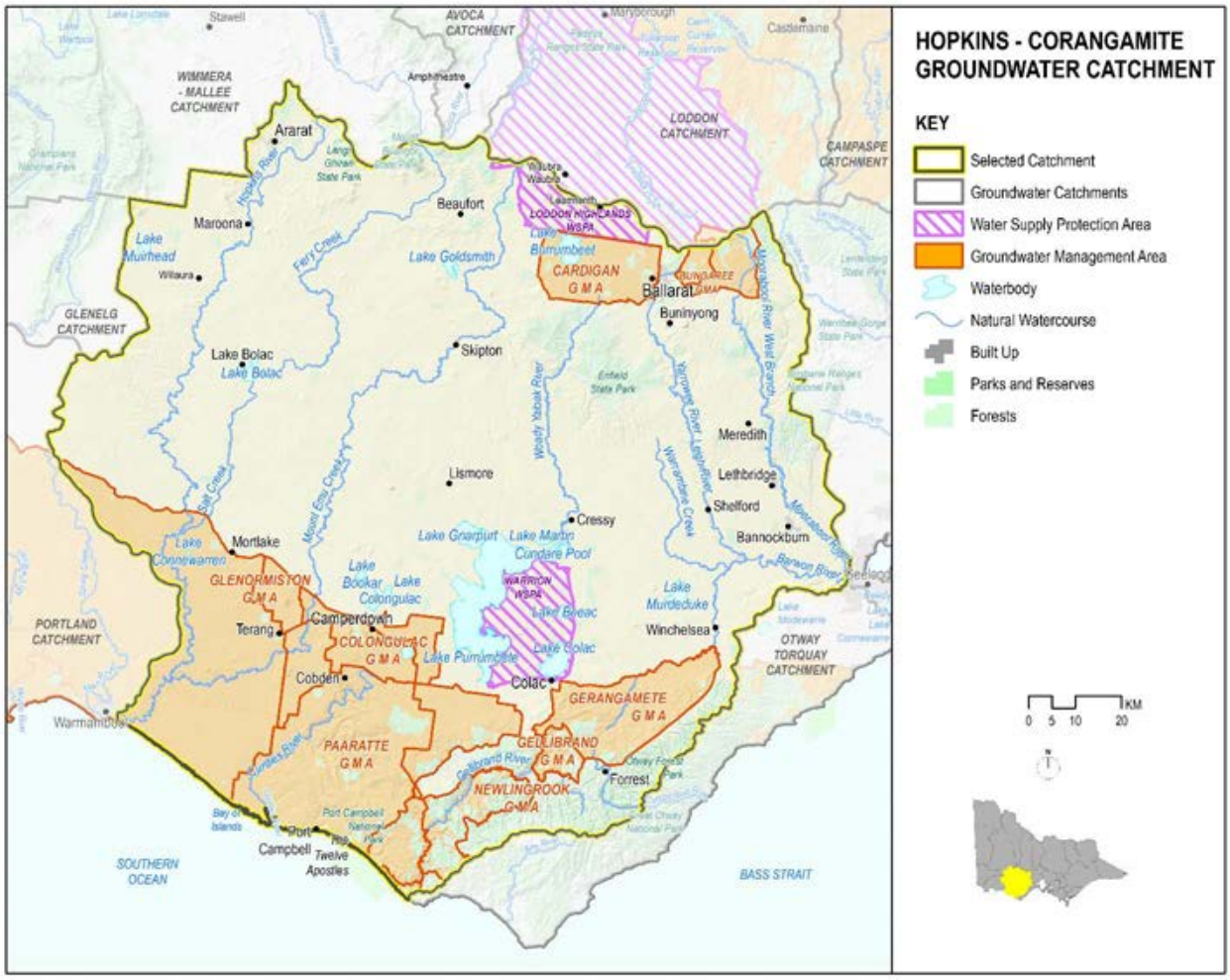
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year
- **bulk entitlement provisions:** holders of entitlements do not breach any provisions that are documented in their bulk entitlement orders.

Otway–Torquay – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (246 ML) was within the volume available for the year (14,410 ML).**
✓ **No individual bulk entitlement holder took more than the annual volume made available to them.**
✓ **Individual bulk entitlement holders complied with all provisions in their entitlements.**

7.5.2 Hopkins–Corangamite groundwater catchment

The Hopkins–Corangamite groundwater catchment (Figure 7-16) is located in the Otway–Torquay groundwater management 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 7-16 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Hopkins–Corangamite groundwater catchment contains the Cardigan GMA, Colongulac GMA, Gellibrand GMA, Gerangamete GMA, Glenormiston GMA, Newlingrook GMA, Paaratte GMA and Warrion WSPA. Bungaree GMA (which had its WSPA status revoked by the Minister for Water in December 2016) is also located in this groundwater catchment. The South West Limestone GMA is partly within the Hopkins–Corangamite 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.

7.5.2.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-31. The trends were generally categorised as stable for the majority of the year. The Warrion WSPA had a rising trend for the beginning of the year, the Bungaree and Gerangamete GMAs ended the year with a declining trend and the South West Limestone GMA was declining for most of the year.

Table 7-31 Hopkins–Corangamite groundwater level trends

Groundwater management unit [1]	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Warrion	Rising	Rising	Stable	**Stable**	**Rising**
Groundwater management area					
Bungaree	Stable	Stable	Declining	**Declining**	**Declining**
Cardigan	Stable	Stable	Declining	**Stable**	**Stable**
Colongulac	Stable	Stable	Stable	**Stable**	**Rising**
Gellibrand	Stable	Stable	Stable	**Stable**	**Stable**
Gerangamete	Rising	Rising	Declining	**Declining**	**Stable**
Newlingrook	Stable	Stable	Stable	**Stable**	**Stable**
Paaratte	Stable	Stable	Stable	**Stable**	**Stable**
Southwest Limestone [2]	Declining	Declining	Declining	**Stable**	**Declining**

Notes

(1) There are insufficient state observation bores in the Glenormiston GMA to adequately define the groundwater resource or changes to the resource over time.

(2) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2018–19, 33,549 ML of water was extracted for consumptive use, which was less than the 35,533 ML extracted in the previous year. Of this volume, 1,105 ML was extracted for urban use and 2,622 ML was estimated to have been used for domestic and stock purposes.

7.5.2.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown 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 use in Table 7-32. In the Hopkins–Corangamite groundwater catchment, groundwater provides urban water supply to Beaufort, Caramut, Darlington, Dean, Mortlake, Port Campbell, Timboon, Peterborough, Curdie Vale, Streatham, areas around Carlisle, Ballarat and Geelong.

Groundwater use decreased slightly in 2018–19, compared to 2017–18.

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 7-30.

GWMWater provide urban groundwater supply to Willaura. Although Willaura is located in the Hopkins–Corangamite groundwater catchment, the bores that supply the town are located in Mafeking in the Wimmera–Mallee groundwater catchment and are therefore reported in that chapter (see chapter 7.6.2).

Table 7-32 Licensed groundwater volumes and use in the Hopkins–Corangamite groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Bungaree GMA	Licensed use (non-urban)	5,194	-	5,194	0	**5,194**	**3,172**
	Ballarat supply urban	69	-	69	0	**69**	**64**
	Dean urban	30	-	30	0	**30**	**10**
	Domestic & stock	-	-	-	-	-	**174**
Cardigan GMA	Licensed use (non-urban)	889	-	892	0	**892**	**404**
	Ballarat urban [1]	3,000	-	2,997	0	**2,997**	**522**
	Domestic & stock	-	-	-	-	-	**98**
Colongulac GMA	Licensed use (non-urban)	4,404	-	4,406	0	**4,406**	**1,576**
	Domestic & stock	-	-	-	-	-	**104**
Gerangamete GMA	Licensed use (non-urban)	238	-	238	0	**238**	**121**
	Greater Geelong (Sourced from Barwon Downs Bore Field) urban [2]	20,000	-	20,000	0	**20,000**	**0**
	Domestic & stock	-	-	-	-	-	**5**
Glenormiston GMA	Licensed use (non-urban)	2,636	-	2,636	0	**2,636**	**1,211**
	Domestic & stock	-	-	-	-	-	**65**
Loddon Highlands WSPA	Licensed use (non-urban)	2	-	0	2	**2**	**0**
	Domestic & stock [3]	-	-	-	-	-	**112**
Newlingrook GMA	Licensed use (non-urban)	158	-	158	0	**158**	**15**
	Otway system (Carlisle) urban	1,800	-	1,800	0	**1,800**	**39**
	Domestic & stock	-	-	-	-	-	**2**
Paaratte GMA	Licensed use (non-urban)	53	-	53	0	**53**	**0**

	Port Campbell, Timboon, Peterborough & Curdie Vale urban	3,159	-	3,159	0	**3,159**	**339**
	Domestic & stock	-	-	-	-	-	**2**
South West Limestone GMA (4)	Licensed use (non-urban)	27,378	7,540	27,328	()	**34,868**	**15,867**
	Domestic & stock	-	-	-	-	-	**933**
Warrion WSPA	Licensed use (non-urban)	14,075	-	14,079	0	**14,079**	**3,854**
	Domestic & stock	-	-	-	-	-	**188**
Outside management area	Licensed use (non-urban)	11,419	-	11,455	0	**11,455**	**3,607**
	Beaufort urban	200	-	200	0	**200**	**68**
	Darlington urban	10	-	10	0	**10**	**4**
	Mortlake (part) urban	335	-	335	0	**335**	**23**
	Streatham urban	60	-	60	0	**60**	**36**
	Domestic & stock	-	-	-	-	-	**939**
Hopkins–Corangamite total 2018–19		**95,110**	**7,540**	**95,099**	**2**	**102,641**	**33,549**
Hopkins–Corangamite total 2017–18		95,148	n/a	n/a	n/a	n/a	35,533

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) This entitlement is held by Barwon Water and has the following limits: 20,000 ML in one year, 80,000 ML over ten years and 400,000 ML over 100 years. The entitlement limit in Table 7-32 represents the single-year limit, but compliance is also assessed at the 10-year and 100-year levels.

(3) Estimated domestic and stock use for Loddon Highlands WSPA is calculated using a factor of 2 ML per bore.

