Water for the Environment in Victoria 2019-20

VICTORIAN ENVIRONMENTAL WATER HOLDER

VICTORIA State Government

Moorabool River, by VEWH

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 we value their ongoing contribution to managing Victoria's landscapes. We 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 the science, planning, managing and monitoring of environmental flows and the benefits that have resulted from these partnerships.

Stories in this edition of Reflections highlight several examples of the benefits and partnerships arising from this contribution. 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

Reflections celebrates some examples of the outstanding work of the many partners in Victoria's environmental watering program in 2019-20.

The environmental watering program is a collaborative effort, relying on coordination between Victoria's waterway, storage and land managers, as well as the Victorian Department of Environment, Land, Water and Planning (DELWP), the Commonwealth Environmental Water Holder, Murray-Darling Basin Authority, New South Wales and South Australian water managers.

The VEWH particularly acknowledges the work of our pivotal partners, catchment management authorities (CMAs) and Melbourne Water, who lead the on-ground implementation of the environmental watering program.

Image Disclaimer:

All images contained within this document were taken prior to the COVID-19 pandemic. No images were taken of people during the COVID-19 pandemic within this document and imagery may not show social distancing measures being undertaken nor face masks being worn.

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Foreword

Over the past four years, as a part of the state's water plan, Water for Victoria, the Victorian Government has invested a record $222 million in waterway and catchment health.

Reflections 2019-20 showcases how Victorian water managers are delivering initiatives as part of this investment, meeting the challenges of climate change, supporting healthy forests and wetlands, and ensuring the environmental watering program results in healthy waterways for all Victorians to enjoy.

In the past year, the importance of healthy waterways and green spaces has been underlined by the impacts of the COVID pandemic on people's mental health and wellbeing. Many Victorians have used their natural environment for recreation, rest and relaxation, helping them deal with the challenges we've all faced over recent months and underlining again the importance of healthy local environments. Amendments to the *Water Act 1989* made by our Government in 2019 enshrined in law the recreational value of our waterways. This formal recognition ensures that water for the environment is used in the most efficient and productive way possible to produce both environmental and recreational benefits. Benefits that became even more apparent in 2020.

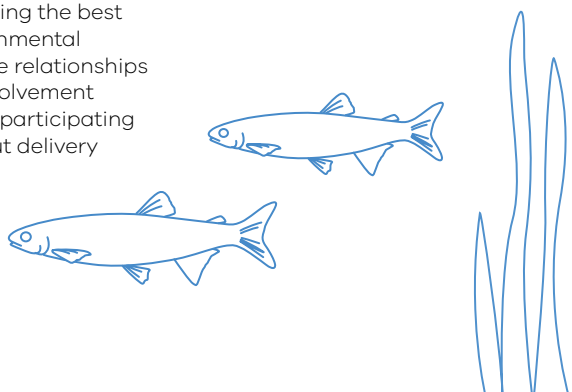
Our Government's approach focuses on strengthening local relationships and putting community at the centre of decision making. I acknowledge the extensive contribution that community partners have made to the program and the hard work of Victoria's water managers, including the VEWH, catchment management authorities and storage managers, as well as land managers, Traditional Owner groups, local government and scientists in delivering the program.

I would also like to particularly recognise the efforts of these groups and regional communities in dealing with last summer's terrible bushfires – particularly in the North East and East Gippsland.

Last year, for the first time in Victoria, the changes to the *Water Act 1989* also made it a legal requirement to recognise Aboriginal cultural values and knowledge in water and catchment management and to include Traditional Owners in these processes. The deepening of partnerships between Traditional Owners and our program partners is shown throughout Reflections and is a valued part of ensuring the best outcomes for the environmental watering program. These relationships sanction meaningful involvement with Traditional Owners participating in decision making about delivery of water.

On behalf of the Victorian Government I hope you enjoy and find value in the stories presented in Reflections 2019-20.

Hon Lisa Neville
MP Minister for Water



On behalf of the VEWH Commission, staff and program partners, it is my pleasure to present Reflections 2019-2020.

Reflections is an opportunity to show where, how and why we use water for the environment and to demonstrate the environmental, economic, cultural and social benefits it provides for Victorian communities each year.

