Reflections

Water for the Environment
in Victoria 2017–18
Acknowledgement of Traditional Owners

The Victorian Environmental Water Holder proudly acknowledges Victoria’s Aboriginal communities and their rich culture and pays respect to their Elders past and present.

We acknowledge Aboriginal people as Australia’s First Peoples and as Traditional Owners and custodians of the land and water on which we rely. We recognise the intrinsic connection of Traditional Owners to Country, and value their ongoing contribution to managing Victorian landscapes. We also recognise and value the contribution of Aboriginal people and communities to Victorian life and how this enriches us.

The Victorian Environmental Water Holder recognises the intersection between environmental flow objectives and outcomes for Traditional Owners and Aboriginal Victorians. We acknowledge the ongoing contribution that Aboriginal people are making to planning and managing water for the environment and the benefits that have resulted from these partnerships.

The case studies outlined in this edition of Reflections include several examples of these benefits. These, however, are only a small sample of the partnerships that are taking place in many regions of Victoria. Traditional Owner Nations have strong relationships with environmental watering program partners, and they are working to better realise Aboriginal Victorians’ aspirations and incorporate ‘Traditional Owners’ objectives into environmental flow management. There still remain further opportunities for the Victorian Environmental Water Holder and its partners to develop enduring partnerships with Traditional Owners who wish to participate in the management of water for the environment, and we will continue to look for these opportunities.

The Victorian Environmental Water Holder embraces the spirit of reconciliation, working towards equity and an equal voice for Traditional Owners.

Acknowledgement of program partners

The Victorian Environmental Water Holder acknowledges the significant contribution of program partners, particularly the Commonwealth Environmental Water Holder, the Murray-Darling Basin Authority and Victorian waterway, storage and land managers, all of which work tirelessly to improve the health of the state’s rivers, wetlands and floodplains.

Victoria’s water for the environment program is overseen by the Department of Environment, Land, Water and Planning (DELWP) on behalf of the Minister for Water. It is part of the Victorian Government’s broader $222 million investment in healthy waterways and catchments.

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This investment includes delivering water for the environment, improving habitat and habitat within our waterways, restoring connectivity so that fish can move freely and monitoring to demonstrate the outcomes of this. Healthy waterways support vibrant communities in rural and urban landscapes. Rivers and wetlands sustain towns, farms and businesses and ultimately support our physical and mental wellbeing. They provide relaxing places for people to connect with nature and sustain healthy Country for Aboriginal people.

Water for the environment is an integral part of protecting and improving the health of waterways. Reflections tells wonderful stories of how plants, animals and communities are benefiting from water for the environment. It is pleasing to read in Reflections the growing evidence of how water for the environment is improving the health of Victoria’s rivers, wetlands and headwaters. In every Reflections report there are positive examples for our native fish such as Australian greyling, our waterbirds including the threatened black swan, and other animals such as the elusive platypus, as well as the environments on which they rely.

I commend the Victorian Environmental Water Holder and program partners such as Catchment Management Authorities to continually strive to engage with local communities, Traditional Owners and scientists to incorporate local knowledge to inform our seasonal watering plans. It is essential for us to understand the challenges within each region so we can provide the best possible delivery of environmental flows. We also need to understand that complementary waterway work is part of the bigger picture of looking after environmental and community waterway values. This includes and enhances reusing urban stormwater, removing fencing off waterways from stock and our creeks, providing access to waterways, restoring river and wetland ecosystems, and the plants, animals and people who rely on them, can recover and flourish once dry conditions ease.

This annual publication reflects the work of the Victorian Environmental Water Holder and its program partners in supporting rivers, wetlands, wildlife and communities.

The Victorian Government has invested a record $222 million over four years to improve the health of our waterways and catchments.

It is particularly encouraging to see the genuine partnerships that are being formed by the Victorian Environmental Water Holder and program partners with communities and stakeholders. It is great to see water for the environment supporting cultural connections and Aboriginal environmental outcomes as well as recreational opportunities and other shared community benefits. While the benefits of water for the environment are clear, I recognise that environmental water management is still relatively new, with the Victorian Environmental Water Holder established in 2011. Environmental water managers continue to learn and adapt the way they manage water for the environment to ensure the best possible outcomes.

The benefits of water for the environment are demonstrated through Victorian Government monitoring programs including the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) and the Wetland Monitoring and Assessment Program (WetMAP). These provide information to the Victorian Environmental Water Holder and catchment management authorities to continually improve the way that water for the environment is delivered. This investment in large-scale and long-term monitoring is providing vital information about responses to waterway environments in regulated river systems across Victoria, which in turn provides the evidence to sustain organisations like the VEWH.

Healthy rivers and wetlands are at the heart of healthy communities across Victoria, with studies showing they contribute significantly to mental health and financial benefits. They attract visitors and are places where people gather for events such as fishing competitions, park runs, outdoor concerts and food festivals. Camping, picnics, stand-up paddle boarding, canoeing, birdwatching, taking the dog for a walk and bike riding near waterways are part of our everyday lives.

Every year brings new water challenges and the biggest challenge during 2017-18 was dry conditions. 2016 was Victoria’s wettest year since the flood year of 2011, which meant there were good reserves of water in storage for use in 2017-18. However, a lack of follow-up rain along with a dry and hot summer and autumn resulted in many communities, rivers and wetlands across the state, particularly in 2018. While we have experience of desert conditions, we are often asked ‘why do you deliver environmental water?’ This is a good question and we appreciate the opportunity to raise awareness. Water for the environment is essential to help Victoria’s highly-modified river and wetland systems survive. Water stored following a wet year allows us to provide flows for the plants and animals that need them when it’s dry. Our rivers and wetlands need water for the environment to help them sustain us so they and the plants, animals and people who rely on them, can recover and flourish once dry conditions ease.

Reflections gives us the opportunity to highlight what water for the environment delivers to people, the economy and the environment. It is a privilege to work with our program partners who all share a similar passion for ensuring the work we do today looks after the long-term health of our communities, plants and animals that rely on healthy waterways to survive and prosper.

Chairperson
Denis Flett

Hor Lisa Neville MP Minister for Water
Highlights of environmental watering in 2017-18

**Werribee system**
Native fish are moving and breeding further up the Werribee River than previously recorded in response to improvements in the river’s health over recent years. Thanks to water for the environment and works to help fish passage.

**Yarra system**
The first environmental watering of Bolin Bolin Billabong improved wetland vegetation communities and supported Aboriginal cultural values.

**Snowy River**
The Snowy River received its largest ever environmental flow, with 206,000 megalitres released to provide a productivity boost for the river, benefiting fish and other animals. It is certainly a delight for town paddlers!

**Yarra system**
Gaynor Swamp saw a waterbird boom after environmental flows were delivered there for the first time, with brolgas arriving at the wetland within a few days of the water going in!

**Glenelg system**
A trial in the Grampians-Gariwerd National Park introduced water for the environment to the upper Glenelg River for the first time ever, with benefits for the entire floodplain which is critical habitat for aquatic species and endangered animals like the long-nosed potoroo and southern brown bandicoot.

**Werribee system**
Not only fish are moving and breeding further up the Werribee River than previously recorded in response to improvements in the river’s health over recent years, thanks to water for the environment and works to help fish passage.

**Yarra system**
Scientists recorded the highest catch rates of tupong (a native fish that spends part of its life in saltwater and part in freshwater) in 14 years – an improvement also seen the year before, due to environmental flows.

**Wimmera-Mallee wetlands system**
Several juvenile platypus were found during population surveys in the MacKenzie River, indicating that the population hit hard by river regulation and the Millennium Drought may be slowly recovering thanks to water for the environment.
Environmental watering in Victoria is the collaborative management of water available for environmental purposes. It is used to improve the health of Victoria’s rivers and wetlands and the native plants and animals that depend on them.

The need for environmental watering

As Victoria’s population has grown, many of its rivers and wetlands have been modified to provide water for communities to grow and thrive.

In some rivers, up to half of the water that would have naturally flowed in them is removed each year to provide water for farms, homes and industry. As a result, these waterways cannot function as they would naturally, so it is necessary to actively manage how water flows through them. These managed flows that are used to achieve specific environmental outcomes are called ‘water for the environment’ or ‘environmental flows’.

Water for the environment is set aside in storages and released into rivers, wetlands and floodplains to support them, the plants that grow in them and the native animals that live, feed and breed in them.

In 2017-18, the Victorian Environmental Water Holder (VEWH) coordinated the delivery of water for the environment to 88 river reaches (across 41 rivers) and 83 wetlands, totalling 171 sites across Victoria.

Water for the environment work?

Water for the environment is released into rivers to mimic some of the flows that would have occurred naturally before the construction of dams, weirs and channels. This is vital to maintain the physical, chemical and biological health of rivers.

Managers of water for the environment generally focus on returning some of the small and medium sized river flows that are essential in the life cycles of native plants and animals. These flows can move sediment and nutrients through river systems, connect habitats and improve water quality.

The success of environmental watering relies on the timing, magnitude and frequency of flow – just as agriculture requires water to be applied at the right time and in the right amount. For benefits to occur, water must be released at a particular time, in a certain amount, for an adequate number of days.

The timing, duration and volume of water delivery is designed to support the plants and animals that rely on these flows. For example, fish such as Australian grayling rely on an increased river flow in autumn as it signals them to migrate downstream for spawning, when fish release eggs. Waterbirds require wetlands to retain water for long enough to allow their chicks to grow, and floodplain forests require inundation every few years to ensure the survival of tree species such as river red gums and black box.

Many wetlands in Victoria are now either disconnected from the rivers that used to naturally fill them or are permanently connected to rivers or channels. This means that some wetlands do not get enough water, and others get too much.

In wetlands, the aim is to mimic the natural cycles of wetting and drying on which many plants and animals depend for their diversity and long-term resilience.

For example, where wetlands and floodplains have been cut off from natural river flows, water for the environment can be used to reconnect these areas, sometimes via irrigation infrastructure (such as pumps, channels and regulators).
Seasonal watering plan
Every year a seasonal watering plan is developed that guides environmental watering decisions in Victoria. This provides stakeholders with a sense of what to expect during the watering year.

Environmental watering objectives and water availability may differ depending on seasonal conditions. Planning considers the range of potential seasonal conditions or water availability scenarios ranging from drought to very wet.

Who is involved in the Victorian environmental watering program?
The Victorian environmental watering program involves collaboration and strong working relationships between a range of groups and organisations that are the foundation of the program.

This includes local communities, waterway managers (Victoria’s Catchment Management Authorities (CMAs) and Melbourne Water), storage managers (largely water holders), environmental water holders (the VEWH, Commonwealth Environmental Water Holder (CEWH) and Murray-Darling Basin Authority), and land managers, such as Parks Victoria, the Department of Environment, Land, Water and Planning (DELWP) and Traditional Owner land management boards.

The VEWH is an independent body, established by the Victorian Government in 2011, responsible for managing Victoria’s water for the environment. Set up under the Water Act 1989, the VEWH manages environmental water entitlements—the legal right to access a share of water available at specified locations to improve the environmental values and health of Victoria’s rivers, wetlands and floodplains, and the plants and animals that rely on them.

The VEWH’s operations fit within Victorian Government policies for integrated catchment and waterway management. Key policy and strategies influencing the VEWH’s operations include Water for Victoria, Victorian Waterway Management Strategy, Our Catchments, Our Environment – Biodiversity 2037 and Basin Plan 2012.

The VEWH works with local waterway managers to ensure water for the environment achieves the best environmental outcomes.

The role of the VEWH is to:
- make decisions about the most effective use of the environmental water entitlements, including for use, carryover or trade
- commit water and authorise waterway managers to implement watering decisions
- work with storage managers and other water holders to coordinate and optimise environmental outcomes from the delivery of all water
- commission projects to demonstrate the ecological outcomes of environmental flows at key sites and to help improve the management of water for the environment
- publicly communicate environmental watering decisions and outcomes

The VEWH works with local waterway managers to ensure water for the environment achieves the best environmental outcomes.

The VEWH consists of four part-time commissioners and a small team. The commissioners are Denis Flett (Chairperson), Geoff Hocking (Deputy Chairperson), Chris Chesterfield (Commissioner) and Rueben Berg (Commissioner).

Scientists and local communities
To effectively manage water for the environment, it is essential to draw on the collective understanding of scientists, Traditional Owners and local communities.

Scientists, such as those at the Arthur Rylah Institute in Victoria, provide advice about how water for the environment will best support native plants and animals. Their ongoing work to monitor, evaluate and report on the outcomes of environmental watering ensures ongoing improvements to the program.