(4) The South West Limestone GMA extends into both the Portland and Glenelg groundwater catchments, and an additional 36,647 ML and 17,169 ML of entitlement volume is reported in the Portland and Glenelg catchment accounts respectively (Table 7-34 and Table 7-36). The total entitlement volume for the South West Limestone GMA as at 30 June 2019 was 81,194 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Hopkins–Corangamite – Key compliance points

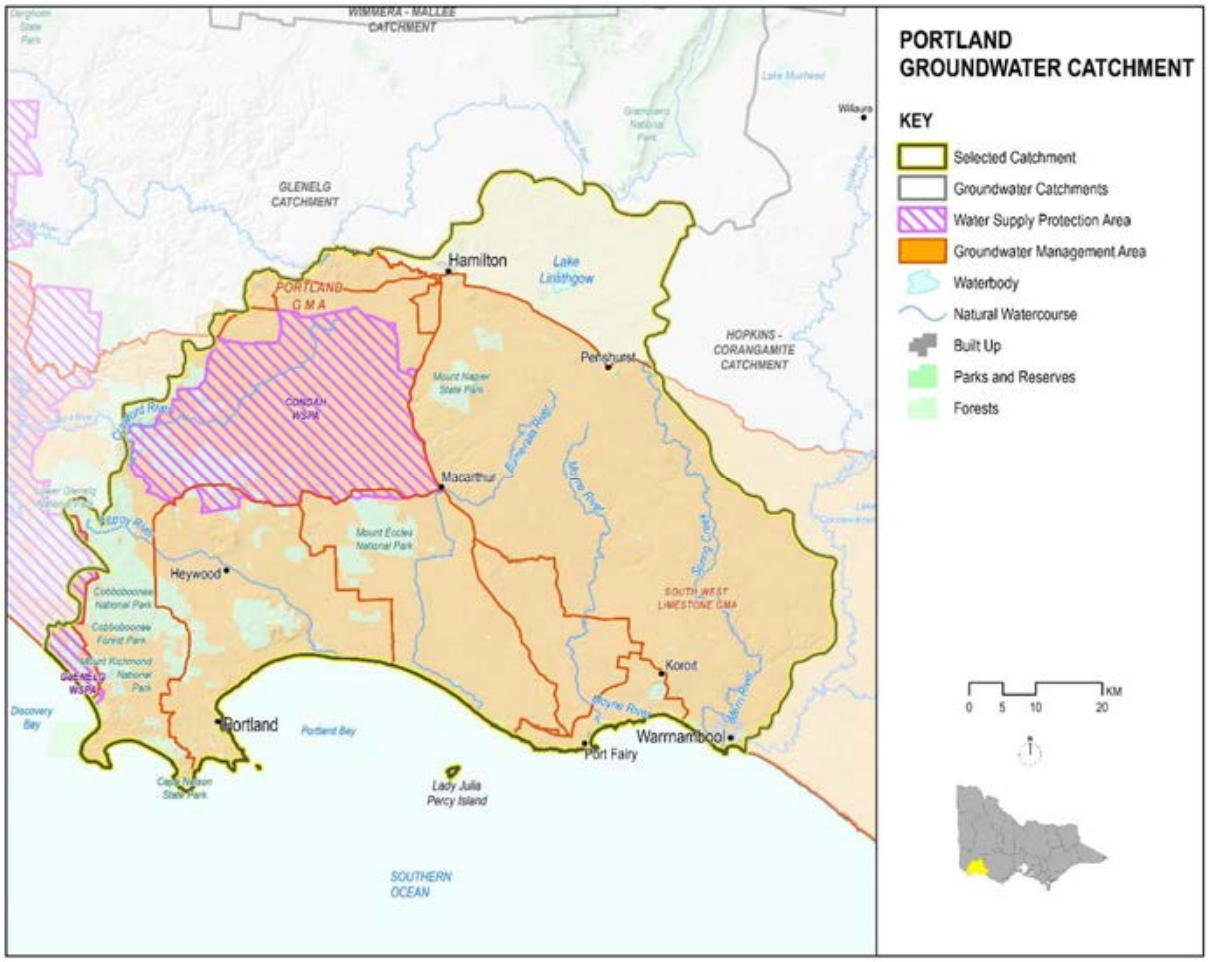
✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (33,549 ML) was within the volume available for the year (102,641 ML).**

7.5.3 Portland groundwater catchment

The Portland groundwater catchment (Figure 7-17) is located in the Otway–Torquay groundwater management basin in south-western Victoria. Neighbouring groundwater catchments are Glenelg to the west and Hopkins–Corangamite to the east.

Figure 7-17 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use.

The Portland groundwater catchment contains the Condah WSPA, Portland GMA, a portion of the South West Limestone GMA and a small part of the Glenelg WSPA. 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.

7.5.3.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-33. The trends were categorised as declining in the Portland GMA for the year, and they were mostly declining in the South West Limestone GMA and Condah WSPA.

Table 7-33 Portland groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Condah	Declining	Declining	Stable	**Stable**	**Stable**
Groundwater management area					
Portland	Declining	Declining	Declining	**Declining**	**Declining**
South West Limestone (1)	Declining	Declining	Declining	**Stable**	**Declining**

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2018–19, 25,204 ML of water was extracted for consumptive use, which was less than the 26,181 ML extracted in the previous year. Of this volume, 3,136 ML was extracted for urban use and 2,595 ML was estimated to have been used for domestic and stock purposes.

7.5.3.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-34. 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. Groundwater is used as an urban water supply for some towns in the Portland groundwater catchment.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-34 Licensed groundwater volumes and use in the Portland groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Condah WSPA	Licensed use (non-urban)	7,340	0	7,340	0	**7,340**	**3,453**
	Macarthur urban	130	0	130	0	**130**	**25**
	Domestic & stock	-	-	-	-	-	**107**
Portland GMA	Licensed use (non-urban)	213	0	213	0	**213**	**0**
	Heywood urban	333	0	333	0	**333**	**179**
	Port Fairy urban	1,026	0	1,026	0	**1,026**	**615**
	Portland urban	6,222	0	6,222	0	**6,222**	**1,767**
	Domestic & stock	-	-	-	-	-	**2**
South West Limestone GMA	Licensed use (non-urban)	35,373	10,585	36,469	0	**47,054**	**15,197**
	Koroit urban	524	157	524	0	**681**	**0**
	Warrnambool, Allansford and Koroit (part) urban	750	225	750	0	**975**	**427**
	Domestic & stock	-	-	-	-	-	**2,412**
Outside management area	Licensed use (non-urban)	3,917	0	3,919	0	**3,919**	**824**
	Caramut urban	50	0	50	0	**50**	**35**
	Penshurst urban	250	0	250	0	**250**	**88**
	Domestic & stock	-	-	-	-	-	**74**
Portland total 2018–19		**56,128**	**10,967**	**57,226**	**0**	**68,193**	**25,204**
Portland total 2017–18		57,388	n/a	n/a	n/a	n/a	26,181

Note

(1) The South West Limestone GMA extends into both the Hopkins–Corangamite and Glenelg groundwater catchments, and an additional 27,378 ML and 17,169 ML of entitlement volume is reported in the Hopkins–Corangamite and Glenelg catchment accounts respectively (Table 7-32 and Table 7-36). The total entitlement volume for the South West Limestone GMA as at 30 June 2019 was 81,194 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

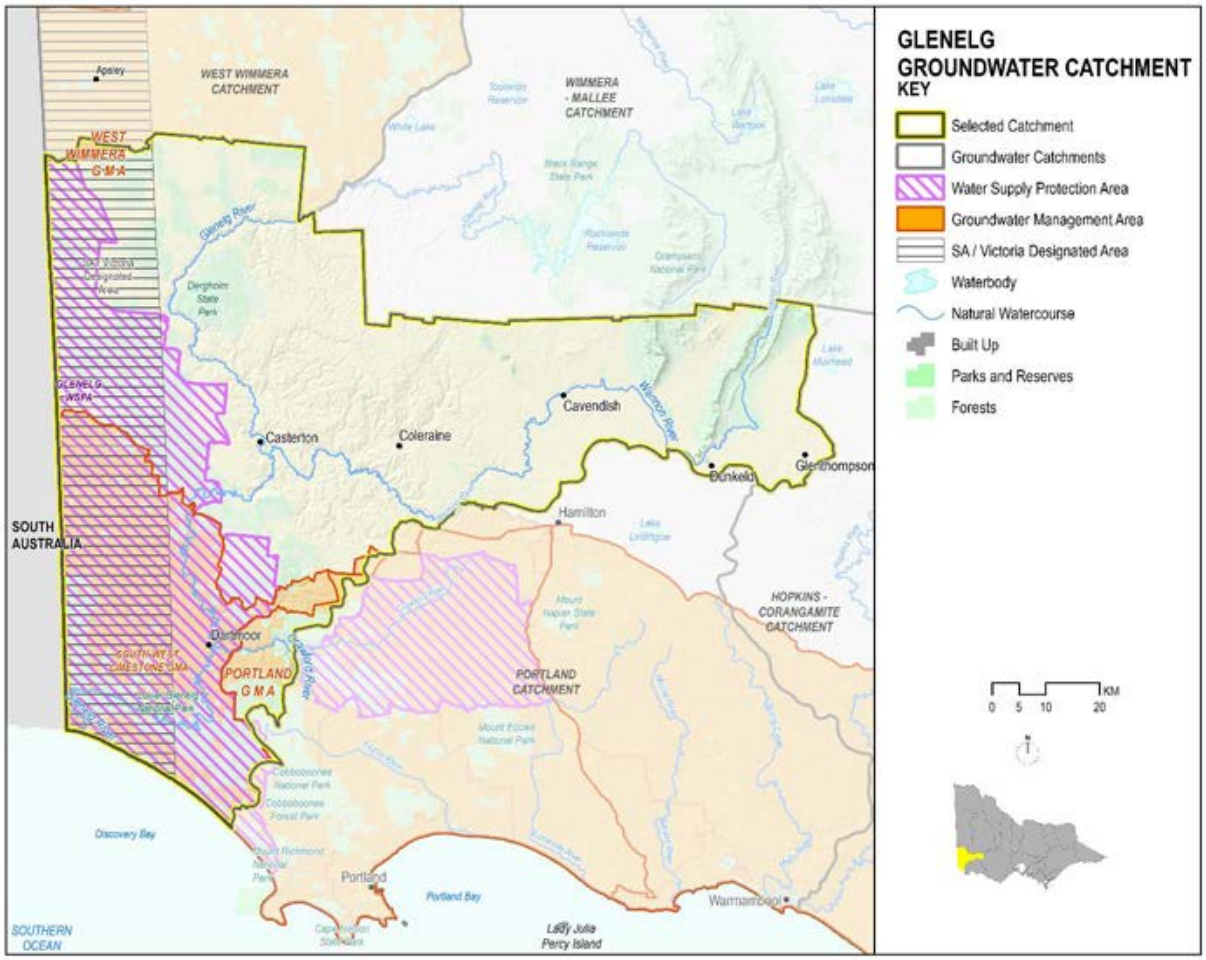
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Portland – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (25,204 ML) was within the volume available for the year (68,193 ML).**

7.5.4 Glenelg groundwater catchment

The Glenelg groundwater catchment (Figure 7-18) is located in the Otway–Torquay groundwater basin in western Victoria. 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 Portland to the south-east, Hopkins–Corangamite to the east and West Wimmera and Wimmera–Mallee to the north.