It is also a chance for us to step back and reflect, and to acknowledge the tireless efforts of those who work with us to protect our waterways; our program partners, Traditional Owners, and local communities.

The summer of 2019-20 saw the extraordinary effects of climate change on our environment with an increase in the ferocity and frequency of bushfires across Australia, following years of drier than average conditions. The effects of climate change will continue to impact the way we make decisions, showing the need for long-term planning which is adaptable to changing climatic conditions.

In the workplace, we've faced new challenges dealing with the impact of coronavirus (COVID-19). Despite many of us working remotely, the VEWH and our partners have continued to maintain connections and delivered on our commitment to protect and improve the health of Victorian waterways.

The importance of healthy waterways to Victorian communities was reinforced this year by a new report that showed that the health of rivers and wetlands is directly connected to the social and economic wellbeing of local communities. By protecting the places and ecosystems that communities' value, their wellbeing is directly supported. This relationship can also be seen financially with healthy waterways boosting Victoria's recreation and tourism income by millions of dollars each year.

We've continued to value the involvement of Traditional Owners in the environmental watering program and have worked with our partners to increase the influence of Aboriginal people and culture in water management. For example, the first delivery of water to Horseshoe Lagoon last year saw a fantastic partnership between the Taungurung Traditional Owners, local landowners, Goulburn Broken CMA, VEWH and others, delivering shared environmental and cultural benefits to a site of strong cultural significance.

At our fifth Victorian Environmental Water Matters Forum in March 2020, we listened to interest groups from across the state including irrigators, anglers, Traditional Owners, scientists, environmental groups and educators. The forum saw us strengthening valuable relationships with these stakeholders and the discussions held will help to inform and guide our work with communities across Victoria.

Reflections is a demonstration of the ongoing commitment of the VEWH and our partners - waterway managers, storage managers, land managers, scientists and communities – to achieve the best possible outcomes from water for the environment. Our work is underpinned by rigorous science and local knowledge across the Gippsland, central, western and northern regions of Victoria.

I hope you enjoy Reflections and I thank everyone who has contributed to the success of the environmental watering program.

Your work helps to protect our waterways, and the plants and animals that rely on them, for the benefit of all Victorians both now and into the future.

Chris Chesterfield
Chairperson

Vegetation Gunbower Forest, by North Central CMA

Victoria's environmental watering program

Environmental watering in Victoria is the collaborative management of water available for environmental purposes. Water held by environmental water holders under water entitlements and released at a time that improves river and wetland health, including their biodiversity, ecological function, water quality and other uses that depend on environmental condition.

It is not the only water that contributes to environmental condition, but it is water that governments reserve specifically to be actively managed to help mitigate the environmental impacts resulting from the modification of rivers and wetlands to supply water for consumptive uses.

The need for water for the environment

As Victoria's population has grown, many of its rivers and wetlands have been highly modified compared to how they were cared for and managed by Traditional Owners for tens of thousands of years. Water now flows very differently through the landscape – it is captured in dams and weirs, diverted by pipelines, pumps, drains, levees and constructed channels to support towns, cities, industry and farming.

Some of our rivers give up more than a third, and sometimes half, of their water for farms, homes and businesses. Instead of flowing naturally, with high flows in winter and low flows in the hotter summer months, many rivers now run higher when water needs to be delivered for farming and urban use.

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.

Healthy waterways support healthy communities. Healthy rivers and wetlands make cities and towns more liveable and support the physical and mental wellbeing of communities. Rivers and wetlands provide places for people to play, relax and connect with nature, and they sustain healthy Country for Aboriginal communities.

In 2019-20, the Victorian Environmental Water Holder (VEWH) coordinated the delivery of water for the environment to 92 river reaches (across 41 rivers) and 76 wetlands, totalling 168 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. It aims to protect and enhance the remaining environmental values, including native plant and animal populations; it is not feasible to try to return these waterways to their pre-European conditions.

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 to release their eggs. Waterbirds require wetlands to retain water for long enough to allow their chicks to grow, and floodplain forests require inundation every few years to ensure the survival of tree species such as river red gums and black box.