Cultural scientists are increasingly monitoring the outcomes of environmental watering. Volunteers from BirdLife Australia and Waterwatch have been collecting vital information to inform management decisions.

Local communities are often actively involved with local rivers and wetlands and bring important environmental, cultural, social and economic perspectives to the program.

The VEWH and program partners recognise and support the need to develop enduring partnerships with Traditional Owner Nations who want to manage water in their country for the benefit of the environment. The VEWH is investing in projects to identify opportunities and to better realise Aboriginal Victorians’ aspirations to incorporate Traditional Owners’ objectives into the management of environmental flows.

Effective and efficient management
As much as possible, the VEWH seeks to meet environmental water demands (and avoid water supply shortfalls) by implementing seasonally adaptive planning and efficient use of water for the environment. This includes release of return flows and investigation of water management tools such as carryover and trading. Storage managers working with storage managers to offer the timing and route for delivery of consumptive water, can also help to achieve environmental objectives efficiently without negatively impacting other water users.

Carryover and trade
Carryover means that water allocated in one year can be kept in storage for use in the following year, subject to certain conditions. Water trading is buying, selling or exchanging water. These mechanisms enable water for the environment to be used when and where it is most needed.

Carryover rules allow for the flexible management of water between seasons. Irrigators and environmental water holders rely on carryover to manage differences between water supply and demand in wet years versus dry years.

Examples of environmental watering objectives under different planning scenarios

<table>
<thead>
<tr>
<th>Drought</th>
<th>Main objective: PROTECT</th>
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<tbody>
<tr>
<td>Avoid critical loss</td>
<td></td>
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<tr>
<td>Maintain key refuges</td>
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<td>Avoid catastrophic events</td>
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<table>
<thead>
<tr>
<th>Dry</th>
<th>Main objective: MAINTAIN</th>
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<tbody>
<tr>
<td>Maintain river functioning with environmental objectives captured</td>
<td></td>
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<tr>
<td>Maintain key functions at high priority wetlands</td>
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<tr>
<td>Manage after dry spell tolerance</td>
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<table>
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<tr>
<th>Average</th>
<th>Main objective: RECOVER</th>
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<tbody>
<tr>
<td>Improve ecological health and resilience</td>
<td></td>
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<tr>
<td>Improve recruitment opportunities for key animal and plant species</td>
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<table>
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<tr>
<th>Wet to very wet</th>
<th>Main objective: ENHANCE</th>
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<tbody>
<tr>
<td>Restore key floodplain and wetland linkage</td>
<td></td>
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<tr>
<td>Enhance recruitment opportunities for key animal and plant species</td>
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At the end of 2017–18, there were 469,181 megalitres carried over for potential use in 2018–19, subject to carryover rules and conditions.

In 2017–18, the VEWH used water trades to effectively and efficiently manage its environmental water portfolio. For example, water trading over the wetting year included:

- in the Central region, Melbourne Water and the VEWH jointly purchased just under 300 megalitres to allow the Manduramong system to receive water for the environment
- in the Northern region, the VEWH sold 15,000 megalitres of Murray allocation that was not needed for carryover into 2018–19
- in the Northern region, the VEWH transferred allocation between its own accounts to make best use of carryover capacity and minimise the risk of carryover spilling in 2018–19. For example, 3,000 megalitres was traded from the Campaspe system to the Goulburn system.

Investing in research and catchment improvements

The VEWH invests in monitoring and technical investigations such as research to better understand hydrology, community engagement and technical investigations such as water quality monitoring at multiple sites across the state, including the Glenelg River, Mount William Creek, (Wimmera), Lower Barwon wetlands, Moonabool River, Loddon River, Pyramid Creek, Gunbower Forest and others.

In 2017–18, some of the projects the VEWH invested in included:

- a platypus monitoring project in the Glenelg River, including providing training in best practice monitoring techniques and capacity building opportunities for the Budj Bil and Barngi Gadjin Land Council Rangers and Traditional Owners
- a citizen science project with Birdlife Australia to monitor waterbird response to environmental watering of Lake Cullen
- funding to waterway managers to communicate the benefits of environmental watering (using photos, video or signage) to their communities
- development of a standardised approach to assessing condition of black box and river red gum trees
- winter low flow habitat modelling in the Goulburn River below Lake Eildon
- development of a decision support tool to inform water releases to the Glenelg River
- groundwater-surface water interaction investigation at Lake Cullen
- water flow measurement at multiple sites across the state, including the Glenelg River, Mount William Creek, (Wimmera), Lower Barwon wetlands, Moonabool River, Loddon River, Pyramid Creek, Gunbower Forest and others.

Benefits to the community

There is no doubt that the beauty of Victoria’s waterways brings a sense of joy to communities. Water for the environment is for everyone, providing social, economic and recreational benefits and Aboriginal cultural benefits.

By improving the health of waterways, water for the environment supports vibrant and healthy communities sustaining towns, farms and businesses. In a recent survey, 90 percent of Victorians said they visited waterways to relax, rest and enjoy the scenery. Healthy rivers and wetlands make cities and towns more liveable and support the physical and mental wellbeing of communities. They provide places for people to play, relax and connect with nature, and sustain healthy Country for Aboriginal communities.

The benefits of healthy waterways include fishing, birdwatching, kayaking, bushwalking, cycling, camping, yabbying, swimming and picnicking. These activities are all enjoyed on or around Victoria’s rivers, rivers and floodplains, and the benefits of healthy waterways are also enjoyed on or around Victoria’s rivers, rivers and floodplains.

Healthy rivers help sustain recreational fishing in Victoria. Of the top 50 Victorian recreational fishing river reaches, 28 can receive water for the environment. River tour operators and canoe clubs have also been enjoying healthier rivers, getting out on environmental flows.


The VEWH

The VEWH

Right: Water quality monitoring at Gunbower Creek, by Kathryn Walker, VEWH

The VEWH

The VEWH

In 2017–18, 92% of environmental flows delivered in northern Victoria were also re-used to meet downstream environmental water needs. To increase efficiency, where possible environmental flows were also ‘piggybacked’ on water delivered for towns and farms.

In 2017–18, 92% of required potential watering actions were fully or partially achieved, through environmental flow deliveries, natural river flows or delivery of cross-system water en route to customers.


The VEWH


In 2017–18, 82% of environmental flows delivered for towns and farms in Victoria in 2017–18 received water for the environment. Twenty-seven (96%) of these reaches received water for the environment in 2017–18.
Just adding water for the environment is not the only factor to consider for improving the health of rivers, wetlands and floodplains; complementary works and measures are also equally important as part of ‘integrated catchment management’.

Integrated catchment management is a holistic way of managing land, water and biodiversity from the top to the bottom of a catchment. This might include activities such as invasive species control, streamside land management, sustainable agriculture, sustainable land use planning and development, integrated urban water management, providing fish passage or improving in-stream habitat.

Maximising the benefits of water for the environment

Complementary measures are often needed to support the achievement of environmental watering outcomes and to help maximise the benefits from environmental flows.

In this year’s Reflections there are a number of stories that refer to important actions that, together with environmental flows, are helping to meet the environmental objectives set for our waterways – for example, carp removal at Reedy Lagoon and set for our waterways - for example, environmental flows, are helping to support a number of stories that refer to environmental watering outcomes.

The Glenelg River Restoration Project

More than 20 years of integrated catchment management for the Glenelg River is paying dividends for the Glenelg Hopkins CMA and the community, with tangible benefits to the health of the river and its plant and animal inhabitants.

Native fish have been particular beneficiaries of the comprehensive, landscape-scale program of waterway works, including environmental flows, removal of fish barriers, sand management, reducing stock access, installing ‘snags’ and ‘fish hotels’ (adding woody debris in the river for fish habitat) and past management in-stream and on land.

“We have fish like estuary perch and tupong moving back into their old range – hundreds of kilometres upstream from where they were found when we started monitoring 10 years ago,” said Glenelg Hopkins CMA’s Bryce Morden.

Recent monitoring under the Victorian Environmental Flows Monitoring and Assessment Program has shown tupong are now moving more than 330 kilometres upstream from the estuary mouth. “This wasn’t possible even four years ago,” Bryce said.

“Our fish monitoring back in 2009 found a single female tupong just upstream of Dartmouth. We’ve since been delivering a program of environmental flows, removed 12 different barriers to fish movement, and installed habitat in the river so they have places to feed and rest – amongst other things. We’ve seen a steady increasing trend over the years in both the range and number of fish we’re catching. In 2018 we captured over 300 tupong in our surveys, including many juveniles, which shows that they’re breeding and recruiting.”

Other recreational fish species such as the estuary perch have also responded to the river restoration works. These key angling species also found well up the river system and are being caught in big numbers.

The Glenelg River

“it’s not just about adding water”

It’s not just about adding water – water for the environment in Victoria 2017-18

Revegetation

Rehabilitated waterway frontage, including more than 500,000 trees planted for habitat and to prevent erosion

Sand management

Up to 30,000m³ of excess bedload removed per year

Fish barrier removal

Twelve fish barriers removed, opening 917km of waterway for fish to move and breed

Riverside fencing

Over 2,000 km of fence installed in partnership with over 700 landholders

Fish screens

Carp screens on the Rocklands Reservoir outlet

Re-habitation of fish habitats

Carp screens on the Rocklands Reservoir outlet

Fish habitat installation

Transplanting ‘snags’ or constructed ‘fish hotels’

Sand management

Up to 30,000m³ of excess bedload removed per year

Fish barrier removal

Twelve fish barriers removed, opening 917km of waterway for fish to move and breed

Riverside fencing

Over 2,000 km of fence installed in partnership with over 700 landholders
Rivers and wetlands get dry naturally too. So why do we put water into the environment when nature, and regulation of rivers, has turned off the tap?

In last year’s Reflections, the question we answered for our community was ‘Why do we water when it is wet?’ It’s also important to ask the same questions when it’s dry, especially given competing demands for water.

On one level, it is apparent that during dry years environmental flows are needed to sustain parched wetlands and rivers and refresh stagnant pools. However, when water becomes scarce, some people question why we still release water for the environment, at the same time water is needed for irrigated farming.

The artificial drought
Rain or shine, many of Victoria’s rivers, floodplains and wetlands constantly experience an artificial drought. This is because Victoria’s waterways have continued to be modified as the population has grown, to provide water for food production, towns and industry. The water in rivers is now pooled up in water storages and flow is controlled by weirs and other mechanisms. In some rivers, up to half of the water that would have naturally flowed in them is removed each year for farms, homes and businesses.

Even when it’s wet, these rivers and wetlands get less water than they would naturally. But this impact is far greater when it’s dry, which can mean real problems for our waterways and the plants, animals and communities that rely on them.

Dams allow water to be captured in a wet year and kept for use when it’s dry. This is why the VEWH had high amounts of water for the environment in 2017-18 even when it wasn’t raining much. Environmental flow managers use that water to build the resilience of waterways. This is critical, so that rivers, wetlands and the plants and animals that rely on them can better cope when it gets really dry – in conditions like the Millennium Drought – when there is little rain and little water in storage.

Planning for all conditions
The VEWH shares community concerns about water scarcity and supply during dry conditions. We keep a close eye on climate predictions and weather conditions through the seasons to make the most of any water used to protect our environment.

An extensive amount of planning goes into preparing for drought, dry, average and wet scenarios. In the same way rainfall patterns influence how people water their gardens or paddocks, different climatic conditions influence how we manage water for the environment.

In any given year, the need for environmental flows, as outlined in the annual seasonal watering plan, can be higher than the available water. Therefore, it is important to consider where water is most needed and how it can be used most efficiently to achieve the best environmental outcomes.

A healthy environment underpins healthy communities, and in dry conditions, waterways and wetlands are a haven for plants and animals, as well as people.
Late October and November 2016 brought the largest floods seen in the River Murray in the last two decades. The Hattah Lakes and floodplains were flooded for over four months, providing perfect conditions for the recovery of black box trees that had not been flooded since the 1990s.

The boost to these plants can be short-lived unless more water is provided in following years. Therefore, over 110,000 megalitres of water for the environment was delivered to Hattah between July to October 2017 to support further growth and recovery of black box trees.

Recent monitoring has shown that the black box trees are flourishing, with improved health and tree canopy cover in the areas that received environmental flows in 2017-18.