Figure 7-18 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 also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. 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, the South West Limestone GMA and a very small part of the Portland GMA (which is mostly within the Portland groundwater catchment). Groundwater resources supply licence entitlements, domestic and stock use and Casterton, Dartmoor and Merino.

7.5.4.2 2018–19 groundwater resources overview

Groundwater level trends for 2018–19 are shown in Table 7-35. The trends were categorised as mostly declining throughout the year for the South West Limestone GMA and the Glenelg WSPA. Both GMUs ended the year with a stable trend.

Table 7-35 Glenelg groundwater level trends in the Glenelg groundwater catchment

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Water supply protection area					
Glenelg	Declining	Declining	Stable	**Stable**	**Stable**
Groundwater management area					
South West Limestone (1)	Declining	Declining	Declining	**Stable**	**Declining**

Note
(1) The South West Limestone GMA is partly contained within the Hopkins–Corangamite, Portland and Glenelg groundwater catchments.

In 2018–19, 11,466 ML of water was extracted for consumptive use, which was more than the 10,794 ML extracted in the previous year. Of this volume, 439 ML was extracted for urban use and 684 ML was estimated to have been used for domestic and stock purposes.

7.5.4.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-36. 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 7-36. Groundwater is available for urban water supply to Casterton, Dartmoor and Merino.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-36 Licensed groundwater volumes and use in the Glenelg groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Glenelg WSPA	Licensed use (non-urban)	14,942	0	16,110	0	**16,110**	**5,483**
	Casterton urban	1,000	0	1,000	0	**1,000**	**417**
	Dartmoor urban	150	0	150	0	**150**	**22**
	Domestic & stock	-	-	-	-	-	**492**
South West Limestone GMA	Licensed use (non-urban)	17,169	4,708	16,125	0	**20,833**	**4,790**
	Domestic & stock	-	-	-	-	-	**27**
Outside management area	Licensed use (non-urban)	909	0	909	0	**909**	**69**
	Hamilton Tarrington Dunkeld urban	1,102	0	1,102	0	**1,102**	**0**
	Merino urban	0	0	100	0	**100**	**0**
	Domestic & stock	-	-	-	-	-	**165**
Glenelg total 2018–19		**35,272**	**4,708**	**35,496**	**0**	**40,204**	**11,466**
Glenelg total 2017–18		34,329	n/a	n/a	n/a	n/a	10,794

Note

(1) The South West Limestone GMA extends into both the Hopkins–Corangamite and Portland groundwater catchments, and an additional 27,378 ML and 36,647 ML of entitlement volume is reported in the Hopkins–Corangamite and Portland catchment accounts respectively (Table 7-32 and Table 7-34). The total entitlement volume for the South West Limestone GMA as at 30 June 2019 was 81,194 ML.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Glenelg – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (11,466 ML) was within the volume available for the year (40,204 ML).**

7.6 Wimmera–Mallee groundwater management basin

The Wimmera–Mallee groundwater management basins located in north-western Victoria. It borders the Otway–Torquay groundwater management basin to the south and the Goulburn–Murray groundwater management basin to the east. The Wimmera–Mallee groundwater management 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 management 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 management 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.

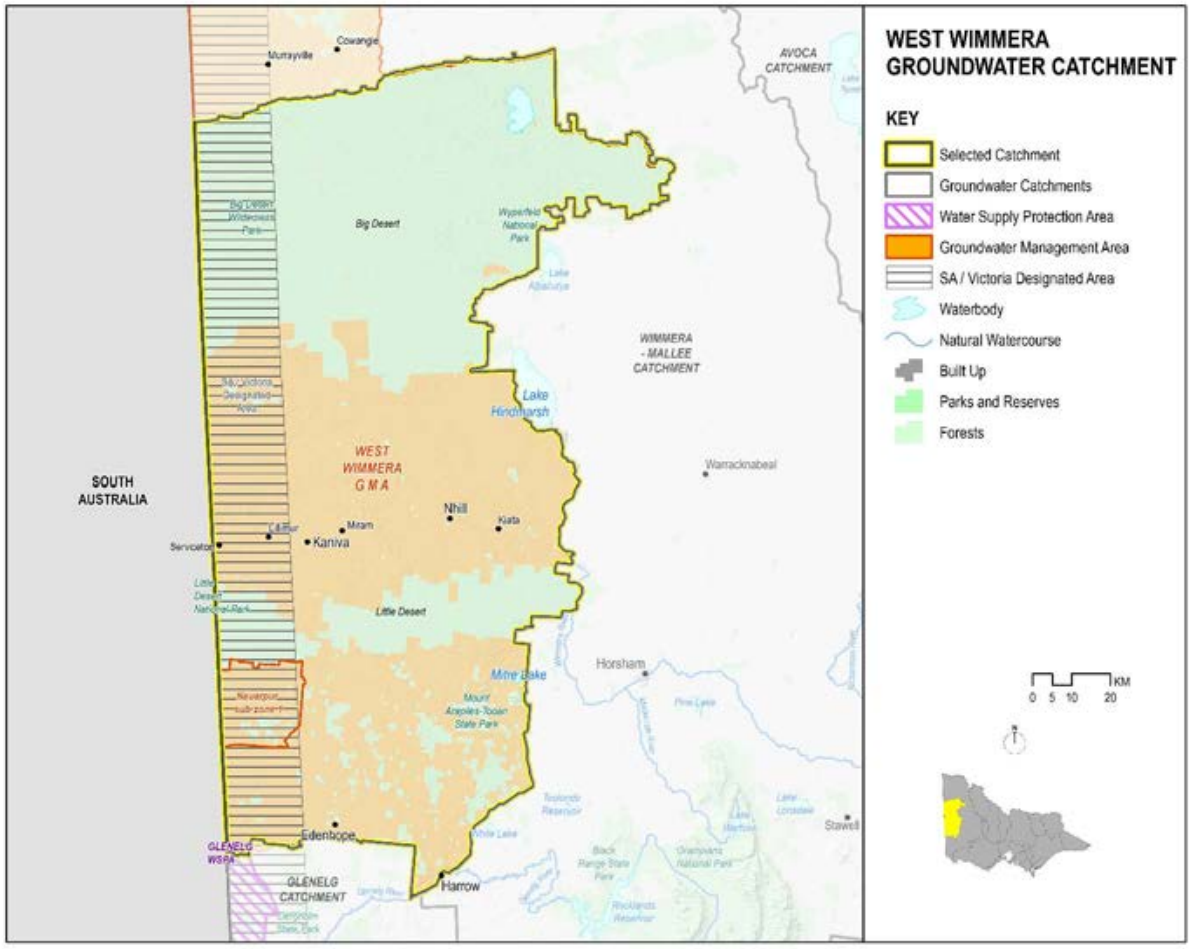
In most areas, all the aquifers are considered to be connected, with thin aquitards between the aquifers in part or all of the catchment. The Renmark Group Aquifer in the West Wimmera GMA is the exception: it is considered to be disconnected from the water above it.

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.

7.6.1 West Wimmera groundwater catchment

The West Wimmera groundwater catchment (Figure 7-19) is located in western Victoria. 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 Wimmera–Mallee to the east and north and Glenelg to the south.

Figure 7-19 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 licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. 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. Groundwater resources are used for irrigation, domestic and stock water and to supply the townships of Apsley, Harrow, Miram, Serviceton, Edenhope, Kiata, Goroke, Lillimur, Kaniva and Nhill.

7.6.1.2 2018–19 groundwater resources overview

In the West Wimmera groundwater catchment, licence holders in the Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% of their licence volume.

Groundwater level trends for 2018–19 are shown in Table 7-37. Although trends in the West Wimmera GMA were categorised as stable for most of the year, levels in the Neuarpur subzone 1 (in the western part of the catchment) have historically been declining.

Table 7-37 West Wimmera groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
West Wimmera	Stable	Stable	Stable	**Declining**	**Stable**
West Wimmera – Neuarpur subzone 1 (1)	Declining	Declining	Declining	**Declining**	**Declining**

Note
(1) Restrictions on seasonal allocations are in place to address the trend deviation in the Neuarpur subzone in the West Wimmera GMA.

In 2018–19, 27,470 ML of water was extracted for consumptive purposes, less than the 28,558 ML extracted in the previous year. Of this volume, 567 ML was extracted for urban use and 748 ML was estimated to have been used for domestic and stock purposes.

7.6.1.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-38. 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 7-38. Groundwater is available for urban water supply to Apsley, Edenhope, Goroke, Harrow, Kaniva, Kiata, Lillimur, Miram, Nhill and Serviceton.