Many wetlands in Victoria are now either disconnected from the rivers that used to naturally fill them or are permanently connected to rivers or channels. This means that some wetlands do not get enough water, and others get too much. In wetlands, the aim is to mimic the natural cycles of wetting and drying on which many plants and animals depend for their diversity and long-term resilience. For example, where wetlands and floodplains have been cut off from natural river flows, water for the environment can be used to reconnect these areas, sometimes via irrigation infrastructure (such as pumps, channels and regulators).

Seasonal watering plan

Every year a seasonal watering plan is developed that guides environmental watering decisions in Victoria. It outlines all the potential watering actions that might be delivered under a range of planning scenarios. This provides stakeholders with a sense of what to expect during the watering year.

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

For a comprehensive overview of the environmental watering program and the annual Seasonal Watering Plan see the VEWH website www.vewh.vic.gov.au

Examples of environmental watering objectives under different planning scenarios

Drought
Main objective: PROTECT

- Avoid critical loss
- Maintain key refuges
- Avoid catastrophic events

Dry
Main objective: MAINTAIN

- Maintain river functioning with reduced reproductive capacity
- Maintain key functions of high priority wetlands
- Manage within dry-spell tolerances

Average
Main objective: RECOVER

- Improve ecological health and resilience
- Improve recruitment opportunities for key animal and plant species

Wet to very wet
Main objective: ENHANCE

- Restore key floodplain and wetland linkages
- Enhance recruitment opportunities for key animal and plant species

Who is involved in the Victorian environmental watering program?

The Victorian environmental watering program is a collaborative effort and relies on 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 Traditional Owner land management boards, Parks Victoria, and the Department of Environment, Land, Water and Planning (DELWP).

The Victorian Environmental Water Holder

The Victorian Environmental Water Holder (VEWH) is an independent body, established by the Victorian Government in 2011.

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.

An exciting trip hosted by Mallee Catchment Management Authority (CMA) saw the Victorian Environmental Water Holder (VEWH) Commissioners, Co-CEOs and executive team venture north. The group visited various sites, meeting with staff from the CMA and local water corporations as well as Traditional Owners of the area to discuss all matters water for the environment.

"It is important for us to regularly visit the regions where water for the environment is delivered," said VEWH Deputy Chairperson Peta Maddy.

"In overseeing Victoria's environmental watering, it is crucial that we connect to the different sites, work with local program partners and stakeholders and understand the challenges and opportunities," said Peta.

Right: VEWH Commissioners: Chris Chesterfield, Peta Maddy, Rueben Berg and Jennifer Fraser at Hattah Lakes, by Sarina Loo, VEWH

A brief snapshot of environmental achievements in 2019-20

The VEWH oversaw delivery of about

890,227 ML

of environmental water.

The total includes 596,308 megalitres of water made available by the CEWH and 38,428 megalitres by the Living Murray program.

82% of environmental flows

delivered in northern Victoria were re-used to meet downstream environmental water needs. To further increase efficiency, environmental flows are also 'piggybacked' on water delivered for towns and farms.

At least **70 species** benefitted from watering events and **28 vulnerable or threatened species** were supported by environmental flow deliveries.

The VEWH coordinated delivery of water for the environment to

168 river

reaches and wetlands in Victoria.

87% of required potential watering actions

were fully or partially achieved. These actions were achieved through environmental flow deliveries, natural river flows or delivery of consumptive water en-route to customers.

182 stakeholders

were engaged during the development of the seasonal watering proposals that contributed to the seasonal watering plan.

Of the top 50 Victorian recreational fishing reaches, 28 can receive environmental flows.

Twenty-seven (96%) of these reaches received environmental flows.

Of the six Ramsar sites that can receive water for the environment, five were watered.

At least 11 environmental environmental watering activities were delivered and/ or monitored in partnership with Traditional Owners.