Hattah Lakes benefits from a top up

Above: Dry Hattah in 2015, by Mallee CMA
Bottom: Black box trees and flowers in 2017, by Mallee CMA
Right: Old man saltbush (Atriplex nummularia) at Hattah Lakes, by Mallee CMA
Water for the environment delivered to the Gippsland region in 2017-18 (megalitres)

- Latrobe system: 11,224 ML
- Thomson system: 18,072 ML
- Macalister system: 15,884 ML
- Snowy River: 206,000 ML

Water for the environment enhanced conditions in the Macalister and Thomson rivers for the native tupong fish. The Snowy River saw its largest ever environmental flow delivered – 206,000 megalitres – providing a boost in the productivity of the river and a delight to paddlers.

To protect water quality, Parks Victoria contracted local professional fishermen who caught and removed a whopping 25 tonnes of carp! The recovered carp were then used in a fertiliser trial run by the National Carp Control Program. Adrian Clements, Environmental Water Officer at the West Gippsland CMA, said the damage that carp do to wetlands can be devastating.

“They compete with native fish and their feeding method in sediment, called ‘rumbling’, destroys native plants. I was glad when the opportunity arose to provide environmental flows to Sale Common at a time when it was mostly free of carp.”

Removing the carp provided a rare opportunity to increase the environmental outcomes of environmental flows. Beginning in May 2018, West Gippsland CMA provided inflows from the Latrobe River to Sale Common via the wetland regulator. The regulator contains a carp screen that prevents adult carp from entering the wetland. This allows wetland plants an opportunity to re-establish and grow due to less disturbance from carp.

“We know that large numbers of carp will get back into the wetland during the next flood and small carp will grow, but by that stage, wetland plants will be better able to withstand the impact of the carp, and a healthier wetland will be the result,” said Adrian.

Waterway manager: West Gippsland CMA
Storage manager: Southern Rural Water

Above: Welcome swallows at Sale Common, by David Stork, West Gippsland CMA
Tupong, a little-known native fish species that spends part of its life in saltwater and part in freshwater, is benefitting from environmental flows in the Thomson and Macalister rivers.

Coordinated environmental flows were delivered to the Macalister and Thomson rivers in spring 2017 to attract juvenile tupong, as well as Australian grayling and bass, into both systems. Following the flow, scientists from the Arthur Rylah Institute recorded the highest catch rates of tupong in the Thomson River in 14 years—an improvement on the high catch rates that were also seen the year before. Environmental flows continue to improve these river systems every year.

The environmental flows were made possible, in part, due to a special management arrangement whereby passing flows were reduced to create water savings in the Thomson system.

Passing flows are low flows released from Thomson Reservoir each day, providing benefit for the environment and for irrigators along the Thomson River. An agreement between the VEWH and Southern Rural Water allowed a reduction in passing flows in July 2017 so that the VEWH could ‘bank’ the water that was not released. The arrangement saved 2,500 megalitres of water for the environment that was used in a spring environmental flow to attract tupong into the Thomson River.

“Coordinated environmental flows made it possible to attract more fish into the Thomson River, which resulted in improved catch rates,” said Stephanie Suter from West Gippsland CMA.

The arrangement saved 2,500 megalitres of water for the environment that was used in a spring environmental flow to attract tupong into the Thomson River.

“The spring flow requires 3,800 megalitres of water, and so the saved passing flows provided 65 percent of the water for this event,” said Stephanie Suter from West Gippsland CMA.

“This enabled us to achieve bigger and better outcomes for native fish than we normally could.”

Waterway manager: West Gippsland CMA
Storage manager: Southern Rural Water

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<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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<tbody>
<tr>
<td>Thomson River</td>
<td>18,072</td>
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<tr>
<td>Macalister River</td>
<td>15,884</td>
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</tbody>
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Above: Macalister River, by West Gippsland CMA
Right: Thomson River, by West Gippsland CMA
Traditional Owners and catchment managers learning from each other

The partnership between the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) and West Gippsland CMA has been ongoing for many years, and in 2017-18 they took a big step forward. Representatives of the two organisations travelled to south-west Victoria to learn from local catchment managers and Traditional Owners— and each other— about practical ways they can work together.

The journey began in Gippsland, with a ‘water for the environment 101’ session that included information from the CMA about environmental flows and a joint discussion of how this relates to cultural values in the Latrobe, Thompson and Macalister rivers which flow through Gunaikurnai country.

After this session, CMA staff and GLaWAC representatives travelled to south-west Victoria to meet with Barengi Gadjin and Gunditj Mirring Traditional Owners and staff from Glenelg Hopkins CMA, to find out how they have been working together through the Glenelg River Towards Cultural Flows project.

As they travelled down the Glenelg River, the Traditional Owners and catchment managers from Gippsland learnt from their western Victorian counterparts about their world leading project, and how it has been integrating Aboriginal values and traditional knowledge into environmental water planning and delivery. It has also given Traditional Owners the opportunity to develop their knowledge and capacity to participate in water management.

Dan Stoessel from the Arthur Rylah Institute said that the size of the environmental flow could only be considered the equivalent of a small fresh in an historical sense, but promisingly, it was associated with a minor increase in productivity, which would likely have been of benefit to animals, such as fish, higher up in the food chain.

Waterway manager: NSW Department of Primary Industries, East Gippsland CMA

Storage Manager: Snowy Hydro Limited

The equivalent of 3,200 Olympic swimming pools of water was released from Lake Jindabyne during a single day in November 2017. It was one of five peak flows delivered between June and November 2017.

Wildlife and the community benefitted from the flows. McKillops Bridge became a temporary home to rafts, canoes and kayaks as paddlers keen for adventure navigated the river and its rapids downstream to where the Buchan River joins the Snowy.

Scientists set out to determine the effect that the flow had on the productivity of the estuary of the Snowy River. Hundreds of kilometres downstream of where the flows are released, McKillops Bridge became a temporary home to rafts, canoes and kayaks as paddlers keen for adventure navigated the river and its rapids downstream to where the Buchan River joins the Snowy.

Scientists set out to determine the effect that the flow had on the productivity of the estuary of the Snowy River. Hundreds of kilometres downstream of where the flows are released, McKillops Bridge became a temporary home to rafts, canoes and kayaks as paddlers keen for adventure navigated the river and its rapids downstream to where the Buchan River joins the Snowy.

The Snowy River received its largest ever volume of environmental flows, with 206,000 megalitres released to benefit the environment—and to the joy of keen paddlers!

Above: Paddling on the Snowy River, by East Gippsland CMA

Right: Traditional Owners from Gunditj Mirring, Barengi Gadjin Land Council, Gunaikurnai Land and Waters Aboriginal Corporation and CMA staff, by Minni Tom

The partnership between the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) and West Gippsland CMA has been ongoing for many years, and in 2017-18 they took a big step forward.
In 2017–18 in the Central region, there were fabulous outcomes for native fish such as the Australian grayling, as well as frogs, plants and the iconic platypus. Water for the environment delivered to Bolin Bolin Billabong for the first time helped native vegetation growth and provided cultural benefits for Wurundjeri people.

In February 2018, during a particularly hot and dry spell with continuous low flows in the Yarra River, oxygen in the water was dropping to critical levels that are harmful to fish. “The dissolved oxygen was approaching 3 milligrams/litre and dropping. Above 5 milligrams/litre is good, below 2 milligrams/litre becomes critical. The temperature was 26 degrees Celsius and rising, which prompted us to bring forward our planned summer environmental flow,” Cheryl said.

“As a result, oxygen stabilised after the flow release came through and this was maintained throughout the high-risk summer period, allowing fish to pass through the Dights Falls weir pool to better quality habitat further upstream.”

Fish monitoring has shown improvements to locations where priority fish have been detected, including the threatened Australian grayling, with evidence they occur as far up the Yarra River as Woori Yallock. Scientists have also recorded other threatened species such as Macquarie perch, common galaxias and river blackfish throughout the waterway.

### Yarra River

**The Wurundjeri people call the Yarra River ‘Birrarung’, meaning ‘place of mist and shadows’. In 1835, when surveyor John Wedge asked Wurundjeri people what they called the lower section of the river they replied ‘Yarro Yarro’, meaning ‘it flows’. He misunderstood and the river became known as the Yarra.**

Source: Melbourne Water

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**Water for the environment delivered to the Central region in 2017–18 (megalitres)**

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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<tbody>
<tr>
<td>Yarra River</td>
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<tr>
<td>Tarago River</td>
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<tr>
<td>Maribyrnong system</td>
<td>290</td>
</tr>
<tr>
<td>Werribee system</td>
<td>2,573</td>
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<tr>
<td>Moorabool River</td>
<td>2,746</td>
</tr>
<tr>
<td>Lower Barwon wetlands</td>
<td>Water diverted from Barwon River</td>
</tr>
</tbody>
</table>

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**Dights Falls is a special location on the Yarra River: downstream of the falls, the river is a brackish water estuary, while upstream of the falls, the river is freshwater. The falls have created a very deep and large weir pool on the upstream side, which is important habitat for native fish like Australian grayling that migrate from the estuary into the freshwater.**

Water quality in the weir pool can reduce, particularly in the summer months when water temperatures warm up. At times, low oxygen levels can be harmful to fish and other animals living in the river. Delivering water for the environment can quickly improve water quality at Dights Falls.

To protect native fish as they move upstream and through the Dights Falls fishway, Melbourne Water installs specialised water quality monitoring equipment over the warm summer months to continuously measure dissolved oxygen and temperature. “During December to February, we install a temporary buoy, which has three sensors suspended through the water column below. This gives us live information on the condition of the water in the river and helps us target our releases of summer freshes from the upper Yarra system,” said Melbourne Water’s Cheryl Edwards.

“During December to February, we install a temporary buoy, which has three sensors suspended through the water column below. This gives us live information on the condition of the water in the river and helps us target our releases of summer freshes from the upper Yarra system,” said Melbourne Water’s Cheryl Edwards.

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**Left: Buoy at Dights Falls, by Cheryl Edwards, Melbourne Water**

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Maribyrnong River:
The name Maribyrnong is a version of the Aboriginal term 'Mirring-gnay-bir-nong', which translates as 'I can hear a ringtail possum'.

Source: Melbourne Water

Tarago River
The threatened Australian grayling is being given a boost from environmental flows into the Tarago River.

Monitoring in the Tarago River is improving understanding about the link between environmental flows and Australian grayling migration and spawning, with the duration of the release being the critical ingredient.

“We are now really confident that environmental flows need to be at least 10 days’ duration to support fish migration and initiate successful spawning,” said Melbourne Water’s Sarah Gaskill.

“In April 2018, we were pleased to successfully deliver this flow because it was such a dry autumn that there was no chance of the flows occurring naturally.”

Monitoring has shown that environmental flows in the Tarago River improve the quality and quantity of food and habitat for platypus and increase opportunities for these rare animals to move. In 2017-18 this monitoring was fed into a review of the environmental flows study. This study helps enhance water delivery targeted at specific plants, animals, fish and river processes.

“It’s not only the threatened native plants and animals that are getting a much-needed boost from the flows – visitors to the Glen Cromie Holiday Park also appreciated the timing. The delivery of a summer environmental flow was planned to coincide with a long weekend. So, in addition to the ecological and water quality benefits, the community enjoyed the flows, too.

“Waterway manager: Melbourne Water

Storage manager: Melbourne Water

Above: Charlie and Karen Azzopardi (owners of Glen Cromie Caravan Park) with Sarah Gaskill (Melbourne Water) at the park’s environmental flow information sign, by Alison Miller, VEWH

Maribyrnong system
A delivery of flows in summer helped support movement of native fish in Jacksons Creek, which flows into the Maribyrnong River – one of Melbourne’s most valued waterways.

Much of the upper Maribyrnong catchment was an ephemeral system, meaning that it did not flow continuously all year round. However, Jacksons Creek, which flows from Roslynne Reservoir into the Maribyrnong River, maintains a permanent flow now, and has deep pools to provide refuge for fish such as short-finned eels, common and ornate galaxias, flathead gudgeon, yapping and Australian smelt. Platypus also inhabit several reaches of the creek.

“When the flow passes through many small but permanent pools along the way, the fresh water improves water quality and gives fish a chance to move from pool to pool and find better habitat.”

The VEWH does not hold a formal environmental entitlement in the Maribyrnong system and relies on temporary trades to maintain the river’s water quality and health.

Waterway manager: Melbourne Water
Storage manager: Southern Rural Water

Above: Maribyrnong River, by Bill Moulton, Melbourne Water

Site | Volume delivered in 2017–18 (ML)
--- | ---
Tarago River | 1764

Site | Volume delivered in 2017–18 (ML)
--- | ---
Upper Jacksons Creek | 280

The timing, from our perspective, was sensational,” said Karen Azzopardi from Glen Cromie Holiday Park.

