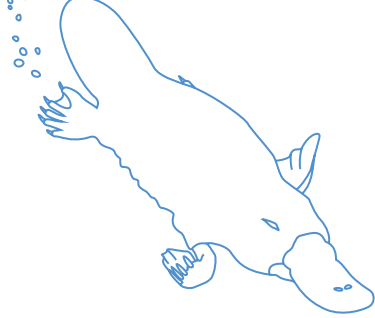




# Water for the Environment

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 are still 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 Victoria’s waterway, storage and land managers, all of which work tirelessly to improve the health of the state’s rivers, wetlands and floodplains.

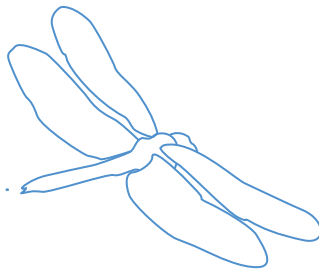
Victoria’s water for the environment program is overseen by the Department of Environment, Land, Water and Planning (DELWP) on behalf of the Minister for Water. It is part of the Victorian Government’s broader \$222 million investment in healthy waterways and catchments.

Collaboration is an important focus of the Victorian Environmental Water Holder. We have a pivotal partnership with Victoria’s waterway managers - catchment management authorities (CMAs) and Melbourne Water (see logos below).



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

This investment includes delivering water for the environment, improving habitat alongside and within our waterways, restoring connectivity so that fish can move freely and monitoring to demonstrate the outcomes being achieved.

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 floodplains. In every Reflections report there are positive examples for our native fish such as Australian grayling, our waterbirds including the threatened brolga, and other animals such as the elusive platypus, as well as the environments on which they rely.

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 environmental watering in regulated

river systems across Victoria, which in turn provides the evidence to sustain organisations like the VEWH.

I commend the Victorian Environmental Water Holder and partners in the environmental watering program for their continuing focus on using water as efficiently and effectively as possible. I was pleased to see that 82 percent of environmental flows delivered in 2017-18 in northern Victoria were re-used to meet downstream environmental water needs.

The outcomes highlighted in Reflections soundly demonstrate how, integrated with broader waterway health programs, water for the environment provides significant benefits for Victorian waterways and communities.



Hon Lisa Neville MP Minister for Water



## Welcome to *Reflections – Water for the Environment in Victoria 2017-18*. This annual publication reflects the work of the Victorian Environmental Water Holder and its program partners in supporting rivers, wetlands, wildlife and communities.

Healthy rivers and wetlands are at the heart of healthy communities across Victoria, with studies showing they contribute significant 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 placed stress on many communities, rivers and wetlands across the state, particularly in 2018.

When we experience dry 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 sustain them so that they and the plants, animals and people who rely on them, can recover and flourish once dry conditions ease.

The Victorian Environmental Water Holder and lead partners such as Catchment Management Authorities continually strive to engage with local communities, Traditional Owners and scientists to incorporate local knowledge to inform our seasonal watering plans.

It's essential for us to understand the challenges within each region so we can provide the most beneficial waterway environments through 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 activities such as carp removal, fencing off waterways from stock and creating off-stream watering points, plant and animal scientific monitoring and cultural surveys.

Citizen science is playing an increasingly valuable role in our planning. Community wetland bird monitoring, record keeping at fishing

competitions, cultural studies and reporting of sightings of rare animals like platypus and frogs all benefit our understanding of the importance and impacts of water for the environment. Social and economic studies improve understanding that water for the environment truly benefits everyone.

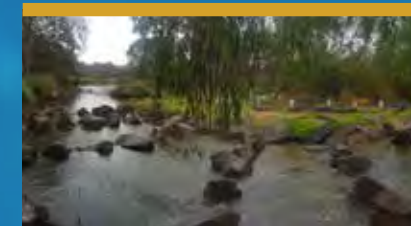
*Reflections* gives us the opportunity to highlight what water for the environment delivers to people, the economy and the environment. It is a privilege to work with our program partners who all share a similar passion for ensuring the work we do today looks after the long-term health of our communities,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



Denis Flett  
Chairperson

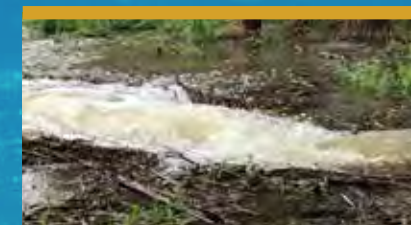






#### Werribee system

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, benefitting fish and other animals. It was also certainly a delight for keen paddlers!



#### Thomson, Macalister and Latrobe systems

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



#### Campaspe River

Environmental flows are boosting fish populations in the Campaspe River. Murray cod spawning was recorded for the first time in 2017, and golden and silver perch were recorded migrating into the river from the Murray.



#### Hattah Lakes

Hattah Lakes was filled to its highest level since the 1990s to sustain black box woodlands, native fish populations and waterbird breeding.



#### Goulburn system

Gaynor Swamp saw a waterbird boom after environmental flows were delivered there for the first time, with broilgas 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.



#### Wimmera 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.



# victoria's environmental watering program

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.

## How does 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).



Above: Before and after the development of dams, weirs and channels  
Left: White-plumed honeyeaters at Mutton Swamp, by Jenny Stephens



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 corporations), 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 Victorian Environmental Water Holder

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 Communities, Protecting Victoria's

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 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.

Citizen 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.

Traditional Owners

Traditional Owners and their Nations in Victoria have an enduring connection to Victoria's waterways spanning tens of thousands of years.

Some Traditional Owner groups are assisting with monitoring environmental watering outcomes. Barapa Barapa Traditional Owners are monitoring in Gunbower Forest, and Budj Bim rangers and Barengi Gadjin Land Council Aboriginal Corporation are monitoring in the Glenelg River, including recording the presence of platypus.

The VEWH and program partners recognise and support the need to develop enduring partnerships with Traditional Owner Nations who want to participate in the management of water for 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.




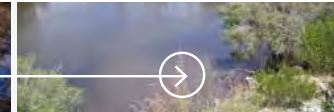
Effective and efficient management

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 reuse of return flows and use of other water management tools such as carryover and trade. Other options, including working with storage managers to alter 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 storages 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.

			
<b>Drought</b>	<b>Dry</b>	<b>Average</b>	<b>Wet to very wet</b>
<b>Main objective: PROTECT</b>	<b>Main objective: MAINTAIN</b>	<b>Main objective: RECOVER</b>	<b>Main objective: ENHANCE</b>
<ul style="list-style-type: none"><li>▶ Avoid critical loss</li><li>▶ Maintain key refuges</li><li>▶ Avoid catastrophic events</li></ul>	<ul style="list-style-type: none"><li>▶ Maintain river functioning with reduced reproductive capacity</li><li>▶ Maintain key functions of high priority wetlands</li><li>▶ Manage within dry-spell tolerances</li></ul>	<ul style="list-style-type: none"><li>▶ Improve ecological health and resilience</li><li>▶ Improve recruitment opportunities for key animal and plant species</li></ul>	<ul style="list-style-type: none"><li>▶ Restore key floodplain and wetland linkages</li><li>▶ Enhance recruitment opportunities for key animal and plant species</li></ul>

Examples of environmental watering objectives under different planning scenarios



VEWH Commissioners: Chris Chesterfield, Rueben Berg, Geoff Hocking and Denis Flett at Barmah Forest, by Sarina Loo, VEWH



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 watering year included:

- in the Central region, Melbourne Water and the VEWH jointly purchased just under 300 megalitres to allow the Maribyrnong 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.
- 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, Moorabool River, Loddon River, Pyramid Creek, Gunbower Forest and others.

## Investing in research and catchment improvements

The VEWH invests in monitoring and technical investigations such as research to better understand hydrology, community engagement and infrastructure projects.