O'Brees Crossing, by Wimmera CMA

Above: Goulburn River, by VEWH

Effective and efficient management

Water is a precious resource and environmental water managers work hard to make sure every drop is used as efficiently and effectively as possible. 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. This is important to environmental water holders because our peak demands are in winter/spring when rivers would naturally flow higher, but early in the water year when allocations can still be low. The amount of environmental water carried over varies from year to year depending on demand and supply, but in general is about the same proportion as other types of entitlement holders.

Since its commencement in 2011, the VEWH has bought and sold water allocation in water systems around Victoria, including the Murray, Goulburn, Loddon, Werribee, Moorabool, Wimmera-Glenelg and Maribyrnong systems. When there has been water available after current year demands and critical carryover needs can be met, the VEWH has sold this water – providing a boost of supplies for irrigators, while generating revenue that can be invested in projects that optimise watering outcomes.

As a public sector organisation, the VEWH seeks to ensure it is operating in the public interest and is not causing impacts to market participants. When considering the volumes of water to sell or purchase, the method of market participation, and the prices considered, the VEWH undertakes an assessment of potential market impacts and takes steps to minimise those impacts.

To support the VEWH's continuous improvement in trade activity, last year an Independent Review was conducted by Marsden Jacobs, giving the VEWH a 'clean bill of health' for its water trading activities. The findings showed that the VEWH has not impacted water market prices, transparently signals its trading intentions to market participants, and effectively avoids market distortion and adverse impacts on other parties.

In northern Victoria, since 2012, the VEWH has sold over 82,000 megalitres in the Murray and Goulburn systems (including 10,000 megalitres in March-April 2019) and has bought 300 megalitres in the Loddon system.

The VEWH's annual Water Allocation Trading Strategy covers the trading activity that the VEWH may undertake in each region depending on priority environmental demands, weather conditions and other factors. This strategy and management and use of environmental water including carryover and trade activities are also reported on annually through the VEWH annual report. These publications are available on the VEWH website: www. vewh.vic.gov.au/watering-program/trading

[1] A report on research to explore Victorians' knowledge of, and attitudes towards, environmental water, ORIMA Research (on behalf of the VEWH), 2017.

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. Never has this been as important for Victorian residents than this year, while dealing with the challenges of coronavirus (COVID-19), where visits to local waterways, wetlands and rivers have been a way to connect with nature, boosting mental and physical wellbeing.

By improving the health of waterways, water for the environment supports vibrant and healthy communities sustaining towns, farms and businesses. 90 percent of Victorians visit waterways to relax, rest and enjoy the scenery[1].

Healthy rivers and wetlands make cities and towns more liveable and support the physical and mental wellbeing of communities and sustain healthy Country for Aboriginal communities.

The recreational benefits of healthy waterways include fishing, canoeing, swimming, walking, running, intensive exercise programs or 'boot camps', meditating, snorkelling, camping, picnicking, photography, mountain bike riding, yoga, plant identification and geocaching. These activities are all enjoyed on or around Victoria's rivers, wetlands and floodplains.

New research proves the value that flows from water for the environment

A Northern Victorian-first report highlights that water for the environment makes a significant economic and social contribution to northern Victorian communities, including for agriculture.

By looking at case studies of just a few of the countless benefits at a few key sites, the report shows water for the environment contributes up to $80 million a year to northern Victorian communities, a figure that will more than double over the next decade to almost $170 million a year.

On the results, Beth Ashworth Co-CEO said "this preliminary report is the first step in finding out more about these positive impacts. The numbers are robust, yet conservative and they are only part of the contribution water for the environment makes to northern Victorian economies and communities."

Benefits for farmers – and so for all Victorians

A big chunk of northern Victoria's $5.6 billion agriculture industry benefits from insect pollination, especially honeybees. About one in every three mouthfuls of food we eat in Victoria is dependent on bees to produce it. Whether it's apples, pears, canola, almonds or lucerne, bees can increase the output of a range of crops. Bees need water to survive, and they also need flowering river red gum forests. By improving the health of those forests, water for the environment helps create the right conditions for bees to thrive.

Water for the environment also improves water quality by buffering nutrient runoff and diluting algae and salinity. Without water for the environment, millions of dollars each year would be added to the cost of salinity management across Northern Victoria. That's great news for livestock and those who rely on stock and domestic water supply.