“We were fully booked for the Australia Day long weekend and, being such a hot weekend, the river was the place to be! I hope that the extra flows were a success for the environment, too. I know it made a big difference here and immediately the eels were coming out in the evening.”

Waterway manager: Melbourne Water
Storage manager: Melbourne Water

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Waterway manager: Melbourne Water
Storage manager: Southern Rural Water

Site | Volume delivered in 2017–18 (ML)
--- | ---
Upper Jacksons Creek | 280

Above: Maribyrnong River, by Bill Moulton, Melbourne Water

Maribyrnong River:
The name Maribyrnong is a version of the Aboriginal term ‘Miring-gray-nir-nong’, which translates as ‘I can hear a ringtail possum’.

Source: Melbourne Water

Site | Volume delivered in 2017–18 (ML)
--- | ---
Upper Jacksons Creek | 280

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Source: Melbourne Water

Site | Volume delivered in 2017–18 (ML)
--- | ---
Upper Jacksons Creek | 280
During October and November 2017, two environmental flows from Merrimu Reservoir to Pyrites Creek were made to provide habitat for waterbugs and frogs. Environmental flows released from Merrimu Reservoir to Pyrites Creek eventually pass through to Melton Reservoir.

“Environmental flows released from Merrimu Reservoir target objectives in Pyrites Creek, which then flow into Melton Reservoir. We’re able to temporarily recapture this water in Melton Reservoir and release it later to target environmental objectives in the lower Werribee River,” said Melbourne Water’s Helen Clarke.

This flexibility is important to achieve improved river health in a system that has only a small amount of water for the environment available. Essentially, the same water can be used to achieve two different sets of outcomes.

“Downstream of Melton Reservoir in the Werribee River, our environmental objectives change from improving outcomes for bugs and frogs to fish and vegetation,” Helen said.

Water temporarily stored in Melton Reservoir was used to deliver a spring environmental flow from Melton Reservoir for the lower reaches of the Werribee River to provide benefits for streamside plants and enable fish movement, so they can feed and breed more successfully.

“Native fish are moving and breeding further up the river than we have ever seen before. This is the result of a gradual improvement in the health of the river over recent years, thanks to water for the environment,” Helen said.

Waterway managers are using water for the environment as efficiently as possible to give nature a boost, by protecting plants, waterbugs, frogs and migratory native fish.

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Waterway manager: Melbourne Water
Storage manager: Southern Rural Water

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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<tbody>
<tr>
<td>Pyrites Creek</td>
<td>1,265</td>
</tr>
<tr>
<td>Werribee River</td>
<td>1,307</td>
</tr>
</tbody>
</table>

Above: Pyrites Creek, by Southern Rural Water
Right: Werribee River looking upstream, by Melbourne Water

Site | Volume delivered in 2017–18 (ML)
-----|----------------------------------
Pyrites Creek | 1,265
Werribee River | 1,307
Most wetlands shouldn’t always be wet. Varying water levels and periodic drying allows for different processes to work, protecting the long-term health of the important plants and animals in the lower Barwon wetlands.

To control the extensive reed beds that are choking the wetlands and to improve habitat for waterbirds, it is recommended that the wetland is partially dried over summer, followed by a fill in winter, in three out of every four years. Once in four years it is recommended that Reedy Lake remains filled all year round.

Corangamite CMA’s Sharon Blum-Caon said it is important to be adaptive.

“The three-in-four-year drying is unachievable if there is a large summer flood. The important thing is to monitor conditions and provide the optimal wetting and drying regime on average, over the long term.”

Sharon said water levels and quality were closely monitored throughout the partial drying to protect other environmental values. “To protect waterbirds, we manage the drawdown as slowly and gradually, drawing down slowly in spring to ensure waterproof nesting sites stayed inundated through the breeding season.”

The process is underpinned by rigorous science to ensure the wetlands can be as healthy as possible. Vegetation monitoring by researchers at the Arthur Rylah Institute has found evidence of recruitment by the endangered hypersaline coastal saltmarsh and increases in the abundance of brackish aquatic herbland.

Community involvement has been vitally important. Lowering water levels at Reedy Lake is an important management action that supports the health of a regionally important wetway, which will ensure all user groups can continue to enjoy the benefits of the lake into the future.

“Wetway manager: Corangamite CMA
Storage manager: Central Highlands Water
Site Volume delivered in 2017-18 (ML)
Reedy Lake 2,746
Hospital Swamps 3,825

Implementing our environmental watering in Reedy Lake and nearby Hospital Swamps. We really value the knowledge and energy they bring to our program,” said Sharon.

Waterway manager: Corangamite CMA
Storage manager: Central Highlands Water
Site Volume delivered in 2017-18 (ML)
Reedy Lake Water was diverted into Reedy Lake from the Barwon River
Hospital Swamps Water was diverted into Hospital Swamps from the Barwon River

An example of this shared benefit of environmental flows was in early February 2018 when an environmental flow was released down the Moorabool River from Lal Lal Reservoir, primarily to trigger the migration of adult short-finned eel.

To coincide with the flow and showcase the shared benefits of flows for both the community and the environment, the Traditional Owners – the Wadawurrung – hosted a fishing day for the Wadawurrung community: the Moorabool Reedy Lake Yaluk Kuwin River Day.

“FishCare provided rods, bait and volunteers, and while we may not have caught many fish, all those who attended had a great day on the river,” said Kristen Lees of Corangamite CMA.

Corrina Eccles, Cultural Education Coordinator at Wathaurung Aboriginal Corporation (trading as Wadawurrung), said it was critically important to have a shared vision of care and understanding of the way their old people cared for water, land and all things living for many generations.

“We need to work together as one, acknowledging the intangible and tangible heritage of the Wadawurrung.”

“Waterway manager: Corangamite CMA
Storage manager: Central Highlands Water
Site Volume delivered in 2017-18 (ML)
Reedy Lake 2,746

Animals and fish that live in the Moorabool River are starting to thrive after water for the environment has improved the river’s health, for both the environment and for people.

I am aware that there are certain parts of the Moorabool River that are stressed and unwell – it is vital we all walk together to get better outcomes for our water.

“Our aspiration is to have Traditional Owners working on Country in caring for water alongside some of these agencies so that our future aspirations and cultural values are embedded, respected and valued.”

Waterway manager: Corangamite CMA
Storage manager: Central Highlands Water
Site Volume delivered in 2017-18 (ML)
Moorabool River 2,746

Above: Reedy Lake inlet channel during drying regime, by Saul Vermeeren, Corangamite CMA
Above: Community activity on Moorabool Yaluk Kuwin River Day, by Corangamite CMA

Above: Moorabool River

Central Highlands Waterway manager: Corangamite CMA
Storage manager: Central Highlands Water
Site Volume delivered in 2017-18 (ML)
Reedy Lake Water was diverted into Reedy Lake from the Barwon River
Hospital Swamps Water was diverted into Hospital Swamps from the Barwon River
Bolin Bolin Billabong, located next to the Yarra River in Bulleen, is one of the few remaining billabongs in Melbourne. It used to have such a large eel population that it was able to sustain up to 500 Wurundjeri people over summer. The billabong is highly valued for ecological, cultural and liveability attributes.

Today paints a different picture, with the Bolin Bolin Billabong under threat due to changes in river flows from the Yarra River, reducing the frequency of water flowing into the billabong. But thanks in part to water for the environment, the billabong’s future looks brighter.

In October 2017, Wurundjeri Council held a ceremony to realise the long-held goal of delivering water into the billabong – the first time it had received water in many years. The environmental response was also immediate – and loud! Frogs found the watering just to their liking, with the calls of four different species filling the evening air.

Monitoring of water levels and vegetation response is currently underway and a long-term solution is being finalised. Rehabilitation work has also been undertaken to complement the watering including pruning hazardous trees, weed control and revegetation with native plants.

The long-term vision is to improve the health of the billabong by providing a more natural wetting and drying regime for the billabong in partnership with key stakeholders. Restoration of Bolin Bolin is pivotal, as the centre of a significant cultural riverscape that is a significant place of gathering and reinvigorated cultural practice for Wurundjeri.

Restoring cultural connections to Bolin Bolin Billabong

Bolin Bolin: Means ‘place of many lagoons’ in the Woi wurrung language. The Bolin Bolin Billabong is a highly significant site to the Wurundjeri people and was an important gathering place for the Kulin Nation during eel harvest time.

Source: Melbourne Water
After a relatively wet spring in 2016, climate conditions in the Western region of Victoria returned to dry for 2017-18. Water for the environment was critical for providing habitat and food for native fish and animals such as platypus and waterbirds. It also boosted events in local townships, including fishing competitions along the Wimmera River at Horsham, Dimboola and Jeparit, and the annual Johnny Mullagh cricket match at Harrow on the Glenelg River.

Water for the environment delivered to the Western region in 2017-18 (megalitres)

- Glenelg system: 11,000 ML
- Wimmera system: 16,347 ML
- Wimmera-Mallee wetlands: 292 ML

In the Grampians-Gariwerd National Park, water for the environment was introduced to an ecologically important section of the upper Glenelg River for the first time ever, with benefits tipped to flow to plants and animals.

Bryce Morden, Water Resources Manager at Glenelg Hopkins CMA, said results were pleasing and would help inform future management of environmental flows.

"We wanted to test whether water could be moved from Moora Moora Reservoir, built in the 1930s, back to the river, with a view to enhance water quality, habitat and conditions for plants and animals downstream," he said.

"Following the event, we now know these old diversion channels and structures can be used to deliver small amounts of water for the environment should we need to do so in the future."

The management agency of Grampians National Park, Parks Victoria, was pleased with the success of the event. Ranger Team Leader, Mike Stevens, said improved river flows would have broad benefits.

"Reinstating environmental flows to the upper Glenelg River improves the condition of the entire floodplain, a system that provides critical habitat not just for aquatic species such as fish and yabbies but also endangered animals like the long-nosed potoroo, southern brown bandicoot and heath mouse," he said.

Waterway manager: Glenelg Hopkins CMA
Storage manager: Grampians Wimmera Mallee Water

The Glenelg River, known as ‘Bochara,’ in the Dhawurd Wurrung language, features in creation stories from the south-west Victoria region and acted as a traditional boundary between the Gunditjmara, Boandik and Jadawadjali people.

Source: Glenelg Hopkins CMA
Wimmera system

A small and fragile platypus population in western Victoria is re-establishing itself in new areas of the Wimmera River system.

Water samples from the MacKenzie River downstream of the Grampians-Gariwerd National Park, have returned strong platypus environmental DNA (eDNA) signals in areas where researchers haven’t recorded the elusive mammals since the Millennium Drought.

The eDNA findings picked up genetic material such as platypus skin cells in the water and confirmed community sightings on the national database platypusSPOT. They also followed the discovery of an adult male in the MacKenzie River at Zumsteins during trapping surveys in the national park in April 2018, which the community has named Pete.

Wimmera CMA chief executive David Brennan says environmental flows play an important role in maintaining platypus habitat, particularly in dry times.

“Environmental flows are critical for the lower section of the MacKenzie River beyond the Grampians National Park during dry conditions. This discovery indicates the river system is providing sufficient food and the high-quality habitat needed to sustain this platypus population.”

Wildlife ecologist Josh Griffiths first trialled eDNA testing for platypus in the Wimmera in 2015, and analyses water samples for cellular traces of platypus and other species as part of ongoing monitoring to measure waterway condition and outcomes from environmental flows.

“The eDNA test is highly sensitive and is a much more efficient method for discovering platypus. It’s noticeable every time I come here that the quality of habitat in the river is improving, which is allowing this platypus population to expand downstream.”

Waterway manager: Wimmera CMA
Storage manager: Grampians Wimmera Mallee Water

The community monitoring program for north-east Wimmera and southern Mallee wetlands is monitoring bird activity at wetlands which receive water for the environment from the Wimmera-Mallee Pipeline.

In response to environmental watering, the community has reported an influx of Australasian grebes, white-necked herons and Pacific black ducks.

Wimmera CMA chief executive David Brennan said since the pipeline project was completed, wetlands in the north-east Wimmera have become vitally important for providing surface water in areas where channel-fed dams used to proliferate.

“The response from birds, frogs and plants to regular environmental watering has been significant. Observation from community members are helping us greatly with long-term planning for environmental water.”