In line with the West Wimmera GMA strategy (which assists with managing the declining levels in the western part of the West Wimmera groundwater catchment), an 80% seasonal allocation remained in place in the Neuarpur subzone 1 — a trading zone in the West Wimmera GMA — in 2018–18.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-38 Licensed groundwater volumes and use in the West Wimmera groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
West Wimmera GMA	Licensed use (non-urban)	51,458	10,184	47,345	10	**57,539**	**26,156**
	Apsley urban	40	12	40	0	**52**	**25**
	Edenhope urban	250	75	250	0	**325**	**142**
	Goroke urban	86	26	86	(10)	**102**	**61**
	Harrow urban	60	14	60	0	**74**	**47**
	Kaniva urban	600	180	600	0	**780**	**153**
	Kiata urban	40	12	40	0	**52**	**6**
	Lillimur urban	32	10	32	0	**42**	**6**
	Miram urban	7	2	7	0	**9**	**1**
	Nhill urban	1,000	300	1,000	0	**1,300**	**117**
	Serviceton urban	25	8	25	0	**33**	**9**
	Domestic & stock	-	-	-	-	-	**746**
Outside management area	Domestic & stock	-	-	-	-	-	**2**
West Wimmera total 2018–19		**53,598**	**10,821**	**49,485**		**60,306**	**27,470**
West Wimmera total 2017–18		53,603	n/a	n/a	n/a	n/a	28,558

Compliance against water entitlements is reported in this groundwater catchment in two areas:

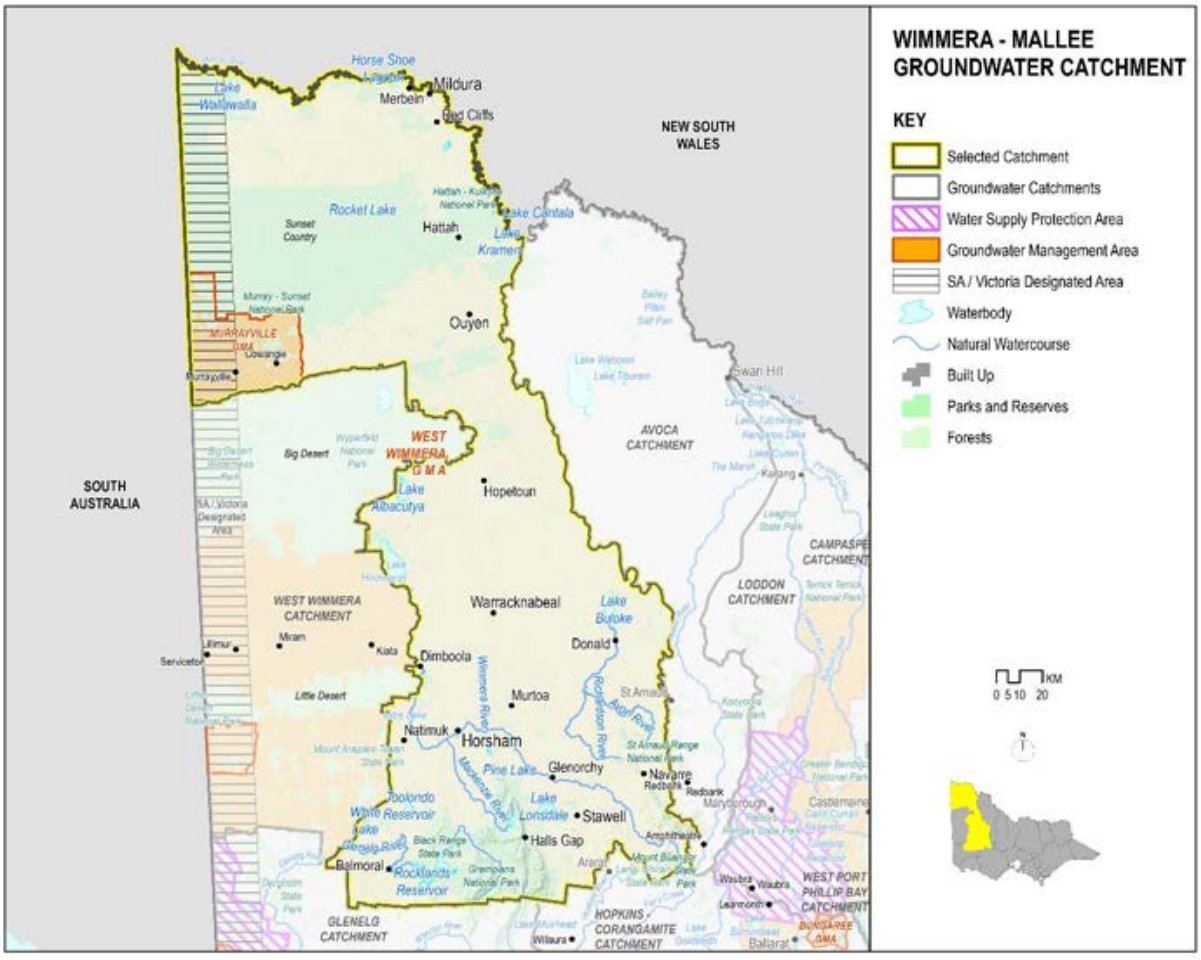
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

West Wimmera – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (27,470 ML) was within the volume available for the year (60,306 ML).**

7.6.2 Wimmera–Mallee groundwater catchment

The Wimmera–Mallee groundwater catchment (Figure 7-20) is located in north-western Victoria. Neighbouring groundwater catchments are West Wimmera to the west, Avoca to the east and Glenelg and Hopkins–Corangamite to the south.

Figure 7-20 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, bore construction and surface water diversions, and it administers domestic and stock use. 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 GMA.

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.

7.6.2.2 2018–19 groundwater resources overview

The groundwater level trend for 2018–19 is shown in Table 7-39. In 2018–19, the trend in the Murrayville GMA was categorised as stable.

Table 7-39 Wimmera-Mallee groundwater level trends

Groundwater management unit	Groundwater level trend 2018–19				Groundwater level trend June 2018
	Sep-18	Dec-18	Mar-19	Jun-19	
Groundwater management area					
Murrayville	Stable	Stable	Stable	**Stable**	**Stable**

In 2018–19, 7,176 ML of water was extracted for consumptive use, which was less than the 9,464 ML extracted in the previous year. Of this volume, 364 ML was extracted for urban use and 380 ML was estimated to have been used for domestic and stock purposes.

7.6.2.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown 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 7-40. Groundwater is used for urban water supply to Cowangie, Horsham, Landsborough, Murrayville and Willaura.

Groundwater use decreased in 2018–19, compared to 2017–18.

Table 7-40 Licensed groundwater volumes and use in the Wimmera–Mallee groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Murrayville WSPA	Licensed use (non-urban)	9,240	1,083	9,061	0	**10,144**	**6,229**
	Cowangie urban	40	12	40	0	**52**	**3**
	Murrayville urban	475	143	475	0	**618**	**135**
	Domestic & stock	-	-	-	-	-	**84**
Outside management area	Licensed use (non-urban)	5,095	0	5,095	0	**5,095**	**202**
	Horsham Mt Zero urban	1,200	0	1,200	0	**1,200**	**22**
	Landsborough urban	150	0	150	0	**150**	**46**
	Willaura urban	220	0	220	0	**220**	**158**
	Domestic & stock	-	-	-	-	-	**296**
Wimmera–Mallee total 2018–19		**16,420**	**1,237**	**16,241**	**0**	**17,478**	**7,176**
Wimmera–Mallee total 2017–18		16,305	n/a	n/a	n/a	n/a	9,464

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 at Mafeking.

Compliance against water entitlements is reported in this groundwater catchment in two areas:

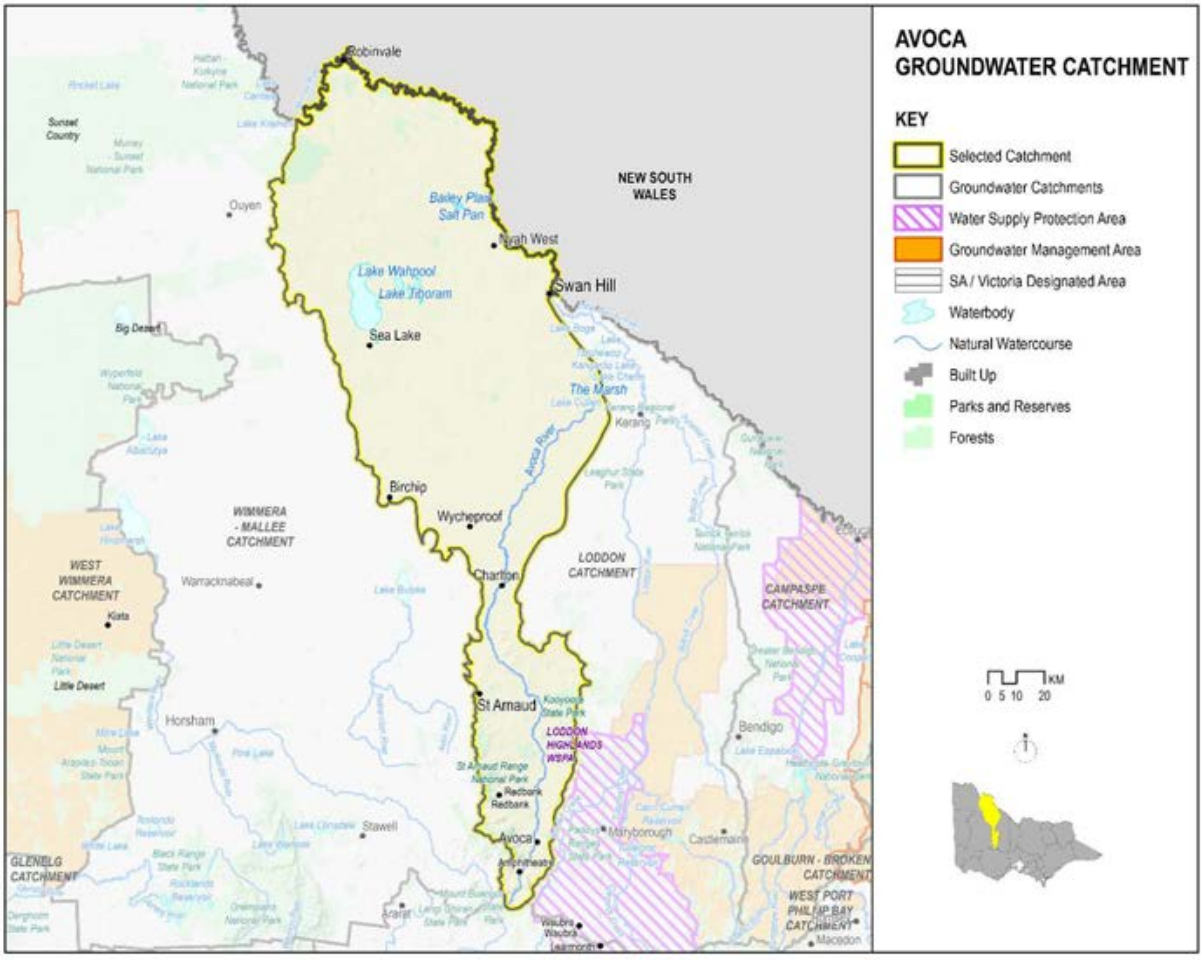
- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Wimmera–Mallee – Key compliance points
✓ **There was no net increase in the total entitlement volume from the previous year.**
✓ **The total volume extracted (7,176 ML) was within the volume available for the year (17,478 ML).**

7.6.3 Avoca groundwater catchment

The Avoca groundwater catchment is in north-western Victoria (Figure 7-21). Neighbouring groundwater catchments are Wimmera–Mallee to the west and Loddon to the east.