Above: Canoing at Lake Carpul, by Mallee CMA

Supporting your wellbeing, and the liveability, recreation and tourism in your town

We all have a strong connection to our part of the world and what makes it special – the bush, the creeks, the wetlands and the rivers. We love our camping, our fishing, our swimming and our kayaking. We love to get away from it all and hunt, bushwalk, picnic, birdwatch and waterski. We love connecting with our ancestors and preserving their way of life for future generations. And to do all this we need clean water, healthy trees, native fish and an abundance of birds. Water for the environment boosts the northern region's recreation and tourism income, for example at places such as the Gunbower Forest, by millions of dollars each year, a figure that will double over the next decade. By helping keep our fish healthy and our bush and wetlands alive, water for the environment is helping the tourism dollar flow through to local communities.

Helping protect you from climate change

Climate change costs our communities dearly. Every heatwave costs Victoria about $1 billion, a cost mostly borne by health and agriculture. Northern Victorian communities and economies suffer more at the hands of climate change than the rest of the state. Healthy floodplain forests and wetlands in northern Victoria help reduce the frequency and intensity of climate events such as drought and heatwaves. They suck the greenhouse gases in, store them or turn them into oxygen. So, as well as helping our animals survive and giving our communities a place for refuge, water for the environment also helps reduce the cost of climate change. This is valuable for our communities and our farmers – a value that will triple over the next decade.

What if we didn't have water for the environment?

Without water for the environment, the quality of water in our rivers would deteriorate as would the numbers of plants and animals that rely on them for their survival. Native fish numbers in our icon sites would be about 10 per cent lower than they are now and decrease by another 10 per cent by 2030. The condition of our native plants, including our majestic river red gums, would have decreased 20 per cent over the past decade, a number that could double by 2030. Waterbird numbers would be 20 per cent lower than they are now if we hadn't had water for the environment over the past decade and will be a further 20 per cent lower if we don't have it for the next decade.

"We all know the great work water for the environment is doing to keep our rivers, wetlands and floodplain forests alive. It's doing its job and it's doing it well. And we're now getting increasing evidence of the social and economic benefits brings too." said Beth Ashworth Co-CEO.

Above: Walking along the Moorabool River, by VEWH

How will climate change affect water for the environment?

Climate change has already started to impact Victorian waterways, and these trends are forecast to continue as temperatures increase. Victoria's climate has seen a drying and warming trend over the last two decades, and it is predicted this trend will continue in the future.

Climate modelling[2] indicates there will be more extreme events including droughts, floods and heatwaves, and there are expected to be more bushfires. Seasonal shifts in rainfall are expected to continue, with proportionally less rain in the cooler months. Average streamflow is predicted to decline across all parts of Victoria, with some of the greatest declines expected in the south-west and parts of the central and northern regions.

Medium- and longer-term climate modelling indicates that the warming and drying we have experienced over the last decade will continue, along with reductions in rainfall in the cooler months of the year. Streamflows are predicted to decline in all parts of Victoria, with some of the greatest declines expected in the south-west and parts of the central and northern regions – a trend that we are already observing, as long-term water availability for the environment in southern Victoria has declined by between 4 and [3]28%.

Above: Out on site working with program partners, by North Central CMA

VEWH Co-CEO Sarina Loo says that the VEWH and our program partners recognise the magnitude of these challenges.

"In drought and dry conditions, the program aims to prevent catastrophic events, avoid species losses and maintain l refuge habitats to prevent significant declines of native populations. In wet conditions, the aim shifts to boosting ecological productivity and environmental condition and to increasing populations of native plants and animals."

"Environmental flow studies and environmental water management plans are revised periodically to update environmental watering objectives and their required water regimes. These reviews consider how climate change will affect current environmental values and the types of outcomes that can be achieved in the future."

[2] Timbal, B. et al. (2016) Climate change science and Victoria. Victoria Climate Change Initiative (VicCI) report. Bureau of Meteorology, Australia. Bureau Research Report 14, pp 94.

[3] Department of Environment Land Water and Planning 2020, Long-Term Water Resource Assessment for Southern Victoria, Victorian Government, Melbourne.