Waterway manager: Wimmera, North Central and Mallee CMAs
Storage manager: Grampians Wimmera Mallee Water

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<tr>
<td>Lower Mount William Creek</td>
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</table>

Above: Australasian grebe at Crow Swamp, by Jenny Stephens

Site                      Volume delivered in 2017–18 (ML)
Wimmera-Mallee wetlands (various sites) 292

Above: Josh Griffiths and John Pye undertaking platypus surveys at the MacKenzie River, by Wimmera CMA
A study into the value of water for the environment revealed the Wimmera River contributed $4.75 million to the economy in 2017, with fishing competitions providing major boosts – events which directly benefit from water for the environment. The study found that Horsham Fishing Competition on the Labour Day long weekend and Jeparit's Easter fishing event result in significant expenditure and reports of increased sales by many businesses. Brett Ireland, from the Jeparit Angling Club, said environmental flows mean the river, and their town, survives. “The Jeparit Fishing Comp is vital to our town and businesses. The flows enable us to host a successful event, and the town gets quite busy and everyone benefits.” Wimmera angler Chris Spence said the region sees some great benefits for the anglers and overall health of the river as a result of water for the environment. “We’ve seen firsthand what these environmental flows do when timed right. They’re an absolute bonus to anglers. It keeps the water moving, keeps the river free of salt and, when flows are on, we see a spark in activity as anglers can explore more water,” he said.

Budj Bim rangers, a wildlife ecologist and Glenelg Hopkins CMA have undertaken detective work trawling for traces of environmental DNA (eDNA) along the Glenelg River in pursuit of an elusive character – the iconic platypus. While there had been reports from locals that platypus thrive in the Glenelg River, scientific surveys to confirm the number and distribution of the species had never been done. Monitoring teams collected water samples from the river between Connewirrico near Harrow and Rocklands Reservoir in search of traces of the platypus. Scientists analyse the samples for cellular traces of platypus DNA left in the environment through shed genetic material like hair, skin or faeces. Results from this inaugural survey for the Glenelg River will help to ascertain the whereabouts of platypus, delivering a better understanding of its distribution. Glenelg Hopkins CMA’s Debbie Dalziel said objectives of the platypus monitoring project were two-fold. “We want to develop a better understanding of platypus distribution in the Glenelg, while also providing opportunities for Aboriginal rangers, CMA staff and scientists to come together and share knowledge of platypus requirements, monitoring techniques and environmental management skills. “Ultimately, this project gives project participants and the wider community an understanding of the benefits of a healthy river system, including the contribution of environmental flows from Rocklands Reservoir.”

River connects communities

Angling and football identity Rex Hunt, who is a regular visitor to Wimmera waterways, said “Just like country footy and netball clubs, the Wimmera River connects communities and towns, helps them prosper and makes them great places to visit and live.”

Left: Michael and Tanner Stasinowsky at the 2018 Horsham Fishing Competition, by Paul Carracher, The Weekly Advertiser. Top right: eDNA collection at Glenelg River with Budj Bim rangers, by Glenelg Hopkins CMA. Bottom right: Platypus monitoring, by Glenelg Hopkins CMA.

Searching for platypus using eDNA

Budj Bim rangers, a wildlife ecologist and Glenelg Hopkins CMA have undertaken detective work trawling for traces of environmental DNA (eDNA) along the Glenelg River in pursuit of an elusive character – the iconic platypus.

Left: Michael and Tanner Stasinowsky at the 2018 Horsham Fishing Competition, by Paul Carracher, The Weekly Advertiser. Top right: eDNA collection at Glenelg River with Budj Bim rangers, by Glenelg Hopkins CMA. Bottom right: Platypus monitoring, by Glenelg Hopkins CMA.

Left: Michael and Tanner Stasinowsky at the 2018 Horsham Fishing Competition, by Paul Carracher, The Weekly Advertiser. Top right: eDNA collection at Glenelg River with Budj Bim rangers, by Glenelg Hopkins CMA. Bottom right: Platypus monitoring, by Glenelg Hopkins CMA.
Despite a dry year, 2017-18 provided an amazing opportunity to use water for the environment in the Northern Region to consolidate the environmental outcomes provided by wetter conditions in 2016. Water for the environment provided the iconic Murray cod a chance to spawn in the Campaspe River – the first time ever recorded. Gaynor Swamp saw a waterbird boom after environmental flows were delivered there for the first time.

**Northern region**

Water for the environment delivered to the Northern region in 2017–18 (megalitres)

- **Goulburn system**: 355,333 ML
- **Broken system**: 42,908 ML
- **Campaspe River**: 31,294 ML
- **Loddon system**: 18,868 ML
- **Ovens system**: 123 ML
- **Victorian Murray system**: 605,185 ML

“Most of the rain and resulting run-off into the Goulburn River is now captured in dams and used to supply towns, industry and farms, so the amount of water flowing down the river in winter and spring has reduced,” Goulburn Broken CMA’s Simon Casanelia said. “It also means the river flows higher and faster in the hotter months of the year when communities require more water, which is the opposite of what would happen if there were no dams and weirs. These changes have affected the health and survival of native plants and animals, so we’re giving nature a helping hand and delivering environmental flows to provide what the Goulburn River needs to be a healthier waterway.”

Simon said 2018 flows along the lower Goulburn River had been running higher than usual to meet increased downstream demand in the River Murray, so they designed the winter environmental flow to decrease at a slower rate than in the past to reduce the risk of riverbank slumping or erosion.

Once the environmental flow reached the Lower Lakes in South Australia, the water was used to deliver a large winter release from the lakes into the Coorong. This flow triggers upstream migration and spawning of pouched lamprey, a rare and primitive eel-like fish, that enters the Murray system through South Australia’s Coorong estuary.

Pouched lamprey move between saltwater and freshwater to complete their lifecycle, migrating from the sea and travelling large distances upriver to spawn. After a similar environmental flow from the Goulburn River made its way down the Murray in winter 2015, a pouched lamprey that was tagged with a microchip at the Coorong estuary was tracked all the way to Lock 11 near Mildura – a journey of almost 900 kilometres.

Victoria and South Australia have been working closely to coordinate winter environmental flows, achieving the best possible environmental outcomes all the way from the Goulburn River to the Coorong.

Waterway manager: Goulburn Broken CMA
Storage manager: Goulburn-Murray Water

Site | VEWH | MDBA | CEWH | Total
--- | --- | --- | --- | ---
Goulburn River – Reach 1 | 4,015 | | | 4,015
Goulburn River – Reach 4 & 5 | 37,635 | 77,559 | 235,624 | 350,818

Left: Gaynor Swamp, by Goulburn Broken CMA
Above: Goulburn River at Eildon, by Goulburn Broken CMA
The 2017-18 watering year was the first year a flow down the Broken River had been managed specifically for environmental purposes, with the aim of improving habitat for native fish, plants and waterbugs.

Broken system

The 2017-18 watering year was the first year a flow down the Broken River had been managed specifically for environmental purposes, with the aim of improving habitat for native fish, plants and waterbugs.

The environmental flow also aimed to support the establishment, survival and growth of bankside plants and to maintain water quality.

The water levels rose between 300 millimetres and 400 millimetres downstream of Lake Nillahcootie in response to the flow. There was 1,000 megalitres of environmental water traded into the Broken system from the Goulburn system to support this event, and this was delivered along with operational water transfers down the Broken River.

Goulburn Broken CMA's Simon Casanelia said, "Summer was hot and dry, and much of the rain and resulting flow into the Broken River was captured by dams and weirs. We gave nature a helping hand by delivering water at this time of year (autumn) to mimic more natural and variable conditions."

The environmental flow also aimed to support the establishment, survival and growth of bankside plants and to maintain water quality.

"For a number of years, the local community has been asking for environmental flows to be delivered to the wetland and now, because we have suitable infrastructure in place, we were able to make the first significant delivery of water for the environment," said Goulburn Broken CMA's Simon Casanelia.

Five hundred megalitres of water for the environment was provided to partially fill the wetland, which holds about 1,900 megalitres when full.

"The bird response to the watering was incredible! Gaynor Swamp is a known brolga breeding site, and within two days of the water going in our staff had spotted a pair," Simon said.

Scientists from the Arthur Rylah Institute, visiting the site as part of Victoria’s Wetland Monitoring and Assessment Program (WetMAP), along with bird enthusiasts from The Melbourne Birder and Birdlife Australia, also reported a couple of brolga pairs, as well as a diversity of other birds.

"We saw over 300 whiskered terns feeding, along with sharp-tailed sandpipers, red-necked avocets, black winged stilts, yellow-billed spoonbills, white-faced and white-necked herons picking through the mudflats and shallows," said the Arthur Rylah Institute's Danny Rogers.

Scientists from the Arthur Rylah Institute, visiting the site as part of Victoria’s Wetland Monitoring and Assessment Program (WetMAP), along with bird enthusiasts from The Melbourne Birder and Birdlife Australia, also reported a couple of brolga pairs, as well as a diversity of other birds.

"There were white-bellied sea eagles, swamp harriers, wedge-tailed eagles and whistling kites all circling the area while we were there – a sure sign that there has been a productivity boom in response to the watering," Danny said.

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"There were white-bellied sea eagles, swamp harriers, wedge-tailed eagles and whistling kites all circling the area while we were there – a sure sign that there has been a productivity boom in response to the watering," Danny said. Researchers also discovered a vulnerable grassland community, known as Alluvial Plains semi-arid grassland, which is uncommon in this area and usually only found in the Mallee. Survival and growth of new plants in these grassland communities depends on shallow, intermittent flooding every five years, so environmental watering is giving these vulnerable plants a boost.
Murray cod spawning was recorded for the first time in the Campaspe River in 2017, on the back of spring environmental flows.

Four Victorian agencies have been working together to relocate and help establish a healthy population of Murray hardyhead—one of Australia’s most endangered fish.

Central Murray wetlands

Site

Volume delivered in 2017–18 (ML)

VEWH

MDBA

CEWH

Total

Campaspe River

17,940

5,300

6,594

29,834

Coliban River

1,460

-  

-  

1,460

Volume delivered in 2017–18 (ML)

Since 2014, North Central CMA, the Department of Environment, Land, Water and Planning, Arthur Rylah Institute and the VEWH have been using water for the environment to create suitable habitat and conditions for the Murray hardyhead in Lake Elizabeth, near Kerang. Murray hardyhead is a small native fish that was once widespread in rivers and wetlands of the lower Murray-Darling Basin.

“Lake Elizabeth’s elevated salinity and abundant plant life provided us with an opportunity to create beneficial conditions for them,” said Amy. “Through delivering water for the environment, we were able to bring the salinity level down considerably, but still keep it high enough to keep predators such as carp out.

Surveys completed in April 2018 found 94 Murray hardyhead, proving the outstanding success of the relocation.

The endangered fish has been a focus of North Central CMA’s environmental watering program, as has the critically endangered silver perch, the vulnerable Murray-Darling rainbowfish, and golden perch (yellow belly). North Central CMA’s Darren White said, in more good news, summer environmental flows had triggered migration of silver and golden perch from the River Murray and into the Campaspe River.

“Water for the environment helps keep water levels relatively steady at key times of the year and prevents rapid increases or decreases that occur as a result of fluctuating demand during the irrigation season,” Darren said.

Bendigo’s Adrian Leo has been fishing in the Campaspe River between Eppalock Dam and Elmore for years.

“Over the past few years, everything is healthier,” Adrian said.

“The water quality has improved, especially in the areas that have been fenced off and the fishing has really improved. It’s not just the amount and their size, but it is the health of the fish as well.”

Above: Murray cod caught at the Campaspe River, by North Central CMA

Since 2014, North Central CMA, the Department of Environment, Land, Water and Planning, Arthur Rylah Institute and the VEWH have been using water for the environment to create suitable habitat and conditions for the Murray hardyhead in Lake Elizabeth, near Kerang. Murray hardyhead is a small native fish that was once widespread in rivers and wetlands of the lower Murray-Darling Basin.

“The species has suffered a severe decline, with less than 10 populations remaining in the Murray-Darling Basin, and the world,” said North Central CMA’s Amy Russell.

“Only two of these remnant populations exist in Victoria, one in the Swan Hill-Kerang region and the other near Mildura.”

“North Central CMA, the Department of Environment, Land, Water and Planning, and the Arthur Rylah Institute have been working together to create suitable habitat and conditions for the Murray hardyhead in Lake Elizabeth, near Kerang. Murray hardyhead is a small native fish that was once widespread in rivers and wetlands of the lower Murray-Darling Basin.

The river is starting to become healthier over time, as flows are delivered, with plants, animals and communities all reaping the benefits.