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 Bim and Barengi Gadjin Land Council Rangers and Traditional Owners
- a citizen science project with Birdlife Australia to monitor waterbird response to environmental watering of Lake Cullen

## 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.

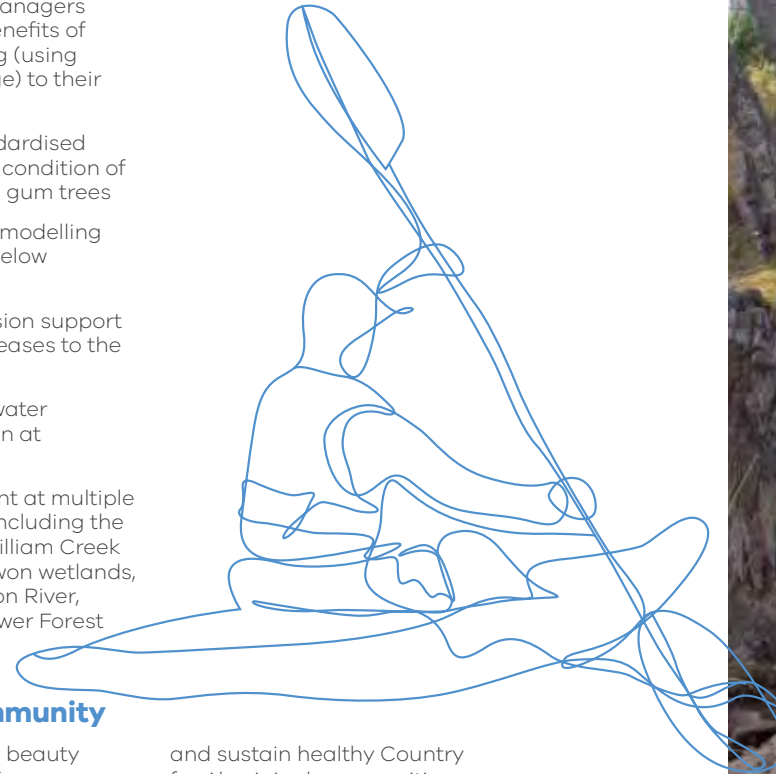
By improving the health of waterways, water for the environment supports vibrant and healthy communities sustaining towns, farms and businesses. In a recent survey, 90 percent of Victorians said they visited waterways to relax, rest and enjoy the scenery.

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,

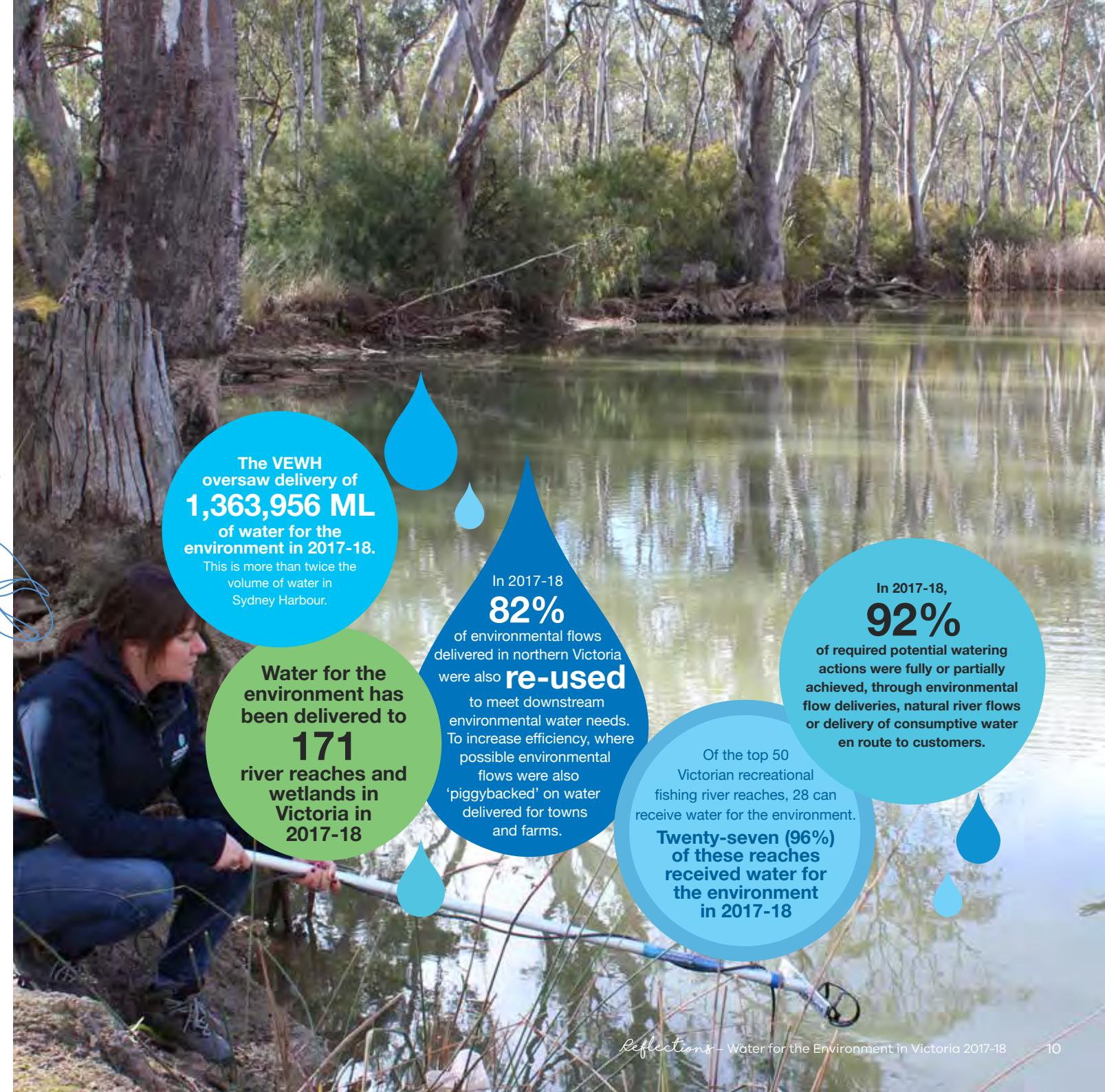
and sustain healthy Country for Aboriginal communities.

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, wetlands 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.



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



The VEWH  
oversaw delivery of  
**1,363,956 ML**  
of water for the  
environment in 2017-18.  
This is more than twice the  
volume of water in  
Sydney Harbour.

Water for the  
environment has  
been delivered to  
**171**  
river reaches and  
wetlands in  
Victoria in  
2017-18

In 2017-18  
**82%**  
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.

Of the top 50  
Victorian recreational  
fishing river reaches, 28 can  
receive water for the environment.  
**Twenty-seven (96%)**  
of these reaches  
received water for  
the environment  
in 2017-18

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



# it's not just about adding water

**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 Sale Common, and fencing out feral animals at Little Rushy Swamp.

## 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 pest 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.

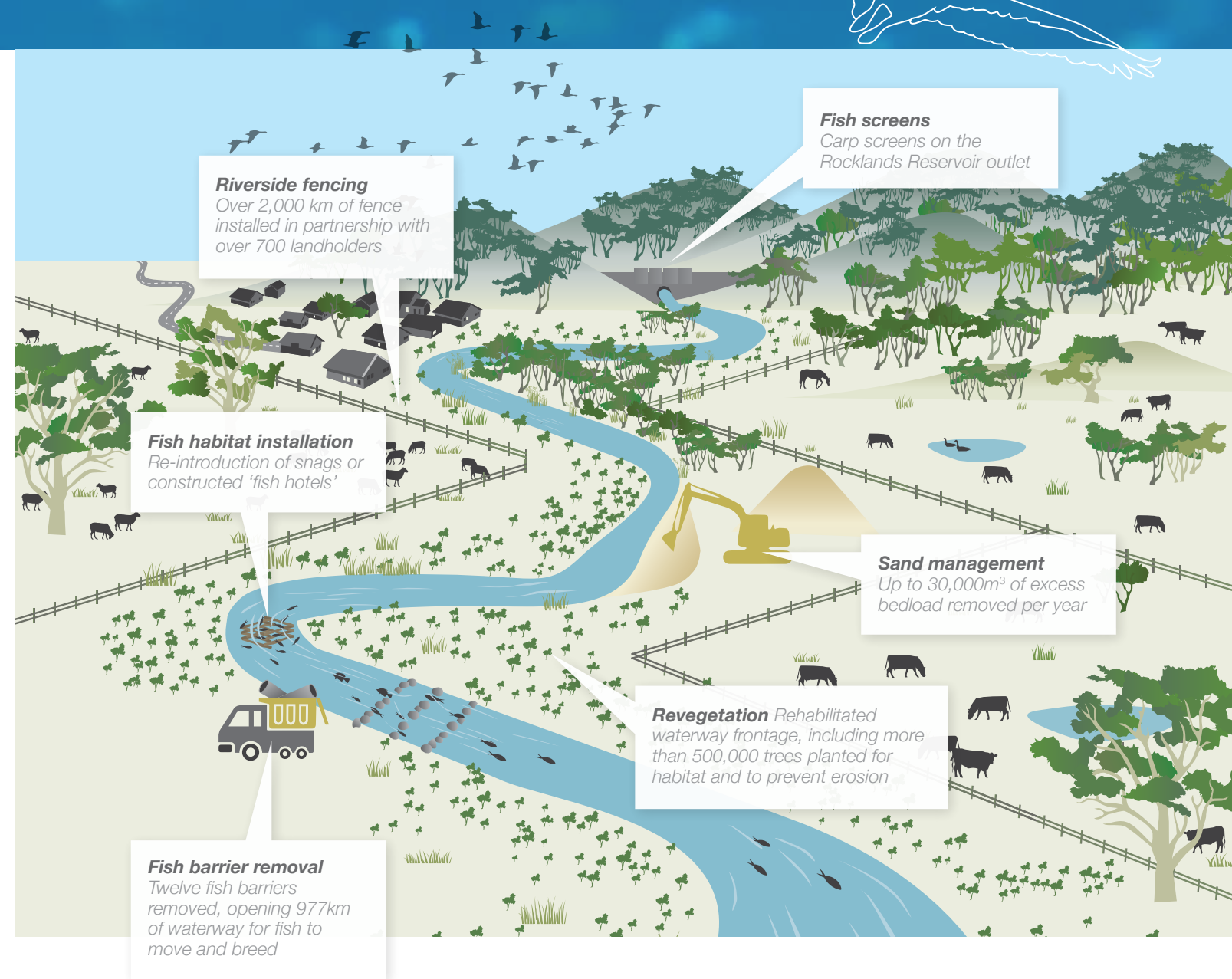
"Our fish monitoring back in 2009 found a single female tupong just upstream of Dartmoor. We've since been delivering a program of environmental flows, removed 12 different barriers to fish movement, and installed habitat in the river so they have places to feed and rest – amongst other things. We've 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 are also found well up the river system and are being caught in big numbers.