Ash, sediment and soot: how our rivers are affected by the 2019-20 bushfires

The 2019-20 bushfires burnt approximately 1.5 million hectares across Victoria destroying many homes, causing loss of livelihoods, loss of life and devastating impacts for our native plant and animal species. It is estimated that 212 species of rare of threatened plants and animals have lost at least 50% of their habitat.

Fire can greatly affect Victorian rivers with detrimental effects continuing after the fires stop burning.

- When burning, fires can heat up water in rivers and wetlands creating a fatal environment for our aquatic species, including native fish species and platypus. The heat can also compromise access for terrestrial animals that visits the edges of rivers and wetlands for drinking water.
- After burning, material such as ash, burnt sediment and burnt logs wash into rivers and streams during rainfall and can clog and dirty rivers. This compromises water quality in rivers, damaging the structure through erosion, smothering aquatic animal habitats and critically reducing food availability for both land and water animals.

Through recovery planning, some rare and at-risk animals were temporarily removed from fire-affected habitats to prevent extinction.

Fighting for our fish

Immediate action was taken by the Victorian Government to ensure many of these species were given the best chance to survive. Zoning in on the Victorian rivers in fire-affected areas, aquatic surveys and risk assessments were undertaken for threatened galaxiids, blackfish, spiny and burrowing crays and freshwater mussels.

Above: Buffalo River, by North East CMA

A critical management strategy that was implemented for fish species, including Macquarie perch, was to relocate some of the population to areas not affected by fires. Species like Macquarie perch are particularly susceptible to the impact of ash and sediment washing into the waterways because they tend to stay in the one area, instead of moving around like many native migratory fish species.

Post-fire freshen up

Another action taken was to release a 'freshening flow.' North East Catchment Management Authority and Goulburn-Murray Water worked together to deliver a fresh in the Buffalo River, combining water for the environment with a bulk water transfer from Lake Buffalo. The aim of the fresh was to improve water quality, move sediment and scour biofilm (algae and bacteria from rocks and fallen timber), as well as providing new food sources for instream animals.

Water quality was monitored to ensure water being released from Lake Buffalo did not negatively impact on the river downstream. Goulburn-Murray Water released the water over the spillway instead of through the outlet valves to ensure that the water being released was as clean as possible to improve conditions in the river.

Above: Macquarie perch, by Jarod Lyon

Above: Little black cormorants Lake Meran, by North Central CMA

Finding refuge in a land of drought and flooding rains

Australia is the driest inhabited continent on Earth, and our wildlife has evolved a range of ways to survive dry times. However, reduced river flows and less frequent wetland inundation has stressed our native fauna and flora beyond normal tolerance levels. One way of assisting our native wildlife is through the delivery of water for the environment. During dry times, we deliver water to refuges that provide habitat and food to enable some plants and animals to survive during droughts so they can hopefully breed and disperse once the drought ends to restore populations. During wet times, we deliver water to build resilience for some species like trees on the floodplain and grow populations of fish and birds to a level that can withstand potential losses.

Once established, most floodplain and riparian plants can tolerate some time without rain and surface water, but fish, frogs, turtles and waterbirds always need access to surface water. Permanent wetlands and deep pools within rivers that persist long after water flow ceases are critical to the survival of these animals and the number and distribution of these refuge waterbodies throughout the landscape can determine the number and variety of animals that live in an area.

Water for the environment is used to maintain over 100 drought refuges in more than 20 river reaches and wetlands across Victoria. Droughts are likely to be more frequent and more severe under climate change and waterway managers continuously aim to refine their management practices to help water-dependent plants and animals cope.

In September 2019, waterway managers from across Victoria, VEWH and the Department of Environment, Land, Water and Planning (DEWLP) joined scientists and other experts at a Drought Management Forum sponsored by the Applied Aquatic Ecology Research Hub.

The main messages from the forum were that effective drought management requires action every year, not just when drought is imminent. For the water for the environment program, this may mean targeted watering in wet years to grow populations to build their resilience and improve the condition of long-lived plants and animals to help them withstand future stress. It also means identifying critical drought refuges and using water to improve their condition in wet periods and reserving water to maintain their quality during dry periods.