Waterway manager:
North Central CMA

Storage manager:
Goulburn-Murray Water

“The water quality has improved, especially in the areas that have been fenced off and the fishing has really improved. It’s not just the amount and their size, but it is the health of the fish as well.”

Above: Murray hardyhead, by North Central CMA

Water for the environment was first delivered to Lake Elizabeth in 2014, and a small number of fish were placed in the lake a year later.

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Above: Murray cod caught at the Campaspe River, by North Central CMA

“Water for the environment was first delivered to Lake Elizabeth in 2014, and a small number of fish were placed in the lake a year later.

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Above: Murray hardyhead, by North Central CMA
Central Murray wetlands

Hird Swamp, part of the internationally recognised Kerang Wetlands, is an important wetland for waterbird resting, nesting and feeding. It is also valued by the community as a popular birdwatching and duck hunting spot.

North Central CMA has been managing a series of environmental flows and drawdowns at the swamp that will limit the growth of reeds, expand the amount of open water, support diversity of wetland plants, rehabilitate plants and provide habitat for waterbirds.

The results are in, and they are sensational! In February 2018, up to 8,000 birds from 47 different species were recorded. One of the highlights was 11 brolgas, including a breeding pair with their young.

Environmental flows are not intended to be delivered for at least another two years to further improve the swamp, as part of the natural wetting and drying cycles.

“Drying the wetland out will ensure the reeds don’t creep back into the swamp and waders can come and make the most of the area,” said Louissa Rogers from North Central CMA.

“Hird Swamp is a great example of environmental flow management being more than just about adding water. It’s about the right amount of water at the right time, mixed in with complementary measures such as revegetation and fencing to protect the site.”

Waterway manager: North Central CMA
Storage manager: Goulburn-Murray Water

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
</tr>
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<tbody>
<tr>
<td>Hird Swamp</td>
<td>2,220</td>
</tr>
<tr>
<td>Lake Elizabeth</td>
<td>310</td>
</tr>
<tr>
<td>Lake Murphy</td>
<td>580</td>
</tr>
<tr>
<td>McDonalds Swamp</td>
<td>350</td>
</tr>
<tr>
<td>Richardsons Lagoon</td>
<td>458</td>
</tr>
<tr>
<td>Round Lake</td>
<td>422</td>
</tr>
<tr>
<td>Wirra-Lo wetland complex</td>
<td>80</td>
</tr>
</tbody>
</table>

Above: Brolgas group at Hird Swamp, by North Central CMA

Highlights of environmental watering 2017-18

- Nationally endangered growling grass frog was recorded at the rehabilitated wetland – the last record of growling grass frog in the area was in 2008
- Nominally endangered growling grass frog was recorded at the rehabilitated wetland – the last record of growling grass frog in the area was in 2008
- Maintained conditions for critically endangered Murray hardyhead
- Supported establishment of new Murray hardyhead population. Threatened waterbirds were observed including royal spoonbill, blue billed duck, common greenshank, Australian shoveler, hardhead and freckled duck
- Over 40 bird species recorded, including threatened Brolga’s crane, whitelipped tern, glossy ibis, royal spoonbill, eastern great egret, Australasian bittern, Australasian little bittern, magpie goose, white-bellied sea eagle, musk duck and nankeen night heron
- Promoted establishment of river red gum seedlings
- Promoted establishment of river red gum seedlings
- Supported establishment of new Murray hardyhead population. Threatened waterbirds were observed including royal spoonbill, blue billed duck, common greenshank, Australian shoveler, hardhead and freckled duck
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Revegetation (mainly for aquatic species) was successfully carried out at the wetland with Barapa Barapa Traditional Owners during the water delivery period.

Rehabilitated various habitat systems including various reedy environments, open water habitats, river red gum and black box floodplain communities.
Lake Cullen is one of 23 wetlands forming the internationally important Kerang Wetlands, which occurs in the larger Central Murray wetlands system.

In 2016 and 2017, North Central CMA delivered environmental flows to Lake Cullen to provide a breeding ground for aquatic plants and waterbugs, which in turn would result in a food boom for birds. To find out if this was successful – and provide information that can guide future deliveries of water for the environment to Lake Cullen – Birdlife Australia teamed up with the VEWH and North Central CMA in February 2018 to hold a ‘Waterbirds of Lake Cullen’ training workshop and field trip for the local community.

Over 50 people from diverse backgrounds attended the workshop, where they gained knowledge from Birdlife Australia and the CMA about the importance of environmental watering to wetlands, how to identify birds, and how participants could contribute to monitoring and conservation.

Since the workshop, information has been flowing into Birdlife Australia’s national database from birdwatchers in the broader Kerang area. Five of these volunteers – including four locals who had not previously been involved in the project – signed on as monthly waterbird monitors.

The records that the birdwatchers have collected are a resounding endorsement of both the success of the watering event and the invaluable contribution that citizen scientists can make to environmental management. Up to 18 threatened species were recorded during the monthly bird counts to June 2018, including freckled ducks, great egrets, little egrets, Australasian bitterns and a pair of brolga. Water for the environment also assisted breeding in six species at Lake Cullen, including the threatened magpie goose. Furthermore, close to 27,000 waterbirds were recorded at Lake Cullen during January and March 2018.

Some of the most exciting observations were of international migratory species which visit Australia from their breeding grounds in the northern hemisphere. These included a black-tailed godwit, which is very rare in Victoria and is listed as a vulnerable species in Victoria.

The most exciting outcome is that citizen scientists have helped to not only record these species, but also identify important habitat needs. Their observations, along with scientific data collected by North Central CMA, gave the CMA and the VEWH the information they needed to deliver more water for the environment into Lake Cullen in the spring of 2018, giving the birds – and the volunteers observing them – a very welcome boost. Following the top-up in October 2018, 29,600 waterbirds were recorded during the November 2018 count.

For left: Waterbirds of Lake Cullen workshop at Kerang, by Zarleen Blakeley, VEWH Centre and right: Identifying birds at Lake Cullen, by Zarleen Blakeley, VEWH

Birdwatchers helping birds at Lake Cullen

Volunteer birdwatchers are giving waterway managers a vital insight into how water for the environment is helping to protect, restore or enhance wetlands and sustain waterbird populations.
At Neds Corner station, Victoria’s largest private nature reserve in the north-west corner of the State, environmental watering is being adapted to protect rare and threatened species.

Each year, careful planning scopes out the likely deliveries of water for the environment at locations across Victoria. But the actual delivery can be influenced by a range of factors, including ecological or biological triggers; for example, the presence, absence or behaviour of key plants or animals. Monitoring and observation are critical to gather the information needed to adapt planning and delivery of environmental flows in the short and longer term.

In September 2017, before environmental flows were delivered, botanists from the Arthur Rylah Institute completed plant monitoring at two of the many wetlands on the property – Neds Corner Central and Neds Corner East. They found 15 threatened plants growing on the drying lake bed at Neds Corner Central, which had received environmental flows the year before.

Phil Papas from the Arthur Rylah Institute said, “Frequent inundation events would be likely to displace most of these rare plants from this wetland. As a comparison, more regularly flooded systems in this area are far more species-poor. While successive years of flooding could occur naturally, this is generally rare and not necessarily helpful to maintaining plant diversity.”

Water for the environment has been critical for keeping this valuable ecosystem healthy.

Waterway manager: Mallee CMA
Storage manager: Goulburn-Murray Water

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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</thead>
<tbody>
<tr>
<td>VEWH</td>
<td>Other</td>
</tr>
<tr>
<td>Brickworks Billabong</td>
<td>250 -</td>
</tr>
<tr>
<td>Cardross Lake</td>
<td>506 -</td>
</tr>
<tr>
<td>Carina Bend</td>
<td>800 -</td>
</tr>
<tr>
<td>J1 Creek</td>
<td>417 -</td>
</tr>
<tr>
<td>Lake Hawthorn</td>
<td>447 -</td>
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<tr>
<td>Liparoo West</td>
<td>240 -</td>
</tr>
<tr>
<td>Little Heywood Lake</td>
<td>612 -</td>
</tr>
<tr>
<td>Neds Corner East</td>
<td>104 -</td>
</tr>
<tr>
<td>Nyah Floodplain</td>
<td>5877 -</td>
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<tr>
<td>Vinifera Floodplain</td>
<td>925 -</td>
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<tr>
<td>Yungara Westland</td>
<td>11 -</td>
</tr>
<tr>
<td>Lock 15 wetlands</td>
<td>+ 1573 -</td>
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Highlights of environmental watering 2017-18

- Shrubs, grasses and herbs germinated when the water receded
- Supported aquatic vegetation that provides habitat for endangered Murray hardyhead
- Supported aquatic plant growth
- Supported river red gum growth
- Formerly dormant black box trees resprouted
- Provided permanent habitat for the endangered broad-shelled turtle
- Improved the condition of mature river red gums and lignum and provided habitat for waterbirds
- Wedding birds were able to forage in the shallow water provided by environmental flows

Left: Lagoon nightshade (Solanum lacunarium) by Nathan Johnson
Scientists from the Arthur Rylah Institute have been keeping their ears to the water listening for golden perch in the Loddon River and Pyramid Creek.

In October 2017, coordinated environmental flows were delivered to the Loddon River and Pyramid Creek to promote migration of Murray cod, silver perch and golden perch. Before delivery of these flows, 69 golden perch were captured, implanted with acoustic tags and released back to the waterways to be tracked so that performance of the environmental flows could be assessed.

Arthur Rylah Institute scientist Matthew Jones said the fish are implanted with an acoustic tag that allows remote tracking of fish for research. “The tag is a sound-emitting device that is harmless to fish.”

“They are linked with acoustic receivers placed in the waterway, allowing us to track the position of fish and determine which way and how far fish are moving when environmental flows are delivered.”

Many of the tagged golden perch responded by moving upstream in the Loddon River and Pyramid Creek when the environmental flow was delivered. One fish moved over 140 kilometres from the River Murray junction and into Kow Swamp. Nearly 40 percent of the fish moved at least 40 kilometres upstream, while about 60 percent remained close to the local area where they were tagged.

“It is an advantage that not all golden perch follow the same movement patterns,” explained Matthew. “It means they can avoid localised catastrophic events and have opportunities to exploit resources in new areas. All of these factors combined increase survival rates and the overall health of the population.”

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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<tbody>
<tr>
<td></td>
<td>VEWH</td>
</tr>
<tr>
<td>Loddon River and Tullaroop Creek</td>
<td>10,958</td>
</tr>
<tr>
<td>Serpentine Creek</td>
<td>3,497</td>
</tr>
<tr>
<td>Pyramid Creek</td>
<td>861</td>
</tr>
<tr>
<td>Little Lake Meran</td>
<td>499</td>
</tr>
</tbody>
</table>

Waterway manager: North Central CMA
Storage manager: Goulburn-Murray Water

Above: Justin O’Connor from the Arthur Rylah Institute releasing a golden perch into the Loddon River at Benjeroop, by Matthew Jones, Arthur Rylah Institute
Right: Loddon River, by Zarleen Blakeley, VEWH
In autumn 2018, North East CMA worked with the Commonwealth Environmental Water Holder and Goulburn-Murray Water to deliver 73 megalitres of water for the environment from Lake Buffalo to the Buffalo River. Additionally, 50 megalitres of water for the environment was provided from Lake William Hovell to the King River. The environmental flows aimed to freshen water quality and provide variability in river height following a weekend rain event.

The Ovens system supports many native fish species including the Murray cod, trout cod, golden perch and fly-specked hardyhead. The Buffalo River is important for large fish species during part of their breeding cycle, while trout cod are found as far up the King River as Whitfield. The Ovens system has seen a successful recovery project for trout cod, and efforts to reintroduce Macquarie perch are underway.

Even a small increase in river height can help fish and other aquatic animals find new food sources. Flows below Lake Buffalo and Lake William Hovell had been steady and low at the time, making this small release of environmental flows all the more important.

Waterway manager:
North East CMA
Storage manager:
Goulburn- Murray Water

### Site

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume delivered in 2017–18 (ML)</th>
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</thead>
<tbody>
<tr>
<td>Ovens River (CEWH)</td>
<td>73</td>
</tr>
<tr>
<td>King River (CEWH)</td>
<td>50</td>
</tr>
</tbody>
</table>

Above: Water released from Lake William Hovell, by North East CMA
Right: Ovens River, by North East CMA
Celebrating its 10th anniversary last year, the Living Murray program is one of Australia’s most significant long-term river restoration projects.