Figure 7-21 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. GWMWater also issues licences for groundwater use, bore construction and surface water diversions, and it administers domestic and stock use. Central Highlands Water also 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 does not contain any GMAs or WSPAs.

7.6.3.2 2018–19 groundwater resources overview

In 2018–19, 1,751 ML of water was extracted for consumptive uses, which was more than the 1,485 ML extracted in the previous year. Of this volume, 9 ML was extracted for urban use and 62 ML was estimated to have been used for domestic and stock purposes.

7.6.3.3 Groundwater use and compliance

Groundwater extracted for consumptive use in 2018–19 from GMUs is shown in Table 7-41. 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 7-41. Groundwater is used to provide urban water supply to three towns in the Avoca groundwater catchment.

Groundwater use increased in 2018–19, compared to 2017–18.

Table 7-41 Licensed groundwater volumes and use in the Avoca groundwater catchment

Groundwater management unit	Use type	Licensed entitlement (ML/year)	Carryover	Licensed volume allocated	Net trade	Total water available	Water extracted
Outside management area	Licensed use (non-urban)	2,655	0	2,655	0	**2,655**	**1,679**
	Amphitheatre urban	20	0	20	0	**20**	**5**
	Redbank urban	50	0	50	0	**50**	**4**
	Domestic and stock use	-	-	-	-	-	**62**
Avoca total 2018–19		**2,725**	**0**	**2,725**	**0**	**2,725**	**1,751**
Avoca total 2017–18		2,572	n/a	n/a	n/a	n/a	1,485

Compliance against water entitlements is reported in this groundwater catchment in two areas:

- **entitlement issued:** the volume of entitlements issued in a basin does not exceed formal caps or has not increased without appropriate approvals
- **water taken:** the volume of water taken during the year does not exceed the volume considered to be available for consumptive and/or in-stream use during that year.

Avoca – Key compliance points

✓ **There was no net increase in the total entitlement volume from the previous year.**

✓ **The total volume extracted (1,751 ML) was within the volume available for the year (2,725 ML).**

Abbreviations

Abbreviation	Term
CEWH	Commonwealth Environmental Water Holder
CMA	catchment management authority
DELWP	Department of Environment, Land, Water and Planning
EPA	Environment Protection Authority Victoria
FFG Act	*Flora and Fauna Guarantee Act 1988*
GL	gigalitre
GMA	groundwater management area
GMU	groundwater management unit
GMW	Goulburn Murray Water
GVW	Goulburn Valley Water
IOD	Indian Ocean Dipole
LTA	long-term average
LTWRA	*Long-Term Water Resource Assessment for Southern Victoria*
MDBA	Murray–Darling Basin Authority
ML	megalitre
NVIRP	Northern Victoria Irrigation Renewal Project
PCV	permissible consumptive volume
PWSR	permanent water-saving rule
REALM	REsource ALlocation Model
RMIF	Victorian River Murray Increased Flows
SDL	sustainable diversion limit
SFMP	streamflow management plan
SRW	Southern Rural Water
SWS	sustainable water strategy
VDP	Victorian Desalination Project
VEWH	Victorian Environmental Water Holder
VWA	Victorian Water Accounts
WMIS	Water Measurement Information System
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 that holds groundwater and allows water to flow through it.

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 former Australian Water Resource Council. The exception is the Murray basin which, for the purposes of this report, includes the Upper Murray basin as defined by the former council and areas in Victoria supplied from the Murray River below Lake Hume. See also 'River basin'.

Bulk entitlement: An entitlement to water held by water corporations and other authorities as defined in the *Water Act 1989*. A bulk entitlement defines the amount of water from a river or storage to which the holder is entitled, and it may include the rate at which it may be taken and the reliability of the entitlement. Appendix D lists the bulk entitlement holders for the year of these accounts.

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: Allocation unused at the end of one season that can rightfully be carried over 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 authority (CMA): A statutory body established under the *Catchment and Land Protection Act 1994* responsible under that Act and under the *Water Act 1989* for river health, regional and catchment planning and coordination, and waterway, floodplain, salinity and water quality management.

Declared system: A water system that has been declared under section 6A of the *Water Act 1989*. Water rights and take and use licences in declared water systems have been converted into unbundled entitlements.

Delivery share: An entitlement to have water delivered to land. It gives access to a share of the available capacity in a channel or piped network that supplies water to a property. A delivery share is tied to the land and stays with the property if it is bought or sold. It also stays with the property if the water share is sold separately.

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: The surroundings in which an organisation operates including the air, water, land, natural resources, plants, humans and other animals — and their interdependence.

Environment entitlement: A right to water granted to the VEWH to improve the environmental values and health of water ecosystems and other uses, depending on the condition of the environment. Chapter 4 reports on environmental entitlements and their use.

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, and evaporation from soils, open water surfaces and the wet surfaces of plants soon after rainfall.

Floodplain: The land adjacent to a river that is subject to overflow during flood events: a floodplain is often valuable for its 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. See also 'Aquifer'.

Groundwater management unit (GMU): An area defined for the purpose of managing groundwater in Victoria. A GMU may be classified as either a groundwater management area (GMA) or a water supply protection area (WSPA): see both definitions below.

Groundwater management area (GMA): A discrete area where groundwater resources of a quality suitable 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.

(The) Living Murray program: 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.

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 groundwater management unit (GMU) under a ministerial declaration.

Qualification of rights: A declaration by the Minister for Water under section 33AAA of the *Water Act 1989* that qualifies 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 environment.

Ramsar Convention: An international treaty that aims to conserve wetlands that 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 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.

Representative river: A river that can be used to represent the major river classes that once occurred naturally across Victoria. The river must be in good condition to be representative. The 2002 *Victorian River Health Strategy* lists suggested representative rivers.

Regulated river: A river containing structures (such as dams or major diversion weirs) that 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: An environmental asset situated alongside a river or stream.

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' (see above).

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: these 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 inquiry established under the NSW *Snowy Hydro Corporatisation Act 1997* that 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.

Streamflow management plan: A statutory management plan prepared for a water supply protection area (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 lake: A lake that forms the endpoint of all surface water flow within a basin.

Traditional Owners: Under section 8A of the *Water Act 1989*, any member of a Traditional Owner group who has a natural resource agreement under the *Traditional Owner Settlement Act 2010* can take and use water from a waterway or bore for traditional purposes. 'Traditional purposes' means providing for the personal, domestic or non-commercial communal needs of group members.

Transpiration: The process by which water that is absorbed by a plant, usually through its roots, is evaporated from the plant's surface into the atmosphere.

Unincorporated area: A previously used term for an area of Victoria with substantial, often-unquantified groundwater that had not been designated as either a groundwater management area (GMA) or a water supply protection area (WSPA).

Unregulated river: A river that along its length does not have dams or major diversion weirs that control its flow.

Use (water use): The water-use data in 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: A website (at www.waterregister.vic.gov.au) with information about water entitlements, seasonal allocations, trade and transfers. It is the authoritative record of water entitlements in Victoria, and it facilitates the transactions that underpin Victoria's water markets.

Wastewater: The volume of sewage that enters a dedicated treatment plant.

Water corporation: A government-owned organisation charged with supplying water to urban and rural water users. It administers the diversion of water from waterways and the extraction of groundwater. Water corporations were formerly known as water authorities.

Water balance: A statement of the water flows in a given area and period — in these accounts, normally a year — 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 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 share: A legally recognised, perpetual entitlement to a secure share of the water available from a declared water system. A water share may be high-reliability or low-reliability. Seasonal resource determinations specify the percentage of a water share that is available annually.

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.

Water-use licence: An entitlement to irrigate a specific parcel or parcels of land. The licence sets out the conditions for use (such as how much water you can use on your land in a single irrigation season). Water-use licences are required for irrigation from the regulated Murray, Goulburn, Broken, Loddon, Campaspe, Bullarook, Werribee or Macalister systems.

Water-use registration: Similar to a take and use licence (see above) but with no fixed term. It authorises take and use from a dam, spring or soak. It is attached to the land and cannot be traded, except on sale of the land. It can however be converted into a take and use licence. Registration licences were able to be issued for one year, between 1 July 2002 and 30 June 2003 and were based on historical water use.

Waterway: A river, creek, stream, watercourse and a natural channel where water regularly flows, whether or not the flow is continuous (as defined by the *Water Act 1989*).

Wetland: An inland, standing, shallow body 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: Estimated evapotranspiration

Evapotranspiration is modelled as the sum of transpiration by plants, evaporation from soil and open water surfaces, and evaporation from the wet surfaces of plants soon after rainfall. This appendix presents modelled basin estimates of evapotranspiration.

Evapotranspiration amounts vary considerably across Victoria depending on a range of factors, including water availability. Averaged across Victoria as a whole, evapotranspiration in 2018–19 was estimated to be 490 mm, which is about 11% below the long-term average from 1961 to 1990.

Modelled estimates of basin evapotranspiration are presented in Figure A-1. Evapotranspiration is presented in terms of millimetres per unit area to allow for direct comparison between basins of different sizes.

Figure A-1 shows that annual evapotranspiration was lower in 2018–19 than average conditions for all Victorian basins. However, evapotranspiration rates resembled the mean most closely in the regions which recorded the highest rainfall as a percentage of long-term average rainfall. These regions included the Kiewa basin in the north-east, which received 82% of its average annual rainfall, and the Lake Corangamite, Hopkins River, Millicent Coast and Otway Coast basins in the south-west, which received 84%, 86%, 86% and 90% of their average annual rainfall respectively. Conversely, some of the lowest rates of evapotranspiration, expressed as a percentage of the long-term average, were modelled for the Mallee, North Central and Gippsland regions, due to lower-than-average rainfall.