Above: Measuring estuary perch, by Glenelg Hopkins CMA

## The Glenelg River restoration project





# why do we water when it's dry?



## 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.

### Building on the good start

To support strong, healthy rivers and wetlands, water for the environment was delivered in 2017-18 to build upon the benefits the previous wet year provided. One wet year does not make the environment healthy. It is nature's way of providing a boost, but good follow-up years are needed to build on the gains made and to ensure the benefits from past watering is not lost. The best outcome for the environment is when these good follow-up years bridge the gap between floods.

As dry conditions through winter and spring unfolded in 2017-18, water for the environment was delivered across the landscape, to rivers, wetlands and floodplains. In many cases, this meant watering (topping up) wetlands and floodplains that were flooded the year before.

In northern Victoria, environmental flows were delivered to new river red gums and black box trees that started growing after the 2016-17 floods to help them become established and better able to survive the next dry period.

Likewise, environmental flows in rivers provided ideal conditions for native fish that recruited in the floods to disperse and boost populations across the whole river system. In places like the Wimmera River, platypus populations had reduced their distribution to the healthiest sections of waterways. Environmental flows have now supported the dispersal of platypus back into sections of waterways that have recovered by bridging the gap between wetter years.



### 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.



Right: Neds Corner watering, by Mallee CMA

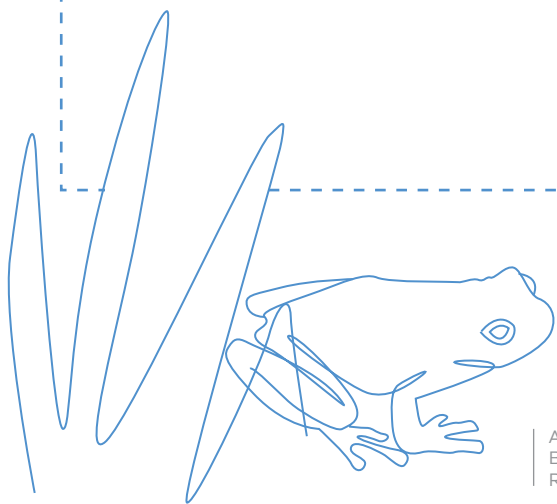


## \* Hattah Lakes benefits from a top up

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.



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





# Gippsland region

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.

## 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



### Latrobe system

**Carp are known as the 'rabbits of the river' due to their prolific breeding and the damage they do to the aquatic environment. By late April, after a hot summer, Sale Common was almost completely dry, apart from a 'big waterhole' where hundreds of carp had congregated.**



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 'mumbling', 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

Site	Volume delivered in 2017-18 (ML)
Latrobe River	11,224
Heart Morass	Water was diverted into Heart Morass from the Latrobe River
Sale Common	Water was diverted into Sale Common from the Latrobe River
Dowd Morass	Water was diverted into Dowd Morass from the Latrobe River

Above: Welcome swallows at Sale Common, by David Stork, West Gippsland CMA



# Gippsland

## Thomson and Macalister systems

**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 VEW and Southern Rural Water

allowed a reduction in passing flows in July 2017 so that the VEW 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.

"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:**  
Melbourne Water,  
Southern Rural Water

Site	Volume delivered in 2017–18 (ML)
Thomson River	18,072

**Waterway manager:**  
West Gippsland CMA

**Storage manager:**  
Southern Rural Water

Site	Volume delivered in 2017–18 (ML)
Macalister River	15,884

Above: Macalister River, by West Gippsland CMA  
Right: Thomson River, by West Gippsland CMA





## Snowy River

**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!**



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.

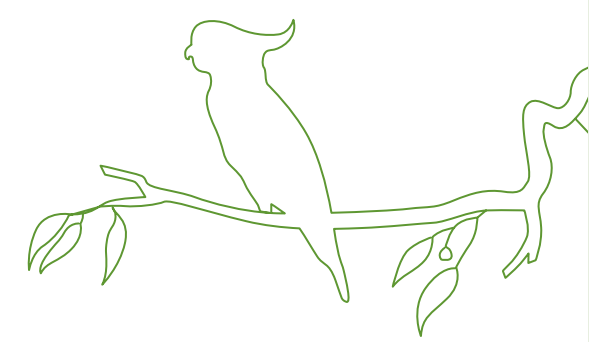
Scientists set out to determine the effect that the flow had on the productivity of the estuary of the Snowy River, hundreds of kilometres downstream of where the flows are released.

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

Site	Volume delivered in 2017–18 (ML)
Snowy River	206,000



Above: Paddling on the Snowy River, by East Gippsland CMA  
Right: Traditional Owners from Gunditj Mirring, Barngi Gadjin Land Council, Gunaikurnai Land and Waters Aboriginal Corporation and CMA staff, by Minna Tom

# community highlights



## \* Traditional Owners and catchment managers learning from each other

Traditional Owners and catchment managers in the West Gippsland region are working together to learn from each other about cultural values and how these relate to water for the environment.

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 Barngi 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.

The CMA and GLaWAC representatives returned to Gippsland enthused about how they can achieve these goals in their river systems. This is already bearing fruit in the second half of 2018, as the Department of Environment, Land, Water and Planning is supporting GLaWAC to do an Aboriginal Waterways Assessment in the Latrobe River, its tributaries and the lower Latrobe wetlands. This is part of the Latrobe Valley Rehabilitation Strategy. This work will also inform the review of the flow recommendations for the system – a project being run by West Gippsland CMA.





# Central region

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.

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

◆ Yarra system	24,054 ML
◆ Tarago River	1,764 ML
◆ Maribyrnong system	290 ML
◆ Werribee system	2,573 ML
◆ Moorabool River	2,746 ML
◆ Lower Barwon wetlands	
Water diverted from Barwon River	



## Yarra system

**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.

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

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.

**Waterway manager:**  
Melbourne Water

**Storage manager:**  
Melbourne Water

Site	Volume delivered in 2017-18 (ML)
Yarra River	24,035
Bolin Bolin Billabong	Water was diverted into Bolin Bolin Billabong from the Yarra River as part of the spring fresh – using the water twice – once for the river and once for the billabong.
Yering Backswamp	19

✳ **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



## 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.



"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

Site	Volume delivered in 2017-18 (ML)
Tarago River	1,764

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 Rosslynne 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, tupong and Australian smelt. Platypus also inhabit several reaches of the creek.

"The environmental flow in Jacksons Creek is not large enough to have an impact in the Maribyrnong River, but there is enough water to provide a flow within the Jacksons Creek from Rosslyn Reservoir," said Melbourne Water's Simon Catzikiris.

"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. Over

Above: Maribyrnong River, by Bill Moulden, Melbourne Water



the past four years, Melbourne Water and the VEWH have worked with local water licence holders to purchase unused water to deliver down the waterway to maintain the river's water quality and health.

**Waterway manager:**  
Melbourne Water

**Storage manager:**  
Southern Rural Water

Site	Volume delivered in 2017-18 (ML)
Upper Jacksons Creek	290

**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



## Werribee system

**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.**

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 flows 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.

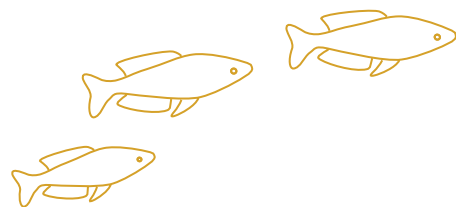


“Native fish are moving and breeding further up the river than we have ever seen before. This is the result of a gradual improvement in the health of the river over recent years, thanks to water for the environment,” Helen said.

**Waterway manager:**  
Melbourne Water

**Storage manager:**  
Southern Rural Water

Site	Volume delivered in 2017–18 (ML)
Pyrites Creek	1,265
Werribee River	1,307



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





## Moorabool River

**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.**

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 – and Corangamite CMA hosted a fishing day for the Wadawurrung community: the Wadawurrung Mooroobull 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.