The program uses water for the environment to improve the health of the River Murray Channel, significant floodplain sites along the river, and the wetland/estuary system near the Murray Mouth. Each targeted area is called an ‘icon site’ and four of these icon sites are in Victoria: Barmah Forest, Gunbower Forest, Hattah Lakes, and the Lindsay, Mulcra and Wallpolla islands.

The program started in the middle of the Millennium Drought, when all the sites were showing visible signs of stress or ill health. Trees such as river red gums and black box were in poor condition, and there were low numbers of native fish, waterbirds and other animals such as frogs and turtles using the sites.

Management plans were developed for all icon sites at the start of the program. These plans described environmental objectives and the water regimes needed to achieve those objectives. The required water regimes have been met to varying degrees at each icon site over the last 10 years through a combination of natural floods and managed use of water for the environment.

New water delivery infrastructure built in 2013-14 and 2014-15 gave waterway managers more control over where and when water for the environment could be delivered. This infrastructure significantly improved the environmental outcomes that could be achieved at Gunbower Forest, Hattah Lakes, Lindsay and Mulcra Island and the Chowilla Floodplain. Barmah Forest and the Lower Lakes and Coorong already had good infrastructure. Koondrook-Perricoota Forest has new infrastructure, but it cannot be used to full effect yet.

Every year scientists monitor fish, vegetation, waterbirds and other biological indicators at the icon sites to determine how well each site is tracking against its objectives. The results for each indicator are presented in a report card format that would be familiar to any school student.

The condition of icon sites that have largely received their recommended watering regime has improved since the Millennium Drought, with most of those sites recording overall scores of A or B over the last three or more years.

The recommended watering regime is yet to be implemented at Koondrook-Perricoota, and has only recently been implemented at Chowilla, and as a result these sites have improved little since the end of the Millennium Drought.

The contrasting results between icon sites demonstrates that the science behind the water for the environment program is sound. Where we can deliver the scientists’ recommended water regime we see good outcomes, and where the recommended water regime cannot be delivered the environment suffers.
Key ecological outcome highlights at Victorian sites include:

**Hattah Lakes**

**Understorey plants**
Since condition monitoring started in 2007 and intervention monitoring projects started in 2011-12, 46 rare and threatened plants have been recorded on the Hattah Lakes floodplain. Some of these species (including Pluchea rubelliflora) are being recorded for the first time in Victoria, while others are being recorded after a prolonged absence, such as Sauropus trachyspermus (also called ‘slender spurge’). Since condition monitoring started in 2007, 46 rare and threatened plants have been recorded on the Hattah Lakes floodplain. Some of these species (including Pluchea rubelliflora) are being recorded for the first time in Victoria, while others are being recorded after a prolonged absence, such as Sauropus trachyspermus (also called ‘slender spurge’).

- Hattah Lakes
- Understorey plants
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- Lindsay, Mulcra and Wallpolla islands
- Fish
Twelve native fish have been recorded over the last 10 years, including high numbers of the iconic Murray cod. Although some species have fluctuated depending on water availability in wetlands, there has been a trend of increasing abundance over time for all native species. The last seven years have seen the return of the endangered freshwater catfish in the waterways of the Icon sites, while Mulloon Creek is renowned as arguably the best Murray cod habitat in the Murray-Darling Basin.

- Barmah Forest
- Waterbirds
Water for the environment is used to provide ideal conditions in Barmah Forest for the successful breeding of waterbirds. In 2015-16, seven species of colonial nesting waterbirds raised chicks from 1,900 nests supported by environmental flows, including little pied cormorants, little black cormorants, Australasian darters, royal spoonbills, Australian white ibis, straw-necked ibis and eastern great egrets.

**Gunbower Forest**

**Aquatic plants**
In 2017, following a carp elimination trial, vast swaths of river swamp wallaby-grass (listed in the Environment Protection and Biodiversity Conservation Act) have sprouted up in Reedy Lagoon. River swamp wallaby-grass had been observed in previous years that Reedy Lagoon was watered, but the coverage in 2017 was prolific. Another highlight has been the recovery of the aquatic and semi-aquatic understorey found in areas where there was previously bare ground during the Millennium Drought.

The Icon site condition: The Living Murray report was released by the Murray-Darling Basin Authority in May 2016.

For more information:

Above: Royal spoonbill chicks at Boals, December 2016, by Keith Ward, Goulburn Broken CMA
Right: Blue pimpernel (Anagallis arvensis caerulea), Hattah Lakes, by Mallee CMA
The method of watering was very efficient. Over 90 percent of the water was returned to the Murray and can be used again at Hattah Lakes. Additionally, nearly half of the water delivered to the Hattah Lakes were returned to the River Murray and continued to provide environmental benefits in the lower Lakes of South Australia. A real win for all.

The Hattah Lakes and floodplains were inundated for four consecutive months, providing perfect conditions for native plants and animals and acts as a refuge in dry years. This provided habitat for threatened freckled ducks and other waterbirds.”

Meanwhile, monitoring has also shown that Hattah is supporting an increased number of native, rare and threatened plants. Environmental watering is delivering results in this place that is highly valued by visitors and locals alike.

Waterway manager: Mallee CMA
Storage manager: Goulburn-Murray Water, Murray-Darling Basin Authority (River Murray Operations)

Research into the health of the Hattah Lakes is already demonstrating that these environmental flows are achieving their intended outcomes. In 2009, only 19 percent of black box trees at Hattah Lakes were healthy, compared to 61 percent by 2017. Prior to 2016, it was thought that as few as 150 threatened regent parrots were still living in the Hattah-Kulkyne region. In 2016 there were 1600 regent parrots sighted in just two hours. Regular environmental watering has helped the regent parrot find a new lease on life.

Before and during floods in 2016, Murray cod were recorded leaving the system and moving downstream towards South Australia. Sadly, many fish also died in a natural hypoxic blackwater event that followed the floods. Hypoxic blackwater can occur after floods when high loads of leaf litter and vegetation from the floodplain breaks down, depletes oxygen in the water, and suffocates fish.

Brad Hollis at the Mallee Catchment Management Authority explained that native fish are re-establishing following the floods. “This year, a radio tracking study found that many tagged adult Murray cod have returned to the Lindsay-Mullaroo system. Juvenile Murray cod also inhabit in Mullaroo Creek, which means that they’ve been successfully breeding in recent years.”

Environmental flows in Lindsay River are helping Murray cod to recover after tragic events in 2016. “Weir pool raising in spring 2017, which was specifically for environmental objectives in the Lock 7 weir pool, increased flows in the upper Lindsay River, allowing us to deliver 8,000 megalitres of water for the environment to Lake Wallawalla. This provided habitat for threatened freshwater blackbirds and other waterbirds.”

Waterway manager: Mallee CMA
Storage manager: Goulburn-Murray Water, Murray-Darling Basin Authority (River Murray Operations)
Ready Lagoon and Black Swamp are of particular cultural importance to Barapa people, who identified a need for an environmental flow in spring 2017 to support native vegetation and waterbirds, an assessment supported by the Murray-Darling Basin Authority. However, there was one big problem — water that had remained in the wetlands following the 2016 floods was full of carp. The carp were damaging wetland vegetation and stirring up sediment, causing high turbidity, and as most of them were mature adults ready to spawn, any new water would easily boost their numbers.

To solve this challenge, Barapa Barapa custodians and CMA staff hit on a novel solution. Firstly, they pumped the existing water out and then Barapa Barapa CMA staff manually removed the carp — all 600 kilograms of them — so that the water for the environment could be delivered for the environment could be delivered in spring 2017 to support native vegetation and waterbirds, which is listed as vulnerable under Federal environmental legislation.

The success of this program highlights how a successful partnership between Traditional Owners and catchment managers can result not just in benefits for communities, but also assist species and ecosystems in ways that far exceed what could be achieved by environmental flows alone.

Above: Sharnie Hamilton (Barapa Barapa) and CMA staff muddy from pumping Reedy Lagoon and Black Swamp, by North Central CMA.

Waterway managers: North Central CMA
Storage manager: Goulburn-Murray Water, Murray-Darling Basin Authority (River Murray Operations)

Goulburn Forest

Plants and animals in Black Swamp and Reedy Lagoon are thriving, due to a creative combination of management strategies adopted by Barapa Barapa Traditional Owners and North Central CMA.

In autumn 2017, a horse and pig-proof fence was erected in Little Rushy Swamp to protect 10 hectares of vegetation from over-grazing. The effects were remarkable. When environmental flows were delivered to Little Rushy Swamp the following spring, Moira grass and river swamp wallaby-grass within the fenced-off area flourished. Keith Ward at Goulburn-Broken CMA said that the pictures tell a thousand words. “From the photographs taken over 12 months, it is really clear that threatened Moira grass and river swamp wallaby-grass has flourished with less competition by introduced grazing animals. With the exclusion of the grazing animals, this trial helps us to better understand the optimal timing and duration of flows that we need to provide to benefit Moira grass across the whole forest.” While the fencing excluded grazing by introduced animals at Little Rushy Swamp, in another unfenced part of Barmah Forest the impact of feral pigs was seen. Over one hundred pairs of ibis had laid eggs and were busy fussing over their nests when feral pigs came through and destroyed the colony. Motion-activated cameras captured the moment the pigs ate the eggs, resulting in the adult birds abandoning the colony and a generation of young birds lost.

The information captured from this event was used in real-time to end the delivery of environmental flows to the wetland early — no longer necessary after the birds abandoned their nests. It will also help managers adapt future delivery of water for the environment, for example by increasing the water height in future years to deter pigs and protect the birds.

These events highlight how other environmental management actions, such as fencing and pest animal control, can complement the delivery of water for the environment, resulting in greater benefits for native species and ecosystems.

Waterway manager: Goulburn-Broken CMA
Storage manager: Goulburn-Murray Water, Murray-Darling Basin Authority (River Murray Operations)

Barmah Forest

A trial exclusion of feral horses and pigs is having a great benefit for some of the vulnerable vegetation that makes Barmah Forest so special and internationally recognised as a highly significant environment.

Volume delivered in 2017-18 (ML)

<table>
<thead>
<tr>
<th>Site</th>
<th>VEWH</th>
<th>MDBA</th>
<th>CEWH</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>Goulburn Forest</td>
<td>9,579</td>
<td>808</td>
<td>-</td>
<td>10,387</td>
</tr>
<tr>
<td>Goulburn Creek</td>
<td>20,656</td>
<td>20,656</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Volume delivered in 2017-18 (ML)

<table>
<thead>
<tr>
<th>Site</th>
<th>VEWH</th>
<th>MDBA</th>
<th>CEWH</th>
<th>Other</th>
<th>Total</th>
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<tbody>
<tr>
<td>Barmah Forest floodplain</td>
<td>17,200</td>
<td>27,934</td>
<td>140,547</td>
<td>247,457</td>
<td>433,558</td>
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<tr>
<td>Boals Deadwood</td>
<td>3,014</td>
<td>-</td>
<td>-</td>
<td></td>
<td>3,014</td>
</tr>
<tr>
<td>Top Island</td>
<td>967</td>
<td>-</td>
<td>-</td>
<td></td>
<td>967</td>
</tr>
</tbody>
</table>

Above left: Little Rushy Swamp, by Goulburn Broken CMA
Bottom sequence: Ibises attacked by feral pigs, captured on motion-activated cameras, by Goulburn Broken CMA.
Just over 100 years ago, the River Murray was changed forever. Instead of water flowing across the landscape naturally, it was captured in storages by dams and weirs, diverted by pipelines, levees and constructed channels, and used for towns, industry and farming. As a result, big floods became less frequent, and the health of the river and the wetlands, floodplains and lakes that relied on the river suffered. Environmental watering projects are helping mimic more traditional water flows, bringing new life and hope to unique sites in the Mallee, such as Hattah Lakes.

The focus of this on-Country day was to demonstrate the difference between areas receiving environmental water, compared to those which aren’t. Thanks to a series of pumps and weirs installed in 2012 as part of the first stage of the Hattah project, large areas of the Hattah-Kulkyne National Park are receiving water, and the group spent the day exploring these lakes, which are brimming with wildlife and fresh growth, before moving on to visit a dry area.

Everyone was stunned by the difference. The ARG members described the un-watered areas as being like a ‘fire and brimstone landscape’.

“We ended up on the banks of a dry lake in the far north of the national park, and here we really saw what happens to our land when it’s not cared for; all the water plants are gone, replaced with salt bush and other dryland plants. The banks are lined with trees only just clinging to life. There are no birds and a light salt crust has formed on the bottom of the lake.”

The group participated in a plant survey and were delighted to see that native plants are returning to areas getting water, including ‘old man weed’ and ‘broom brush’. ARG members were able to share the importance of these plants, once used for medicinal purposes and to keep their elders’ camps clean.