Figure A-1 Modelled evapotranspiration per unit area (mm), 2018–19

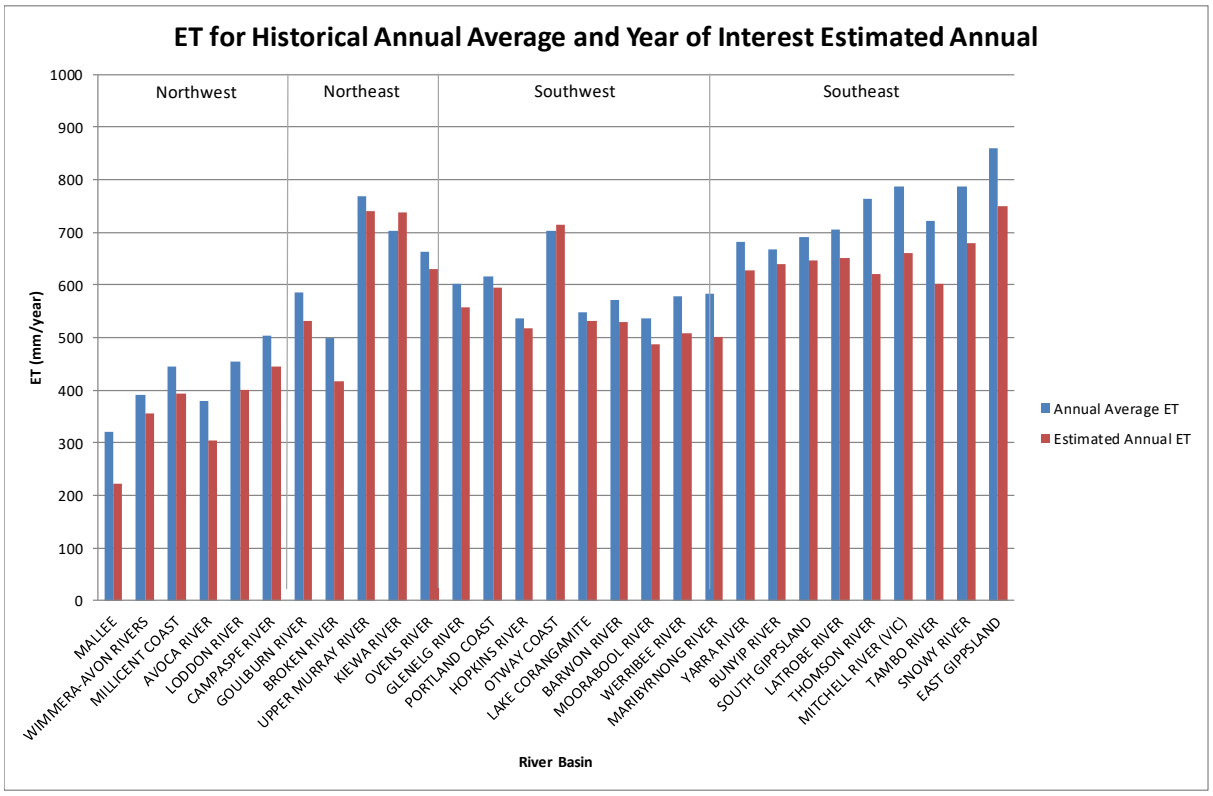
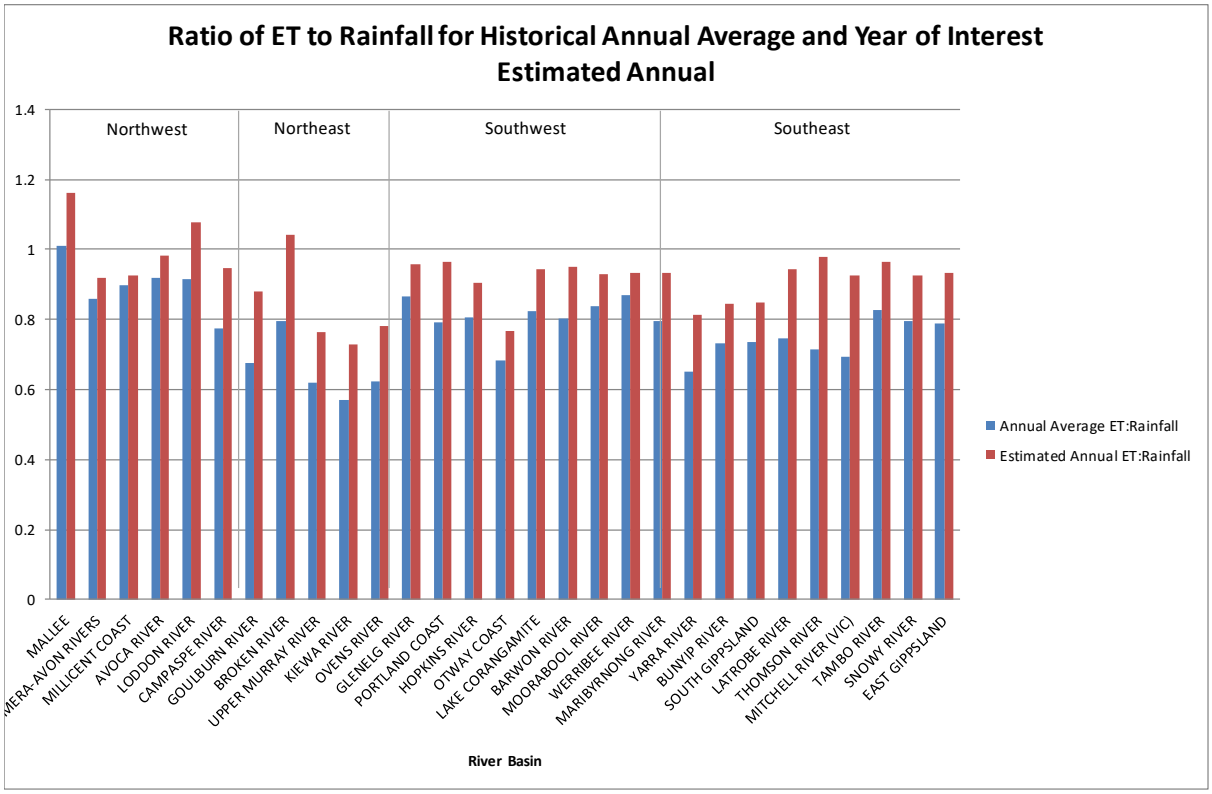


Figure A-2 illustrates evapotranspiration as a proportion of rainfall in Victoria's basins. In 2018–19, the proportion of evapotranspiration to rainfall was higher than the long-term average in all basins. This is consistent with below-average rainfall generally being observed, because the proportion of evapotranspiration to rainfall generally decreases as rainfall increases. Hence, less rainfall remained for streamflow and groundwater recharge in 2018–19 than would be the case in an average year.

Figure A-2 Modelled evapotranspiration as a percentage of rainfall, 2018–19



North-east Victoria (Goulburn to Upper Murray basins)

Below-average rainfall over north-east Victoria in 2018–19 resulted in estimates of evapotranspiration that were below average for the north-eastern basins, except for the Kiewa basin. The estimated evapotranspiration ranged from 420 mm in the Broken basin to 740 mm in the Upper Murray basin, and comparisons with the long-term average ranged from 16% below average in the Broken basin to 5% above average in the Kiewa basin (Figure A-1).

In 2018–19, 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's highest evapotranspiration as a proportion of rainfall (104%, compared to the long-term average of 79%), and the lowest was in the Kiewa basin (73%, compared to the long-term average of 57%) (Figure A-2).

South-east Victoria (East Gippsland to Yarra basins)

Below-average rainfall over south-eastern Victoria in 2018–19 resulted in estimates of evapotranspiration that were below average for the south-eastern basins. The estimated evapotranspiration ranged from 600 mm in the Tambo basin to 750 mm in the East Gippsland basin, and comparisons with the long-term average ranged from 19% below average in the Thomson basin to 4% below average in the Bunyip basin (Figure A-1).

In 2018–19, evapotranspiration as a proportion of rainfall in the south-eastern basins was higher than the long-term average. The Thomson basin was estimated to have the south-east's highest evapotranspiration as a proportion of rainfall (98%, compared to the long-term average of 71%), and the lowest was in the Yarra basin (81%, compared to the long-term average of 65%) (Figure A-2).

South-west Victoria (Maribyrnong to Glenelg basins)

Below-average rainfall over south-western Victoria in 2018–19 resulted in estimates of evapotranspiration that were below average for the south-western basins, except for the Otway Coast basin. The estimated evapotranspiration ranged from 490 mm in the Moorabool basin to 720 mm in the Otway Coast basin, and comparisons with the long-term average ranged from 14% below average in the Maribyrnong basin to 2% above average in the Otway Coast basin (Figure A-1).

In 2018–19, evapotranspiration as a proportion of rainfall in the south-western basins was higher than the long-term average. The Portland Coast basin was estimated to have the south-west's highest evapotranspiration as a proportion of rainfall (97%, compared to the long-term average of 79%) and the lowest was in the Otway Coast basin (77%, compared to the long-term average of 68%) (Figure A-2).

North-west Victoria (Mallee to Campaspe basins)

Below-average rainfall over north-western Victoria in 2018–19 resulted in estimates of evapotranspiration that were below average for the north-western basins. The estimated evapotranspiration ranged from 220 mm in the Mallee basin to 450 mm in the Campaspe basin, and comparisons with the long-term average ranged from 30% below average in the Mallee basin to 9% below average in the Wimmera-Avon basin (Figure A-1).

In 2018–19, evapotranspiration as a proportion of rainfall in the north-western basins was generally higher than the long-term average. The Mallee basin was estimated to have the north-west's highest evapotranspiration as a proportion of rainfall (116%, compared to the long-term average of 101%), and the lowest was in the Wimmera-Avon basin (92%, compared to the long-term average of 86%) (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 (i.e. rises and falls in the water table and soil moisture) or lateral flow
- aggregating 2016 land use information into a series of ten representative land use classes to facilitate water balance modelling; the 2018 land use data was not available in a suitable format in time for this analysis and the 2016 data has been applied, consistent with the *Victorian Water Accounts 2016–17* and *Victorian Water Accounts 2017–18*
- performing this analysis at a one-kilometre gridded resolution.

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 evapotranspiration estimates do not account for water applied by irrigation.