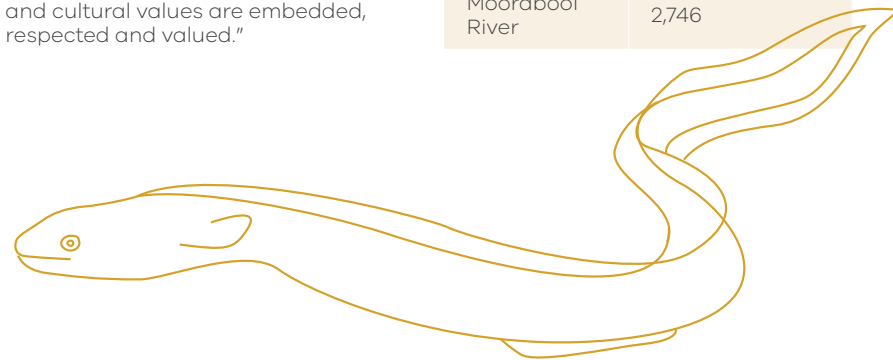
"I am aware that there are certain parts of the Moorabool River that are stressed and unwell – it is vital we all walk together to get better outcomes for our water.

"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: Community activity on Mooroobull Yaluk Kuwin River Day, by Corangamite CMA

## Lower Barwon wetlands

**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 as possible, drawing down slowly in spring to ensure waterfowl nesting sites stayed inundated through the breeding season."

Above: Reedy Lake inlet channel during drying regime, by Saul Vermeeren, Corangamite CMA



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 waterway, which will ensure all user groups can continue to enjoy the benefits of the lake into the future.

"We've had a highly-engaged local advisory committee who provide invaluable advice and support in

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

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



## \* Restoring cultural connections to Bolin Bolin Billabong

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.



\* **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

Left: Didgeridoo at Bolin Bolin Billabong smoking ceremony, by VEWH  
Right: Water released into Bolin Bolin Billabong, by Sarina Loo, VEWH





# Western region

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



## Glenelg system

**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

Site	Volume delivered in 2017-18 (ML)
Glenelg River	11,000

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

Source: Glenelg Hopkins CMA

Left: Platypus, by Josh Griffiths, CESAR  
Above: Moora Moora Reservoir, by 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

Site	Volume delivered in 2017-18 (ML)
Wimmera River	8,641
MacKenzie River and Burnt Creek	6,403
Lower Mount William Creek	1,303

Above: Josh Griffiths and John Pye undertaking platypus surveys at the MacKenzie River, by Wimmera CMA

## Wimmera-Mallee wetlands

**Eagle-eyed residents are honing their birdwatching and bird photography skills with a Wimmera-Mallee wetlands project.**

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.

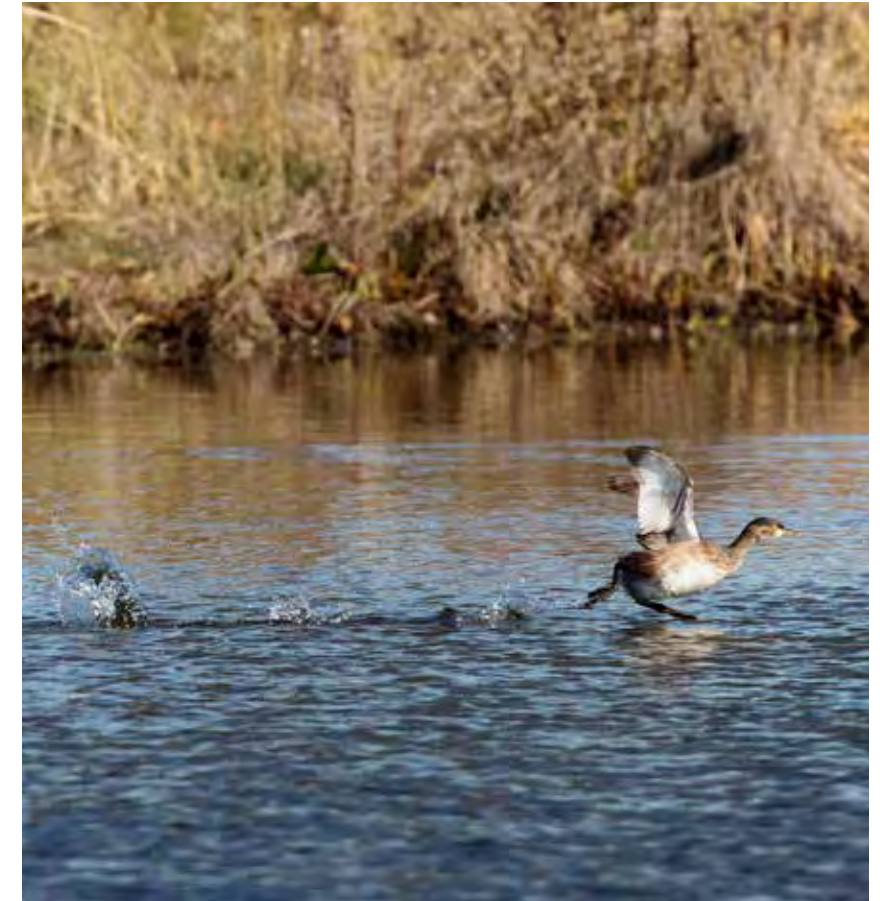
In response to environmental watering, the community has reported an influx of Australasian grebes, white-necked herons and Pacific black ducks.

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



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

Above: Australasian grebe at Crow Swamp, by Jenny Stephens





## \* 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.”

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.



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.

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 Connawirricoo 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.

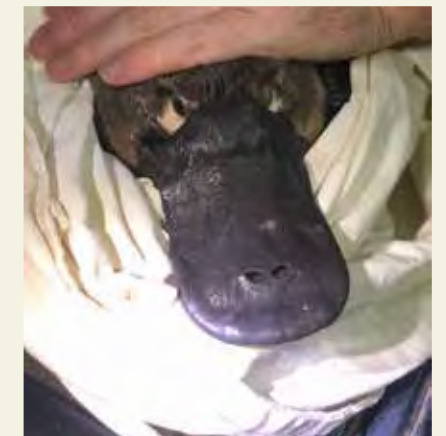
Glenelg Hopkins CMA’s Debbie Dalziel said objectives of the platypus monitoring project were two-fold.

“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.

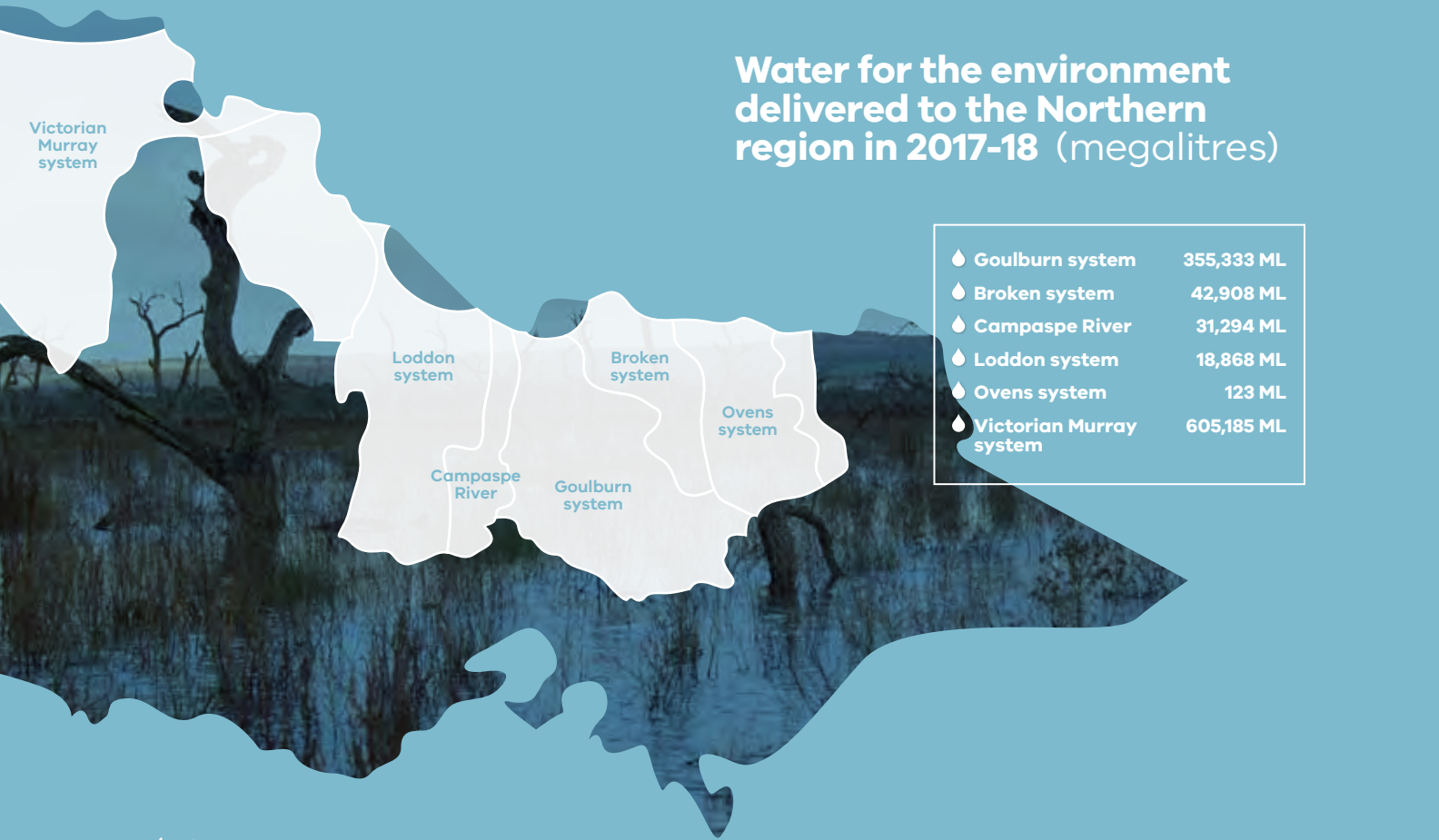
“Ultimately, this project gives project participants and the wider community an understanding of the benefits of a healthy river system, including the contribution of environmental flows from Rocklands Reservoir.”