The experience and knowledge-sharing between the ARG and Mallee CMA staff will be invaluable for future water for the environment projects, as the ARG provides guidance to the CMA on Aboriginal community engagement and input into Mallee CMA initiatives and regional plans.
Drawdown – Water released from a body of water (such as a reservoir) at the end of the irrigation season and actively released to meet purposes.

Drawdown – Water released from storages to operate river and distribution systems and to help deliver water for environmental or disciplinary. The volume of passing flows is generally determined by inflows to those storages.

Gigalitre (GL) – One billion (1,000,000,000) litres.

Groundwater – Water held underground in the soil or in pores and crevices in rock.

Hydrology – The study of the properties of water and its movement in relation to land.

Juvenile – A stage of life at which an animal or plant is not yet fully mature.

Land manager – An agency or authority responsible for conserving natural and cultural heritage on public land including parks and reserves.

Megalitre (ML) – One million (1,000,000) litres.

Millennium Drought – One of the worst droughts recorded in Australia since European settlement, it went from about 1997 to 2009.

Passing flows – Water released from storages to operate river and distribution systems and to help deliver water for environmental or disciplinary. The volume of passing flows is generally determined by inflows to those storages.

Recruitment – The increase in plants or animals when they survive to the settlement or maturity stage.

Return flows – Any flows delivered for environmental purposes and then returned to the downstream system to be reused for other purposes. Return flows may be captured and stored downstream for later reuse, although most commonly they remain within the waterway for instream reuse.

Riverbank slumping – A form of mass wasting in a river or stream that occurs when a coherent mass of loosely consolidated materials or rock layers moves a short distance down a slope.

Spawning – When fish release eggs for fertilisation. Spawning sites are the sites where they release the fertilised eggs.

Storage manager – Appointed by the Minister for Water to operate major water storages in a river basin to deliver to entitlement holders.

Unregulated entitlement – An entitlement to water declared during periods of unregulated flow in a river system that is, flows that cannot be captured in storages.
### Summary of environmental water delivery 2017–18

<table>
<thead>
<tr>
<th>Region</th>
<th>System</th>
<th>Water Delivery (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gippsland Region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latrobe system</td>
<td>Latrobe River</td>
<td>11,223.6</td>
</tr>
<tr>
<td></td>
<td>Lower Latrobe wetlands</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Heart Morass</td>
<td>Water was diverted into Heart Morass from the Latrobe River</td>
</tr>
<tr>
<td></td>
<td>Sale Common</td>
<td>Water was diverted into Sale Common from the Latrobe River</td>
</tr>
<tr>
<td></td>
<td>Dowd Morass</td>
<td>Water was diverted into Dowd Morass from the Latrobe River</td>
</tr>
<tr>
<td>Thomson River</td>
<td>18,072.0</td>
<td></td>
</tr>
<tr>
<td>Mcoalister River</td>
<td>15,884.0</td>
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</tr>
<tr>
<td>Snowy River</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Gippsland region total</strong></td>
<td>45,179.6</td>
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<tr>
<td><strong>Central Region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yarra system</td>
<td>Yarra River</td>
<td>24,035.0</td>
</tr>
<tr>
<td></td>
<td>Yering Backwamp</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td>Bolin Bolin Billabong</td>
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</tr>
<tr>
<td>Tarago River</td>
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</tr>
<tr>
<td>Mansbymong system</td>
<td>Upper Jacksons Creek</td>
<td>200.2</td>
</tr>
<tr>
<td></td>
<td>Wennebee Creek</td>
<td>1,265.3</td>
</tr>
<tr>
<td></td>
<td>Wennebee River</td>
<td>1,907.3</td>
</tr>
<tr>
<td>Moorabool River</td>
<td>2,745.5</td>
<td></td>
</tr>
<tr>
<td>Lower Barwon wetlands</td>
<td>Reedy Lake Water was diverted into Reedy Lake from the Barwon River</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hospital Swamps</td>
<td>Water was diverted into Hospital Swamps from the Barwon River</td>
</tr>
<tr>
<td><strong>Central region total</strong></td>
<td>31,426.3</td>
<td>13,107.6</td>
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<tr>
<td><strong>Western Region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glenelg system</td>
<td>Glenelg River</td>
<td>11,000.0</td>
</tr>
<tr>
<td>Wimmera system</td>
<td>Wimmera River</td>
<td>6,071.7</td>
</tr>
<tr>
<td></td>
<td>MacKenzie River and Burnt Creek</td>
<td>6,403.0</td>
</tr>
<tr>
<td></td>
<td>Lower Mount William Creek</td>
<td>764.5</td>
</tr>
<tr>
<td></td>
<td>Wimmera-Mallee wetlands</td>
<td>279.0</td>
</tr>
<tr>
<td><strong>Western region total</strong></td>
<td>24,518.2</td>
<td>3,070.6</td>
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</tbody>
</table>

### Summary of environmental water delivery 2017–18

<table>
<thead>
<tr>
<th>Region</th>
<th>Water Delivery (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Region</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Victorian Murray</strong></td>
<td></td>
</tr>
<tr>
<td>Barmah Forest</td>
<td>Barmah Forest floodplain</td>
</tr>
<tr>
<td></td>
<td>Boals Deadwood</td>
</tr>
<tr>
<td></td>
<td>Top Island</td>
</tr>
<tr>
<td><strong>Gundibower</strong></td>
<td>Gundibower Forest</td>
</tr>
<tr>
<td></td>
<td>Gundibower Creek</td>
</tr>
<tr>
<td><strong>Central Murray wetlands</strong></td>
<td></td>
</tr>
<tr>
<td>Hirds Swamp</td>
<td>-</td>
</tr>
<tr>
<td>Lake Elizabeth</td>
<td>-</td>
</tr>
<tr>
<td>Lake Murphy</td>
<td>-</td>
</tr>
<tr>
<td>McDonalds Swamp</td>
<td>-</td>
</tr>
<tr>
<td>Richardson's Lagoon</td>
<td>-</td>
</tr>
<tr>
<td>Round Lake</td>
<td>-</td>
</tr>
<tr>
<td>Wimri-Lo wetland complex</td>
<td>-</td>
</tr>
<tr>
<td><strong>Hattah Lakes</strong></td>
<td>6,9577.7</td>
</tr>
<tr>
<td><strong>Lower Murray wetlands</strong></td>
<td></td>
</tr>
<tr>
<td>Brickworks Billabong</td>
<td>249.9</td>
</tr>
<tr>
<td>Cardross Lake</td>
<td>505.8</td>
</tr>
<tr>
<td>Carina Bend</td>
<td>800.0</td>
</tr>
<tr>
<td>Jt Creek</td>
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</tr>
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<td>Lake Hawthorn</td>
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<tr>
<td>Liparos West</td>
<td>239.7</td>
</tr>
<tr>
<td>Little Heywood Lake</td>
<td>516.6</td>
</tr>
<tr>
<td>Neds Corner East</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>43,557.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>247,470.0</td>
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<tr>
<td><strong>Total</strong></td>
<td>433,557.9</td>
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## Summary of environmental water delivery 2017–18

### Northern Region

<table>
<thead>
<tr>
<th>Victorian Murray</th>
<th>Lower Murray wetlands</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
<th>Total (ML)</th>
</tr>
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<tbody>
<tr>
<td>Nyah Floodplain</td>
<td></td>
<td>1,877.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,877.1</td>
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<tr>
<td>Vinifera Floodplain</td>
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<td>935.2</td>
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<tr>
<td>Yungara Wetland</td>
<td></td>
<td>111.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>111.0</td>
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<tr>
<td>Lock 15 wetlands</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,573.0</td>
<td>1,573.0</td>
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</table>

Lindsay, Mulcra and Wallpolla islands

<table>
<thead>
<tr>
<th>Lindsay Island – including Lindsay River, Mulranor Creek and the Lock 7 weir pool</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
<th>Total (ML)</th>
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<tbody>
<tr>
<td>8,001.3</td>
<td>-</td>
<td>-</td>
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<td>8,001.3</td>
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</table>

Mulcra Island – including Pottawalloogee Creek and the Lock 8 weir pool

Wallpolla Island – Wallpolla East

### Ovens system

<table>
<thead>
<tr>
<th>Ovens River</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
<th>Total (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo River</td>
<td></td>
<td>-</td>
<td>73.0</td>
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King River

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<thead>
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<th>King River</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
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<td>50.0</td>
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Goulburn system

<table>
<thead>
<tr>
<th>Goulburn River – Reach 1</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
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<tr>
<td>4,015.3</td>
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<table>
<thead>
<tr>
<th>Goulburn River – Reach 4 &amp; 5</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
<th>Total (ML)</th>
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<tbody>
<tr>
<td>73,634.6</td>
<td>73,359.0</td>
<td>235,633.6</td>
<td>-</td>
<td>350,872</td>
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Gaynor Swamp

<table>
<thead>
<tr>
<th>Gaynor Swamp</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
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<tbody>
<tr>
<td>500.2</td>
<td>-</td>
<td>-</td>
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### Summary of environmental water delivery 2017–18

<table>
<thead>
<tr>
<th>Northern Region</th>
<th>VEWH (ML)</th>
<th>MDBA (ML)</th>
<th>CEWH (ML)</th>
<th>Other (ML)</th>
<th>Total (ML)</th>
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</thead>
<tbody>
<tr>
<td>Broken system</td>
<td>Broken River</td>
<td>1,000.0</td>
<td>-</td>
<td>-</td>
<td>1,000.0</td>
</tr>
<tr>
<td></td>
<td>Lower Broken Creek</td>
<td>-</td>
<td>-</td>
<td>41,408.0</td>
<td>41,408.0</td>
</tr>
<tr>
<td></td>
<td>Meddie Swamp</td>
<td>-</td>
<td>-</td>
<td>500.0</td>
<td>500.0</td>
</tr>
<tr>
<td>Campaspe system</td>
<td>Campaspe River</td>
<td>17,040.0</td>
<td>5,300.0</td>
<td>6,594.0</td>
<td>29,934.0</td>
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<tr>
<td></td>
<td>Coliban River</td>
<td>1,460.0</td>
<td>-</td>
<td>-</td>
<td>1,460.0</td>
</tr>
<tr>
<td>Loddon system</td>
<td>Loddon River and Tulloarook Creek</td>
<td>10,957.6</td>
<td>-</td>
<td>3,053.9</td>
<td>14,011.5</td>
</tr>
<tr>
<td></td>
<td>Serpentine Creek</td>
<td>3,496.7</td>
<td>-</td>
<td>-</td>
<td>3,496.7</td>
</tr>
<tr>
<td></td>
<td>Pyramid Creek</td>
<td>861.0</td>
<td>-</td>
<td>-</td>
<td>861.0</td>
</tr>
<tr>
<td></td>
<td>Little Lake Meran</td>
<td>498.8</td>
<td>-</td>
<td>-</td>
<td>498.8</td>
</tr>
</tbody>
</table>

### Other source refers to water that was not accounted for under the environmental Water Holdings. For Barmah Forest this includes unverified data for deliveries made through New South Wales accounts.

### The VEWH’s environmental entitlements in the lower Latrobe and lower Barwon systems allow the diversion of water from the Latrobe and Barwon rivers into the wetlands at any time when specific river heights are met. The entitlements do not consist of a set volume and the volume of water diverted into the wetlands is not measured.

### Environmental flows to the Snowy River are managed by the New South Wales Department of Industry, using water made available by Victoria and New South Wales.

### Water used in Bolin Bolin Billabong was diverted from an environmental flow release in the Yarra River.

### In 2017–18, water allocations co-purchased by Melbourne Water and the VEWH contributed to the delivery of 290.2 ML of environmental water to meet environmental objectives in upper Jackson Creek, in the Maribyrnong system, where no permanent environmental Water Holdings are held.

### Delivery to these systems included reuse of return flows.

### Delivery to Little Heywood Lake re-used water delivered to Heywood Lake in 2016–17.

### Environmental flows in Lindsay River, Mulranor Creek, Pottawalloogee Creek and the Lock 15 weir pools in Victoria were achieved by manipulation of water levels in the River Murray locks 7 and 15 weir pools in New South Wales. Use of water for the environment, supplied by the Commonwealth Environmental Water Holder, is attributed to Victoria when weir pools are raised specifically for Victorian sites. Water is attributed to New South Wales at all other times.
water for healthy waterways, valued by communities

vewh.vic.gov.au

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W: www.vewh.vic.gov.au