Appendix B: Storage levels

Basin	Reservoir	On-stream / Off-stream	Storage capacity (ML)	% full at 1 July 2018	% full at 30 June 2019
Murray	Lake Dartmouth (Victoria's share)	On-stream	1,928,116	100%	73%
	Lake Hume (Victoria's share)	On-stream	1,502,579	50%	19%
	Lake Victoria (Victoria's share)	On-stream	338,500	59%	44%
	Menindee Lakes (Victoria's accessible share)	On-stream	865,500	0%	0%
	Kangaroo Lake	Off-stream	39,200	80%	85%
	Kow Swamp	Off-stream	51,710	71%	78%
	Lake Boga	Off-stream	37,000	76%	73%
	Lake Charm	Off-stream	22,000	92%	92%
	Lake Cullulleraine	Off-stream	5,270	84%	84%
Kiewa	Lake Guy	On-stream	1,416	32%	59%
	Rocky Valley	On-stream	28,294	51%	63%
	Clover Pondage	Off-stream	255	53%	20%
	Pretty Valley basin	Off-stream	355	100%	100%
Ovens	Lake Buffalo	On-stream	23,340	59%	61%
	Lake William Hovell	On-stream	13,690	98%	101%
Broken	Lake Nillahcootie	On-stream	40,400	55%	26%
	Loombah-McCall Say	On-stream	1,747	55%	47%
Goulburn	Goulburn Weir	On-stream	25,500	93%	86%
	Lake Eildon	On-stream	3,334,158	55%	38%
	Sunday Creek Reservoir	On-stream	1,650	59%	23%
	Greens Lake	Off-stream	32,500	64%	48%
	Waranga basin	Off-stream	432,360	46%	43%
Campaspe	Campaspe Weir	On-stream	2,624	93%	98%
	Lake Eppalock	On-stream	304,651	61%	36%
	Lauriston Reservoir	On-stream	19,790	79%	81%
	Malmsbury Reservoir	On-stream	12,034	23%	19%
	Upper Coliban Reservoir	On-stream	37,770	75%	71%
Loddon	Cairn Curran Reservoir	On-stream	147,130	53%	37%
	Hepburn Lagoon	On-stream	2,424	49%	57%
	Laanecoorie Reservoir	On-stream	8,000	38%	78%
	Newlyn Reservoir	On-stream	3,012	52%	77%
	Tullaroop Reservoir	On-stream	72,950	56%	47%
	Evansford Reservoir	Off-stream	1,346	75%	102%
	Sandhurst Reservoir	Off-stream	2,595	84%	92%
	Spring Gully Reservoir	Off-stream	1,680	55%	61%
East Gippsland	None	-	-	-	-
Snowy	None	-	-	-	-
Tambo	None	-	-	-	-
Mitchell	None	-	-	-	-
Thomson	Lake Glenmaggie	On-stream	177,640	24%	24%
	Thomson Reservoir	On-stream	1,068,000	57%	46%
Latrobe	Blue Rock Lake	On-stream	198,280	85%	77%
	Lake Narracan	On-stream	7,230	85%	88%
	Moondarra Reservoir	On-stream	30,458	78%	82%
South Gippsland	Candowie Reservoir	On-stream	4,463	56%	49%
	Hyland Reservoir	On-stream	671	29%	44%
	Lance Creek Reservoir	On-stream	4,200	73%	89%
	Western Reservoir	On-stream	1,137	69%	64%
Bunyip	Tarago Reservoir	On-stream	37,580	79%	58%
Yarra	Maroondah Reservoir	On-stream	22,179	54%	37%

	O'Shannassy Reservoir	On-stream	3,123	85%	10%
	Upper Yarra Reservoir	On-stream	200,579	48%	48%
	Yan Yean Reservoir	On-stream	30,266	82%	72%
	Cardinia Reservoir	Off-stream	286,911	59%	60%
	Greenvale Reservoir	Off-stream	26,839	85%	74%
	Silvan Reservoir	Off-stream	40,445	88%	85%
	Sugarloaf Reservoir	Off-stream	96,253	58%	45%
Maribyrnong	Rosslynne Reservoir	On-stream	25,368	24%	19%
Werribee	Djerriwarrh Reservoir	On-stream	1,014	75%	66%
	Melton Reservoir	On-stream	14,364	23%	44%
	Merrimu Reservoir (total)	On-stream	32,516	37%	34%
	Pykes Creek Reservoir	On-stream	22,119	75%	83%
Moorabool	Bostock Reservoir	On-stream	7,455	40%	44%
	Korweinguboora Reservoir	On-stream	2,327	1%	15%
	Lal Lal Reservoir	On-stream	59,549	77%	65%
	Moorabool Reservoir	On-stream	6,192	44%	38%
	Wilsons Reservoir	On-stream	1,010	3%	29%
	Upper Stony Creek Reservoir	Off-stream	9,494	52%	51%
Barwon	Gong Gong Reservoir	On-stream	1,902	71%	75%
	West Barwon Reservoir	On-stream	22,064	31%	26%
	White Swan Reservoir	On-stream	14,107	73%	58%
	Wurdee Boluc Reservoir	Off-stream	40,431	48%	33%
Corangamite	None	-	-	-	-
Otway Coast	West Gellibrand Reservoir	On-stream	1,856	100%	100%
Hopkins	None	-	-	-	-
Portland Coast	None	-	-	-	-
Glenelg	Konongwootong Reservoir	On-stream	1,920	95%	94%
	Moora Moora Reservoir	On-stream	6,300	57%	43%
	Rocklands Reservoir	On-stream	296,000	38%	29%
Millicent Coast	None	-	-	-	-
Wimmera	Fyans Lake	On-stream	18,460	69%	70%
	Green Lake	On-stream	5,350	53%	45%
	Lake Bellfield	On-stream	78,560	79%	69%
	Lake Lonsdale	On-stream	53,300	33%	19%
	Taylors Lake	On-stream	27,060	65%	35%
	Toolondo Reservoir	On-stream	50,530	32%	27%
	Wartook Reservoir	On-stream	29,300	50%	39%
Mallee	None	-	-	-	-
Avoca	None	-	-	-	-
Total			**12,406,348**		

Appendix C: Groundwater entitlement and use

Groundwater management unit	PCV	Licenses			Domestic and stock		Total use (licensed + domestic and stock)
		Licensed entitlement (ML)	No. of licences	Usage (ML)	No. of domestic and stock bores [1]	Estimated use (ML) [2]	
Goulburn-Murray Water							
Water supply protection areas							
Katunga	60,577	60,203	256	**41,104**	710	**1,420**	**42,524**
Loddon Highlands [1]	20,697	20,502	178	**9,097**	430	**860**	**9,957**
Lower Campaspe Valley	55,875	55,860	129	**50,259**	334	**668**	**50,927**
Upper Ovens River [2]	n/a	3,618	99	**1,001**	146	**292**	**1,293**
Groundwater management areas							
Barnawartha	2,100	375	4	**8**	25	**50**	**58**
Broken	3,732	2,844	66	**621**	303	**606**	**1,227**
Central Victorian Mineral Springs	6,024	5,037	143	**1,090**	1,116	**2,232**	**3,322**
Eildon	1,496	603	26	**216**	271	**542**	**758**
Kiewa	3,852	3,117	102	**356**	210	**420**	**776**
Lower Ovens	25,200	19,875	267	**8,285**	921	**1,842**	**10,127**
Mid Goulburn	12,470	12,470	65	**4,766**	115	**230**	**4,996**
Mid Loddon	34,037	33,927	102	**30,310**	161	**322**	**30,632**
Shepparton Irrigation Region [3] [4]	n/a	185,321	1,053	**93,828**	1,080	**2,160**	**95,988**
Strathbogie	1,660	1,427	57	**529**	204	**408**	**937**
Upper Goulburn	8,568	6,107	116	**935**	489	**978**	**1,913**
Upper Murray	7,674	3,532	74	**421**	159	**318**	**739**
West Goulburn	n/a	3,066	44	**1,747**	17	**34**	**1,781**
Outside management units							
Goulburn-Murray Water	n/a	13,031	92	**3,771**	676	**1,352**	**5,123**
Grampians Wimmera Mallee Water							
Groundwater management areas							
Murrayville	11,005	9,755	38	**6,368**	42	**84**	**6,452**
West Wimmera [5] [6]	57,409	53,598	168	**26,722**	373	**746**	**27,468**
Outside management units							
Grampians Wimmera Mallee Water	n/a	9,327	50	**2,116**	180	**360**	**2,476**
Southern Rural Water							
Water supply protection areas							
Condah	7,475	7,470	33	**3,478**	71	**107**	**3,585**
Deutgam [7]	5,100	5,082	148	**796**	35	**53**	**848**
Glenelg	33,262	16,092	35	**5,923**	328	**492**	**6,415**
Koo-Wee-Rup	12,915	12,575	339	**3,964**	467	**701**	**4,664**
Sale	21,238	21,203	113	**17,867**	247	**371**	**18,238**
Warrion	14,086	14,075	132	**3,854**	125	**188**	**4,041**
Yarram	25,690	25,688	85	**16,557**	229	**344**	**16,901**
Groundwater management areas							
Bungaree	5,334	5,293	100	**3,245**	116	**174**	**3,419**
Cardigan	3,967	3,889	21	**925**	65	**98**	**1,023**
Colongulac	4,695	4,404	65	**1,576**	69	**104**	**1,679**
Corinella	2,550	662	13	**63**	41	**62**	**125**
Cut Paw Paw	3,650	511	3	**0**	3	**5**	**5**

Denison [8]	18,502	18,499	120	**11,864**	76	**114**	**11,978**
Frankston	3,200	2,212	28	**183**	36	**54**	**237**
Gellibrand [9]	n/a	0	0	**0**	0	**0**	**0**
Gerangamete [10]	20,239	20,238	4	**121**	3	**5**	**126**
Giffard	5,689	5,689	18	**5,548**	76	**114**	**5,662**
Glenormiston	2,698	2,636	45	**1,211**	43	**65**	**1,276**
Jan Juc [11]	14,250	14,250	3	**201**	3	**5**	**206**
Lancefield	1,485	1,378	15	**282**	47	**71**	**352**
Leongatha	6,500	1,803	33	**149**	34	**51**	**200**
Merrimu	451	10	2	**0**	10	**15**	**15**
Moe	8,200	3,885	98	**785**	82	**123**	**908**
Moorabbin	2,700	2,624	54	**1,228**	169	**254**	**1,481**
Nepean [6]	6,110	6,110	77	**2,856**	1,579	**1,579**	**4,435**
Newlingrook	1,977	1,958	6	**55**	1	**2**	**56**
Orbost	1,217	1,217	4	**545**	3	**5**	**549**
Paaratte [12]	4,606	3,212	6	**339**	1	**2**	**341**
Portland	7,795	7,794	8	**2,561**	1	**2**	**2,563**
Rosedale [5] [13]	22,372	22,322	68	**10,276**	76	**114**	**10,390**
South West Limestone [14]	n/a	81,194	838	**36,281**	2,248	**3,372**	**39,653**
Stratford [5] [12] [15]	27,686	37,084	10	**23,054**	12	**24**	**23,078**
Tarwin	1,300	58	4	**17**	381	**572**	**588**
Wa De Lock [5] [8]	30,795	29,125	250	**10,259**	269	**404**	**10,663**
Wandin Yallock	3,027	3,025	195	**728**	41	**62**	**789**
Wy Yung [5]	7,463	7,462	59	**1,546**	7	**11**	**1,557**
Outside management units							
Southern Rural Water	n/a	71,320	1,326	**14,629**	4,056	**6,084**	**20,713**
Total 2018–19	**650,600**	**965,641**	**7,487**	**466,514**	**19,012**	**31,716**	**498,229**
Total 2017–18	650,361	967,100	7,085	394,401	27,465	45,444	439,845