# Northern region

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.



## Goulburn system

**Water quality and plants on the banks of the Goulburn River benefitted from an environmental flow along the lower Goulburn River in June 2018, with additional benefits extending all the way to South Australia's Coorong.**



"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	Volume delivered in 2017-18 (ML)			
	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



## 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.**

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.

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.

The trade in of environmental water enabled other Broken system water entitlement holders to trade their water out – a benefit to those often restricted by trade limits.

**Waterway manager:**  
Goulburn Broken CMA

**Storage manager:**  
Goulburn-Murray Water



Site	Volume delivered in 2017–18 (ML)		
	VEWH	CEWH	Total
Broken River	1,000	-	1,000
Lower Broken Creek	-	41,408	41,408

Above: Goulding Close looking upstream to Broken River, by Goulburn Broken CMA

## Goulburn Broken wetlands

**Waterbirds and plants were given a helping hand when Goulburn Broken CMA delivered water for the environment to Gaynor Swamp for the first time during autumn 2018.**

"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

Above: Brolga seen during water delivery at Gaynor Swamp, by Goulburn Broken CMA



herons picking through the mudflats and shallows," said the Arthur Rylah Institute's Danny Rogers.

Plenty of ducks also responded to the watering – grey teal, Pacific black ducks, chestnut teal, Australian shovellers, shelducks, pink-eared ducks and a freckled duck were all recorded. A black honeyeater – not often found in Victoria – was also heard.

The abundance of birds of prey indicated the wetland had boosted feeding and foraging opportunities for a range of birds and animals in the area.

"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.

**Waterway manager:**  
Goulburn Broken CMA

**Storage manager:**  
Goulburn-Murray Water

Site	Volume delivered in 2017–18 (ML)			
	VEWH	MDBA	CEWH	Total
Moodie Swamp	-	-	500	500
Gaynor Swamp	500	-	-	500



## Campaspe system

**Murray cod spawning was recorded for the first time in the Campaspe River in 2017, on the back of spring environmental flows.**

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."



"My largest cod is 85 centimetres, but my mate caught a 104 centimetre one, which is almost unheard of in the Campaspe," Adrian said. "I've caught a couple of 70 centimetre cod, including a 75 centimetre with a surface lure, and a lot of 50s. I have also caught a heap of 30s, which shows there are different generations swimming around."

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

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

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

## Central Murray wetlands

**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.**

Since 2014, North Central CMA, the Department of Environment, Land, Water and Planning, Arthur Rylah Institute and the VEWI 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.

"We are trying our best to prevent further localised extinctions, and to increase their numbers by finding new wetland habitats for the species."

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.

"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.

"This has also promoted aquatic plant growth and increased the amount of zooplankton (microscopic animals) present, an important food source for Murray hardyhead."

Surveys completed in April 2018 found 24 Murray hardyhead, proving the outstanding success of the relocation.



## 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."

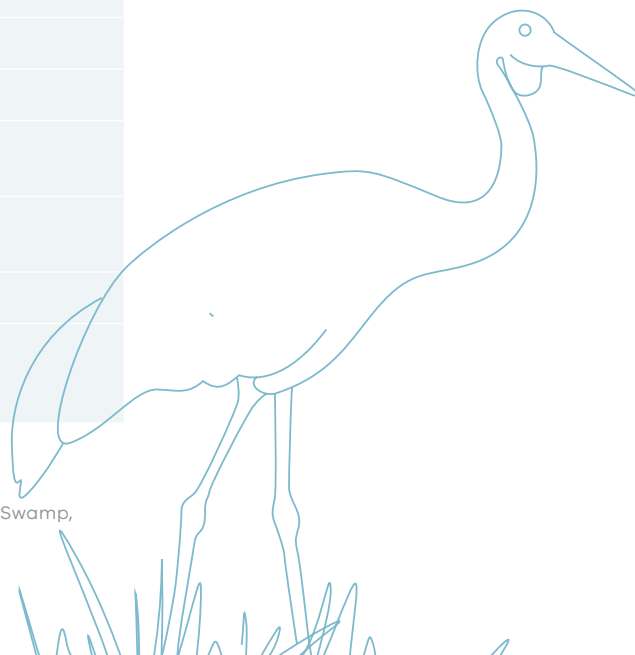


**Waterway manager:**  
North Central CMA

**Storage manager:**  
Goulburn-Murray Water

Site	Volume delivered in 2017-18 (ML)
Hird Swamp	2,220
Lake Elizabeth	530
Lake Murphy	580
McDonalds Swamp	350
Richardsons Lagoon	458
Round Lake	422
Wirra-Lo wetland complex	80

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



## Highlights of environmental watering 2017-18





## \* 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.

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.

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



## Lower Murray wetlands

**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."



"Based on the plants we've found, spacing of at least five years between environmental watering will be a good option to maximise biodiversity at the site."

Neds Corner, owned by Trust for Nature, has been managed for conservation since 2002. With 200 kilometres of River Murray frontage within the Murray Sunset National Park, the site is home to critically endangered reptiles, the De Vis's

banded snake and hooded scaly-foot legless lizard, as well as the nationally vulnerable regent parrot.

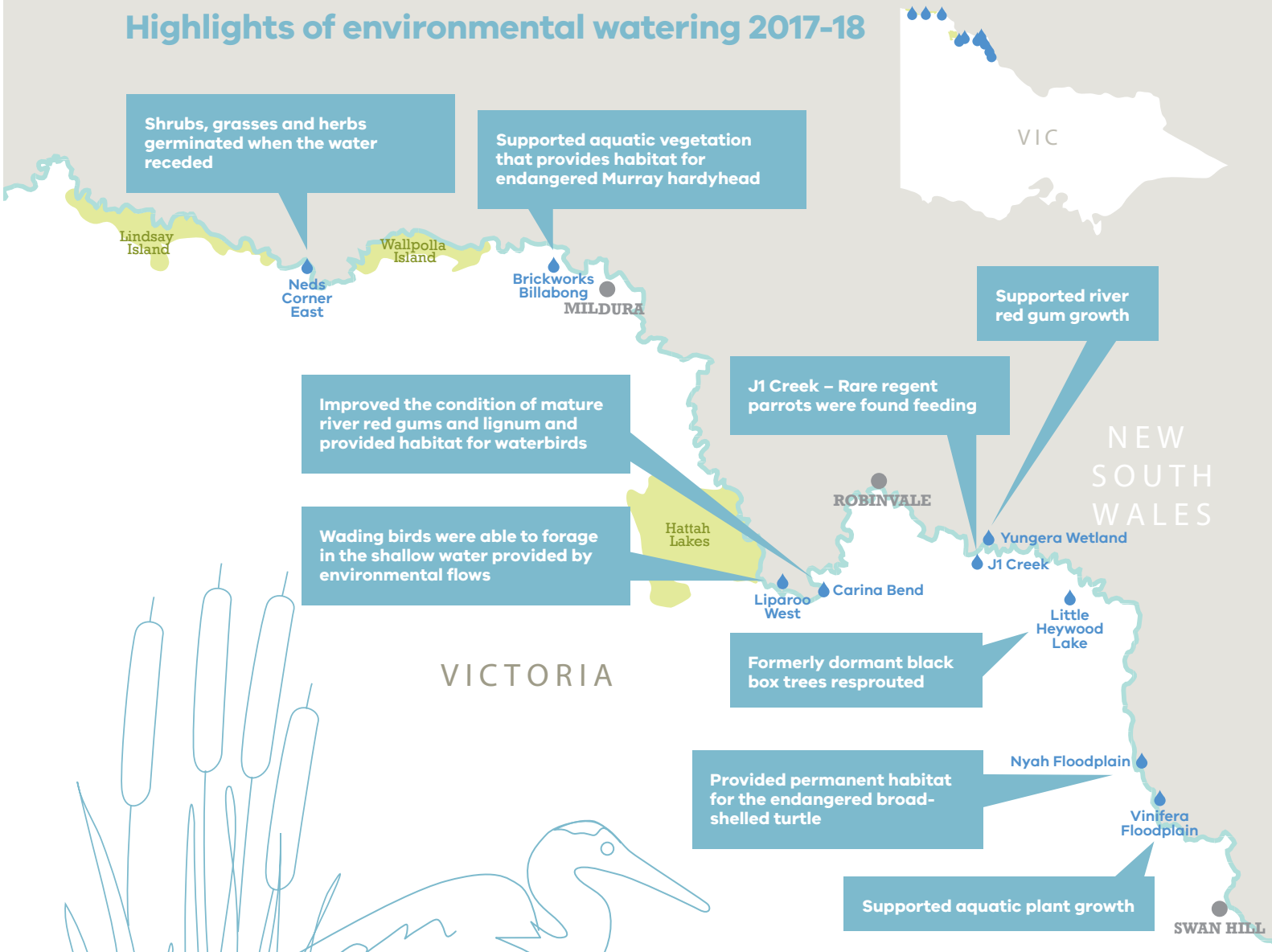
Water for the environment has been critical for keeping this valuable ecosystem healthy.

**Waterway manager:**  
Mallee CMA

**Storage manager:**  
Goulburn-Murray Water

Site	Volume delivered in 2017–18 (ML)	
	VEWH	Other
Brickworks Billabong	250	-
Cardross Lake	506	-
Carina Bend	800	-
J1 Creek	417	-
Lake Hawthorn	447	-
Liparoo West	240	-
Little Heywood Lake	512	-
Neds Corner East	104	-
Nyah Floodplain	1,877	-
Vinifera Floodplain	925	-
Yungera Wetland	111	-
Lock 15 wetlands	-	1,573

## Highlights of environmental watering 2017-18



Left: Lagoon nightshade (*Solanum lacunarium*), by Nathan Johnson



## Loddon system

**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."

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

Site	Volume delivered in 2017-18 (ML)		
	VEWH	CEWH	Total
Loddon River and Tullaroop Creek	10,958	3,054	14,012
Serpentine Creek	3,497	-	3,497
Pyramid Creek	861	-	861
Little Lake Meran	499	-	499

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, VEWB





## Ovens system

**The Ovens River system is home to several threatened and endangered native fish species, and environmental watering over 2017-18 provided a small amount of water that went a long way.**



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.

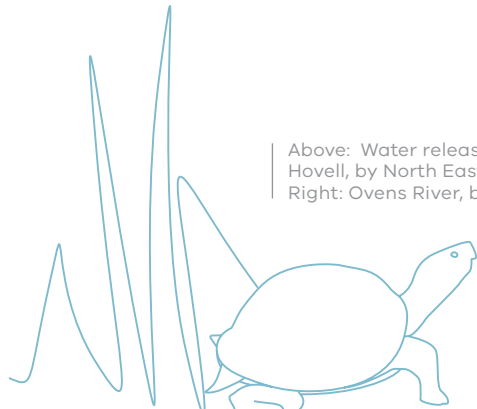
The Ovens system supports many native fish species including the Murray cod, trout cod, golden perch and fly-specked hardyhead. The Buffalo River is important for large fish species during part of their breeding cycle, while trout cod are found as far up the King River as Whitfield. The Ovens system 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	Volume delivered in 2017-18 (ML)
Ovens River	73 (CEWH)
King River	50 (CEWH)



Above: Water released from Lake William Hovell, by North East CMA  
Right: Ovens River, by North East CMA





\* Living Murray icon sites benefit from 10 years of water for the environment

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.

Top: Reedy Lagoon before watering, September 2017, by North Central CMA  
Bottom: Swamp wallaby-grass in Reedy Lagoon after watering, December 2017, by North Central CMA



The table below shows a summary of the overall scores for each icon site over 10 years. Report cards are not currently produced for the River Murray Channel.

	Barmah-Millewa	Gunbower Forest	Koondrook-Perricoota Forest	Hattah Lakes	Lindsay, Mulcra and Wallpolla Islands	Chowilla Floodplain	Lower Lakes, Coorong and Murray Mouth
2016/17	A	B	C	A	B	B	B
2015/16	B	B	D	A	B	C	C
2014/15	B	B	D	A	-	C	B
2013/14	C	B	D	B	C	C	B
2012/13	C	B	D	C	D	C	B
2011/12	C	C	D	B	C	C	B
2010/11	B	B	D	C	C	C	D
2009/10	C	C	D	D	D	C	D
2008/09	D	C	D	D	D	C	D
2007/08	D	D	D	D	D	N/A	D
2006/07	D	-	N/A	-	-	N/A	C
Structures built and operational		Hipwell road 2014	2014/15 (but not able to be used)	2013	Mulcra 2013/14 Lindsay, Wallpolla and Wallawalla	2014/15	

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') – not recorded in Victoria since 1982. The slender spurge is found in the River Murray floodplain in the Mildura and Hattah Lakes area, typically occurring following substantial floods.

### 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 site, while Mullaroo 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 swards 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 2018.

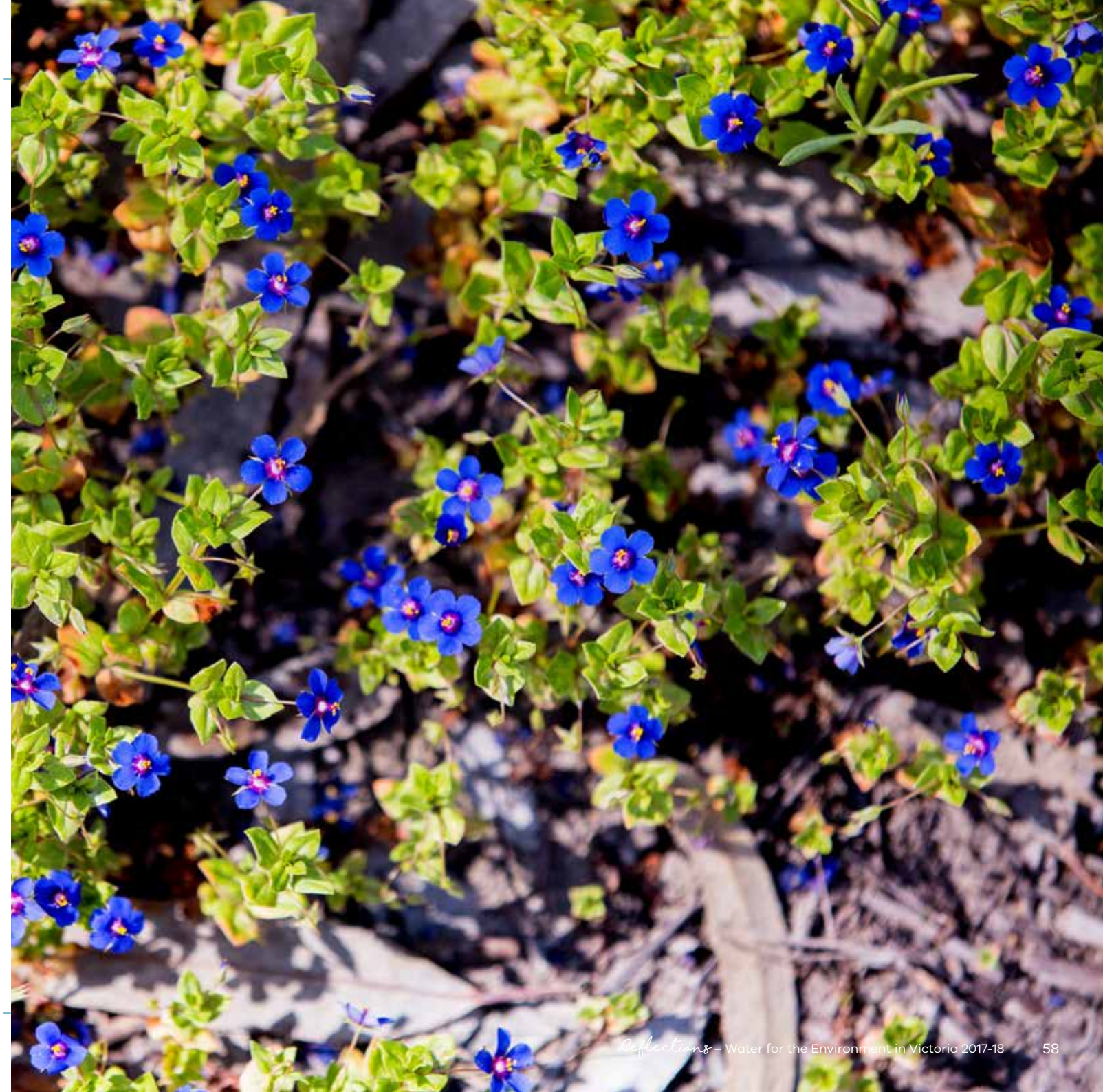
#### For more information:

**Living Murray icon site condition report:** [www.mdba.gov.au/publications/mdba-reports/living-murray-icon-site-condition-report](http://www.mdba.gov.au/publications/mdba-reports/living-murray-icon-site-condition-report)

**Living Murray program:** [www.mdba.gov.au/managing-water/environmental-water/delivering-environmental-water/living-murray-program](http://www.mdba.gov.au/managing-water/environmental-water/delivering-environmental-water/living-murray-program)



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





## Hattah Lakes

**More than 140 species of native plants and a declining black box tree population are getting a much needed drink thanks to the largest-ever delivery of water for the environment at Hattah Lakes.**

Floods in 2016 provided a boost, however increased plant growth associated with floods can be short-lived without watering the next year. Over 110,000 megalitres of water for the environment was delivered between July and October 2017. This helped black box trees to germinate, grow and recover.