Notes

(1) Extractions from Newlyn trading zone in the Loddon Highlands WSPA were restricted to 75% allocation.
(2) The Minister approved the revocation of the PCV on 3 March 2013.
(3) There is no PCV for the Shepparton Irrigation GMA, as there is no limit on the total volume of shallow groundwater entitlement available.
(4) Groundwater use in the Shepparton Irrigation Region GMA is estimated at the end of each season using a method which considers annual use by a subset of Shepparton Irrigation Region GMA licensed groundwater users that are metered, the volume of metered groundwater use in the Katunga Water Supply Protection Area and spring rainfall.
(5) The PCV that applies to West Wimmera GMA, Wy Yung GMA, Nepean GMA, Rosedale GMA, Stratford GMA and Wa De Lock GMA totals the sum of the PCVs for all zones within each GMU.
(6) Extractions from Neuarpur subzone 1 (a trading zone in the West Wimmera GMA) were restricted to 80% allocation.
(7) Extractions from Deutgam WSPA were restricted to 50% allocation.
(8) The volume of use in Denison and Wa De Lock GMA includes metered extractions for salinity control (Denison WSPA 672 ML and Wa De Lock GMA 778 ML).
(9) The Gellibrand PCV of 0 ML was gazetted at the end of 2018–19.
(10) The PCV for the Gerangamete GMA was previously 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. The PCV was decreased to 239 ML on 26 June 2019 after Barwon Water did not renew its licence. The entitlement volume includes the 20,000 ML licence as the licence expired on 30 June 2019.
(11) 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 14,250 ML includes 4,250 ML and the maximum annual bulk entitlement extraction volume of 10,000 ML.
(12) The Paaratte GMA PCV was amended on 23 April 2018. The PCV is now 4,606 ML or that amount plus any additional volume that may be taken under a section 51 licence specifically for the take and use of groundwater for a single pumping test or Managed Aquifer Recharge scheme. Total licensed entitlement volume must not exceed 4,692 ML.
(13) The use volume reported in Rosedale and Stratford GMAs includes metered extractions from Latrobe Valley coal mines (Rosedale GMA 884 ML and Stratford GMA 22,944 ML).
(14) The PCV for the South West Limestone GMA has not been gazetted. The entitlements and use relate to the area defined in the South West Limestone Groundwater Management Area Plan No. LEGL./15-199. The South West Limestone GMA includes the area of the former Nullawarre WSPA, Yangery WSPA, Hawkesdale GMA and Heywood GMA, and the areas outside the former GMUs but included within the South West Limestone GMA area. Abolition of the Nullawarre and Yangery WSPAs was approved on 24 October 2014 and published in the Victoria Government Gazette on 30 October 2014. The PCVs for the four GMUs have not been revoked and still apply. PCV volumes are Nullawarre 22,741 ML, Yangery 14,352 ML, Hawkesdale 16,161 ML and Heywood 8,500 ML.
(15) The licence volume in the Stratford GMA exceeds the PCV because the licences held by the Latrobe Valley coal mines are identified by aquifers which do not align to GMU boundaries; however, the total licensed volume is attributed to Stratford GMU.

Appendix D: Bulk entitlement holders

River basin	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
	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

River basin	Entitlements	Holder
	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
	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

River basin	Entitlements	Holder
	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
	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
	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
	Yarra River Environmental 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

River basin	Entitlements	Holder
	Bulk Entitlement (Upper West Moorabool System) Conversion Order 1995	Central Highlands Water
Barwon	*Barwon River Environmental Entitlement 2011*	Victorian Environmental Water Holder
	Upper Barwon River Environmental Entitlement 2018	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
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 – GWMWater) 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 – GWMWater) 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

Appendix E: Review and update of long-term average inflows

The Victorian Water Accounts present an annual summary of the state's water resources. This is done by reporting basin-scale water availability and use, based on a water balance of inflows, changes to volumes held in storage, consumptive use, losses and basin outflows.

Outflows from each river basin are calculated using streamflow gauges near catchment outlets, or they are estimated using streamflow records from higher in the catchment or from neighbouring catchments. Inflows are back-calculated as the balancing term in the accounts[4]. These inflows are then compared to long-term average (LTA) estimates of inflows.

The estimates of LTA inflows used in the accounts before 2017–18 were derived from the sources shown in Table E-1. Since this time, DELWP has completed the *Long-Term Water Resource Assessment for Southern Victoria* (LTWRA), available at https://www.water.vic.gov.au/planning/long-term-assessments-and-strategies/ltwra. This assessment included an estimation of LTA inflows for most catchments in the state. In the 2017–18 accounts, the new LTWRA estimates of LTA inflows were adopted for most basins. Further work has been completed for the 2018–19 accounts to update the LTA inflow estimates in line with the methodology applied for the calculation of inflows in the Victorian Water Accounts.

Table E-1 Victorian Water Accounts LTA inflow estimates before 2017–18

Basin	Volume (ML/year)	Source	SWS period
East Gippsland	714,000	Gippsland SWS	1979–2005
Snowy	1,022,000	Gippsland SWS	1964–2008
Tambo	297,800	Gippsland SWS	1961–2008
Mitchell	884,500	Gippsland SWS	1955–2007
Thomson	1,101,760	Gippsland SWS	1955–2007
Latrobe	847,400	Gippsland SWS	1957–2007
South Gippsland	911,500	Gippsland SWS	1979–2007
Bunyip	541,000	SDL database	N/A
Yarra	1,054,000	Central SWS	1913–2004
Maribyrnong	113,000	Central SWS	1890–2005
Werribee	102,000	Central SWS	1920–2005
Moorabool	97,000	Central SWS	1927–2004
Barwon	360,000	Central SWS	1927–2004
Corangamite	316,000	SDL database	N/A
Otway Coast	884,000	SDL database	N/A
Hopkins	635,000	SDL database	N/A
Portland Coast	361,000	SDL database	N/A
Glenelg	964,000	SDL database	N/A
Murray	7,618,000	Northern SWS	1890–2007
Kiewa	689,000	Northern SWS	N N/A A
Ovens	1,758,000	Northern SWS	1891–2006
Broken	308,000	Northern SWS	1890–2007
Goulburn	3,363,000	Northern SWS	1890–2007
Campaspe	352,000	Northern SWS	1890–2007
Loddon	373,000	Northern SWS	1890–2007
Avoca	136,200	Western SWS	1972–2005
Wimmera	316,400	Western SWS	1890–2007

The changes to the LTA inflows presented in this year's accounts can be attributed to a combination of the following four actions.

[4] With the exception of the Murray basin, were inflows are estimated using gauged data, and in-stream losses is the balancing term.

- The LTWRA was adopted as a common baseline, as opposed to the sustainable water strategies (SWS) and the SDL database used previously. The reasons for the differences between the SWS and LTWRA estimates of LTA inflows are:
  - for some basins, the methods to derive inflows have been improved. Similarly, for many streamflow gauge records, the LTWRA retrospectively applied improvements in data — typically by adjusting or extending rating curves — over part or all of the period of record
  - in some basins, the SWS included in its estimates of water availability sources of water other than surface flows in local waterways (such as inter-basin transfers, recycled water and return flows). The LTWRA only included surface water flows from local waterways
  - the LTWRA did not add the impact of unlicensed farm dams to the streamflow gauge data, because the LTWRA's definition of surface water availability does not include water intercepted by users external to Victoria's water entitlement framework (such as unlicensed stock and domestic farm dams)
  - there are some differences in the boundary assumptions between the LTWRA and the SWS. The assessment included rivers not included in the SWS but which had a sufficiently long-term streamflow gauge record: for example, the Brodribb River was added in the Snowy basin and Little River was added in the Moorabool basin. Conversely, the assessment did not include a small number of rivers that have a streamflow gauge but a not-long-enough period of record
  - for the Snowy basin, the LTWRA estimated the inflows from Victorian catchments only.
- Estimates of inflows for post-1975 conditions were used, rather than inflow estimates for the full historical record.
- The LTWRA estimate was adjusted to allow for impacts of small catchment dams accounted for in the accounts but not in the LTWRA.
- Additional ungauged areas were added to the accounts' estimates of outflow, and hence water balance, for the East Gippsland, Mitchell, Moorabool, Snowy and Tambo basins.

LTA inflows for the Mallee and Millicent Coast basins have not been previously estimated, and they were not estimated as part of this project.

Table E-2 Summary of updated long-term average inflow estimates for the Victorian Water Accounts

Basin	Updated 2018–19 VWA LTA Inflows (ML)	LTA Inflows before 2017–18 (ML)	Change
Avoca	**87,100**	136,200	-36%
Barwon	**248,000**	360,000	-31%
Broken	**260,800**	308,000	-15%
Bunyip	**564,400**	541,000	4%
Campaspe	**258,600**	352,000	-27%
Corangamite	**86,800**	316,000	-73%
East Gippsland	**857,700**	714,000	20%
Glenelg	**527,300**	964,000	-45%
Goulburn	**2,859,000**	3,363,000	-15%
Hopkins	**325,100**	635,000	-49%
Kiewa	**676,700**	689,000	-2%
Latrobe	**843,300**	847,400	0%
Loddon	**243,400**	373,000	-35%
Maribyrnong	**92,800**	113,000	-18%
Mitchell	**804,100**	884,500	-9%
Moorabool	**103,400**	97,000	7%
Murray	**6,649,300**	7,618,000	-13%
Otway Coast	**733,300**	884,000	-17%
Ovens	**1,729,300**	1,758,000	-2%
Portland Coast	**462,200**	361,000	28%
Snowy	**795,600**	1,022,000	-22%
South Gippsland	**932,900**	911,500	2%
Tambo	**297,200**	297,800	0%
Thomson	**936,400**	1,101,760	-15%
Werribee	**88,600**	102,000	-13%
Wimmera	**223,100**	316,400	-29%
Yarra	**954,200**	1,054,000	-9%