The method of watering was very efficient. Over 90 percent of the water was from return flows – that is, environmental flows first delivered to upstream sites like the Goulburn River, which continue flowing down the Murray and can be used again at Hattah Lakes. Additionally, nearly half of the flows 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 the recovery of black box trees that had not been flooded since the 1990s. Flows were also timed to ensure the National Park was ready for visitors during the peak tourist period, ensuring access tracks were clear of water and that people could enjoy the benefits created by environmental watering.



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 500 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.

Site	Volume delivered in 2017–18 (ML)			
	VEWH	MDBA	CEWH	Total
Hattah Lakes	6,958	72,830	32,145	111,933

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)

Above: Regent parrot at Hattah Lakes, by Mallee CMA

## Lindsay, Mulcra and Walpolla Islands

**Environmental flows in the Murraroo Creek and Lindsay River are helping Murray cod to recover after tragic events in 2016.**

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 are also back in Mullaroo Creek, which means that they’ve been successfully breeding in recent years.”

Environmental flows in Lindsay River also provided additional environmental watering opportunities at Lake Wallawalla, an important floodplain wetland adjacent to the river. The lake provides regionally important habitat for plants and animals and acts as a refuge in dry years.

Above: Nginaid elder participating in a fishing event at Mullaroo Creek, by Mallee CMA

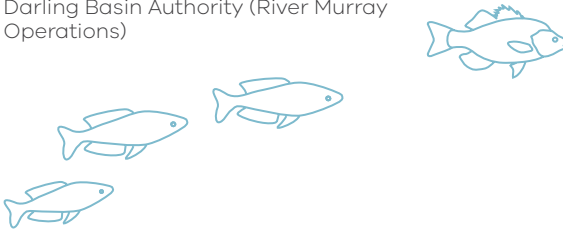


“Depending on the height of the weir pool at Lock 7 in the River Murray, flows are delivered to Lindsay River at varying flow rates,” Brad said.

“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 freckled ducks and other waterbirds.”

**Waterway manager:**  
Mallee CMA

**Storage manager:**  
Goulburn-Murray Water, Murray-Darling Basin Authority (River Murray Operations)



Site		Volume delivered in 2017–18 (ML)			
		VEWH	CEWH	Other	Total
Lindsay Island	Lindsay River, Mullaroo Creek, Lock 7 weir pool	-	784	758	1,542
	Lake Wallawalla	8,001	-	-	8001
Mulcra Island	Potterwalkagee Creek and the Lock 8 weir pool			1,095	1,095
Wallpolla Island	Wallpolla East	1,000			1,000
	Horseshoe Lagoon	399			399
	Sandy Creek	232			232



## Gunbower 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.



Reedy 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 waterway managers at the CMA.

However, there was one big problem – water that had remained in the wetlands following the 2016 floods were 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 only boost their numbers.

To solve this challenge, the Barapa Barapa custodians and CMA staff hit on a novel solution. Firstly, they pumped the existing water out, and then Barapa Barapa and CMA staff manually removed the carp – all 600 kilograms of them – so that the water for the environment could be delivered once the carp were gone.

Additionally, Barapa Barapa monitored the pumping to ensure there were no impacts to cultural heritage.

The results of these complementary measures have been fantastic. According to North Central CMA's Sophia Piscitelli, "Water quality is

exceptionally clear in Reedy Lagoon and relatively good in Black Swamp too. This is most likely to be due to low numbers of carp, as larger carp can re-suspend sediment and pull out aquatic plants through their characteristic 'mumbling' feeding behaviour. The residual pools were extremely turbid before they were drawn down for the carp removal project, and now it is much clearer, especially in Reedy Lagoon. It's fantastic to see positive outcomes for the wetlands after all our work over the past few months."

"Wetland plants in Reedy Lagoon have been absolutely thriving since water for the environment was delivered in October 2017," Sophia said.

"Early results from our summer vegetation monitoring show a dense

cover of river swamp wallaby-grass (*Amphibromus fluitans*) in the shallower parts of Reedy Lagoon, 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.

**Waterway manager:**  
North Central CMA

**Storage manager:**  
Goulburn-Murray Water,  
Murray-Darling Basin Authority  
(River Murray Operations)

Site	Volume delivered in 2017–18 (ML)			
	VEWH	MDBA	CEWH	Total
Gunbower Forest	9,579	808	-	10,387
Gunbower Creek	-	-	20,656	20,656

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

## 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.



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 Barmah Forest 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 grazers, 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 severe. 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)

Site	Volume delivered in 2017–18 (ML)				
	VEWH	MDBA	CEWH	Other	Total
Barmah Forest floodplain	17,720	27,834	140,547	247,457	433,558
Boals Deadwood	3,014	-	-	-	3,014
Top Island	967	-	-	-	967

Above left: Little Rushy Swamp, by Goulburn Broken CMA  
Bottom sequence: Ibis nests attacked by feral pigs, captured on motion-activated cameras, by Goulburn Broken CMA



## \* Aboriginal engagement at Hattah

The Mallee Aboriginal Reference Group (ARG) visited Hattah-Kulkyne National Park to see firsthand how water for the environment projects have improved the landscape – in particular, the health of the Hattah Lakes and floodplain.

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

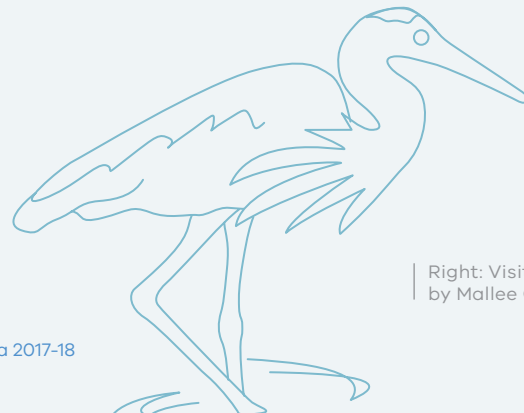
spent the day exploring these lakes, which are brimming with wildlife and fresh growth, before moving on to visit a dry area.

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.



Right: Visiting Hattah Lakes, by Mallee CMA





# glossary

**Allocation (of water)** – The specific volume of water allocated to water entitlements in a given water year or allocated as specified in a water resource plan.

**Blackwater** – A natural occurrence caused by the breakdown of plant matter resulting in the water discolouring. The water turns black and can have very low dissolved oxygen levels, which can stress or kill fish and other animals that breathe underwater.

**Carryover** – Allows entitlement holders to retain ownership of unused water into the following season, according to specified rules.

**Catchment management authority (CMA)** – A statutory authority established to manage river health and regional and catchment planning and to manage waterways, floodplains, salinity and water quality.

**Commonwealth Environmental Water Holder (CEWH)** – An office that manages water entitlements recovered by the Australian Government through a combination of investments in water-saving infrastructure, water purchases and other water recovery programs. The entitlements are held by the CEWH.

**Consumptive water** – Water owned by water corporations or private entitlement holders held in storages and actively released to meet domestic, stock, town and irrigation needs.

**Drawdown** – Water released from a body of water (such as a reservoir) at the end of the irrigation season for dam operation and maintenance purposes.

**Environmental water (water for the environment, environmental flows)** – Water available for environmental purposes including entitlements held by the VEWH, passing flows and unregulated flows.

**Environmental water entitlement** – An entitlement to water to achieve environmental objectives in waterways including an environmental entitlement, environmental bulk entitlement, water share, section 51 licence or supply agreement.

**Estuary** – A partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with saltwater from the ocean.

**Fishway** – A series of pools built like steps to enable fish to travel through a waterway, dam or waterfall.

**Freshes** – Small or short-duration peak-flow events which exceed the baseflow and last for one or several days.

**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 2010.

**Passing flows** – Water released from storages to operate river and distribution systems (often to help deliver water for environmental or consumptive uses) and maintain environmental values and other community benefits. The volume of passing flows is generally determined by inflows to those storages.

**Reach** – A stretch or section of a river, generally defined in an environmental flows study.

**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. Returned 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.

**The Living Murray** – An intergovernmental program, which holds an average of 500,000 ML of environmental water a year for use at six icon sites along the River Murray.

**Trade** – Water shares, allocations and take-and-use licences that can be traded in Victoria under rules the Minister for Water sets.

**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.

**Victorian Environmental Water Holder (VEWH)** – An independent statutory body responsible for holding and managing Victorian environmental water entitlements and allocations.

**Victorian environmental watering program** – The overarching program by which all environmental watering actions are planned and delivered and in which all environmental watering partners are involved.

**Water Act 1989** – The legislation that governs water entitlements and establishes the mechanisms for managing Victoria's water resources.

**Waterways** – Rivers, wetlands, creeks, floodplains and estuaries.

**Water entitlement** – The right to a volume of water that can usually be stored in reservoirs and taken and used under specific conditions.

**Waterway manager** – An agency responsible for the environmental management of catchments and waterways including CMAs and Melbourne Water.





Summary of environmental water delivery 2017–18

Gippsland Region							
Latrobe system	Latrobe River		11,223.6	-	-	-	11,223.6
	Lower Latrobe wetlands <sup>ii</sup>	Heart Morass	Water was diverted into Heart Morass from the Latrobe River				
		Sale Common	Water was diverted into Sale Common from the Latrobe River				
		Dowd Morass	Water was diverted into Dowd Morass from the Latrobe River				
Thomson River			18,072.0	-	-	-	18,072.0
Macalister River			15,884.0	-	-	-	15,884.0
Snowy River <sup>iii</sup>			-	-	-	206,000.0	206,000.0
Gippsland region total			45,179.6	-	-	206,000.0	251,179.6
Central Region							
Yarra system	Yarra River		24,035.0	-	-	-	24,035.0
	Yering Backswamp		19.0	-	-	-	19.0
	Bolin Bolin Billabong <sup>iv</sup>		Water was diverted into Bolin Bolin Billabong from the Yarra River				
Tarago River			1,764.0	-	-	-	1,764.0
Maribyrnong system	Upper Jacksons Creek <sup>v</sup>		290.2	-	-	-	290.2
Werribee system	Pyrites Creek		1,265.3	-	-	-	1,265.3
	Werribee River <sup>vi</sup>		1,307.3	-	-	-	1,307.3
Moorabool River			2,745.5	-	-	-	2,745.5
Lower Barwon wetlands <sup>ii</sup>	Reedy Lake		Water was diverted into Reedy Lake from the Barwon River				
	Hospital Swamps		Water was diverted into Hospital Swamps from the Barwon River				
Central region total			31,426.3	-	-	-	31,426.3
Western Region							
Glenelg system	Glenelg River		11,000.0	-	-	-	11,000.0
Wimmera system	Wimmera River		6,071.7	-	2,569.1	-	8,640.8
	MacKenzie River and Burnt Creek		6,403.0	-	-	-	6,403.0
	Lower Mount William Creek		764.5	-	538.5	-	1,303.0
Wimmera-Mallee wetlands			279.0	-	-	13.1	292.1
Western region total			24,518.2	-	3,107.6	13.1	27,638.9

Summary of environmental water delivery 2017–18

Northern Region							
		VEWH (ML)	MDBA (ML)	CEWH (ML)	Other (ML) <sup>1</sup>	Total (ML)	
Victorian Murray	Barmah Forest	Barmah Forest floodplain	17,719.9	27,834.0	140,547.0	247,457.0	433,557.9
		Boals Deadwood	3,014.0	-	-	-	3,014.0
		Top Island	967.0	-	-	-	967.0
	Gunbower	Gunbower Forest	9,578.8	808.2	-	-	10,387.0
		Gunbower Creek <sup>vi</sup>	-	-	20,656.0	-	20,656.0
	Central Murray wetlands	Hirds Swamp	2,220.0	-	-	-	2,220.0
		Lake Elizabeth	530.3	-	-	-	530.3
		Lake Murphy	580.0	-	-	-	580.0
		McDonalds Swamp	350.0	-	-	-	350.0
		Richardsons Lagoon	457.7	-	-	-	457.7
		Round Lake	422.0	-	-	-	422.0
		Wirra-Lo wetland complex	79.7	-	-	-	79.7
	Hattah Lakes <sup>vi</sup>		6,957.7	72,829.8	32,144.9	-	111,932.4
	Lower Murray wetlands	Brickworks Billabong	249.9	-	-	-	249.9
		Cardross Lake	505.8	-	-	-	505.8
		Carina Bend	800.0	-	-	-	800.0
		J1 Creek	416.9	-	-	-	416.9
		Lake Hawthorn	447.0	-	-	-	447.0
		Liparoo West	239.7	-	-	-	239.7
		Little Heywood Lake <sup>vii</sup>	511.6	-	-	-	511.6
		Neds Corner East	104.0	-	-	-	104.0



Summary of environmental water delivery 2017–18

Northern Region							
Victorian Murray	Lower Murray wetlands	Nyah Floodplain	1,877.1	-	-	-	1,877.1
		Vinifera Floodplain	925.2	-	-	-	925.2
		Yungera Wetland	111.0	-	-	-	111.0
		Lock 15 wetlands <sup>vii</sup>	-	-	-	1,573.0	1,573.0
	Lindsay, Mulcra and Wallpolla islands	Lindsay Island – including Lindsay River, Mullaroo Creek and the Lock 7 weir pool <sup>viii</sup>	-	-	784.0	758.0	1,542.0
		Lindsay Island – Lake Wallwalla <sup>vi</sup>	8,001.3	-	-	-	8,001.3
		Mulcra Island – including Potterwalkagee Creek and the Lock 8 weir pool <sup>viii</sup>	-	-	-	1,095.0	1,095.0
		Wallpolla Island - Wallpolla East	1,000.0	-	-	-	1,000.0
		Wallpolla Island – Horseshoe Lagoon	399.1	-	-	-	399.1
		Wallpolla Island – Sandy Creek	232.5	-	-	-	232.5
	Ovens system	Buffalo River	-	-	73.0	-	73.0
		King River	-	-	50.0	-	50.0
Goulburn system	Goulburn River – Reach 1		4,015.3	-	-	-	4,015.3
	Goulburn River – Reach 4 & 5		37,634.6	77,559.0	235,623.6	-	350,817.2
	Gaynor Swamp		500.2	-	-	-	500.2

Summary of environmental water delivery 2017–18

Northern Region						
Broken system	Broken River	1,000.0	-	-	-	1,000.0
	Lower Broken Creek	-	-	41,408.0	-	41,408.0
	Moodie Swamp	-	-	500.0	-	500.0
Campaspe system	Campaspe River	17,940.0	5,300.0	6,594.0	-	29,834.0
	Coliban River	1,460.0	-	-	-	1,460.0
Loddon system	Loddon River and Tullaroop Creek	10,957.6	-	3,053.9	-	14,011.5
	Serpentine Creek	3,496.7	-	-	-	3,496.7
	Pyramid Creek	861.0	-	-	-	861.0
	Little Lake Meran	498.8	-	-	-	498.8
Northern region total		137,062.4	184,331.0	481,434.4	250,883.0	1053,710.8
Total water use		238,186.5	184,331.0	484,542.0	456,896.1	1,363,955.6

i. 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.

ii. 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.

iii. 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.

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

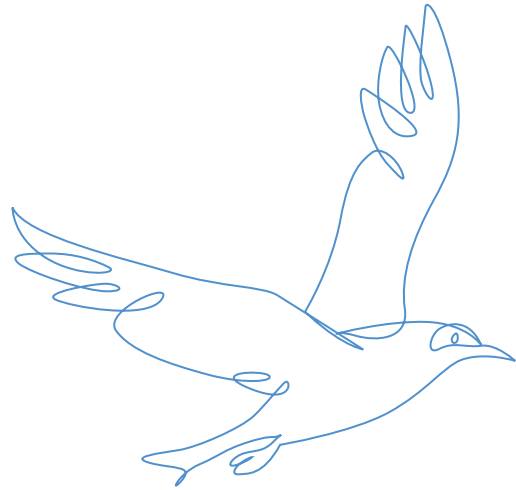
v. In 2017-18, water allocations co-purchased by Melbourne Water and the VEWH contributed to the delivery of 290.2 ML of environmental water to meet environmental objectives in upper Jackson Creek, in the Maribyrnong system, where no permanent environmental Water Holdings are held.

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

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

viii. Environmental flows in Lindsay River, Mullaroo Creek, Potterwalkagee Creek and the Lock 15 wetlands in Victoria were achieved by manipulation of water levels in the River Murray locks 7,8 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.





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