Knowledge-sharing forums such as this are an important part of adaptive management. Waterway managers will apply this knowledge and some of the tools presented at the forum to enhance the benefits of environmental watering in a drier future.

Above: Drought management forum, by VEWH

Stakeholders and program partners come together at the fifth Environmental Water Matters Forum

Representatives from a wide range of community and government organisations met to hear and discuss latest developments in water for the environment, at the VEWH's fifth Victorian Environmental Water Matters Forum.

Those in attendance represented groups from many diverse interest areas' including irrigators, anglers, Traditional Owners, scientists, environmental groups and educators.

Chris Chesterfield, VEWH Chairperson stated *"One of the things I enjoy the most about this forum is the diversity of groups in the room. We always like hearing from a wide range of representatives and their differing views to consider in the direction of our program".*

Above: VEWH Co-CEO Beth Ashworth and Bush Heritage representative Tegan Hibberson at the forum, by VEWH

Above: Discussing key themes at the forum, by VEWH

The day included presentations by the VEWH's Co-Chief Executive Officers, Beth Ashworth and Sarina Loo, on the highlights, challenges and achievements of the environmental watering program from the last two years. There were also presentations by climate change expert, Ross Thompson, and VEWH Commission Rueben Berg who is also a member of the First Peoples' Assembly, representing Aboriginal Victorians in the next phase of the Treaty process.

Professor Ross Thompson from the University of Canberra spoke about the impacts of climate change, drought, bushfires and flood on our waterways. His presentation raised awareness not only of the danger these threats pose, but of the power of water for the environment to make a difference to the ecosystems that they impact.

Rueben Berg spoke about Treaty with a powerful reminder not just of the significance of the Treaty process, but also of the importance of the other work being done across Victoria to better include Traditional Owners in decision making, especially in the water space.

After hearing from these thought-provoking speakers, the floor was opened to the attendees, who shared their views and those of the members, networks and communities they represent, including on how the VEWH could better engage with these communities.

In response to these discussions the VEWH is:

- helping the people and organisations who attended the forum to connect with each other, to assist with networking and foster ongoing relationships
- developing new communications materials, and amending our existing content, to better tailor to the different audiences in communicating the outcomes of environmental watering
- building on relationships with Traditional Owner organisations and working with them to embed Traditional Owner values and interests in water management.

Monitoring results are in - showing that not only is water for the environment working, but that having the right data helps us get better results from this limited resource, leading to more efficient and effective use of environmental flows in Victoria.

The Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) and the Wetland Monitoring and Assessment Program for environmental water (WetMAP) help us better understand how our waterway ecosystems respond to the release of water for the environment so we can manage water for the environment more effectively.

VEFMAP focuses on the response of native fish and vegetation to environmental flows in Victorian rivers, while WetMAP explores our wetland environments providing guidance and insights on water for the environment deliveries and regimes for vegetation, birds, fish and frogs.

This work is coordinated by DELWP Water and Catchments and scientists from the Arthur Rylah Institute for Environmental Research (ARI), in collaboration with catchment management authorities (CMAs), Melbourne Water (MW), the Victorian Environmental Water Holder (VEWH) and independent scientists.

Above: Vegetation surveys, by ARI

Really getting to know our rivers

174 fish sites have been monitored across 12 rivers

Objective: examine the effects of environmental flows on the distribution, dispersal, recruitment, abundance and population trends of key native fish species.

KEY FINDINGS:

Annual fish monitoring has been a key element of VEFMAP since 2005. Analysis of these data from Victorian rivers, combined with flow-event based monitoring since 2016, has helped identify how different flow and non-flow related factors have affected native fish populations.

Long-term trends identified include:

- A decline in the abundance of most fish species during the Millennium Drought, with fish abundance improving since 2012. Species that showed this trend were Murray cod, golden perch, Murray-Darling rainbowfish and trout cod. Trends varied across systems and species. For example, abundances of most species increased substantially in the Campaspe River, while the lower Loddon River saw very little change.
- Improved flow conditions, due to both natural flows and environmental water, have contributed to these improvements in fish abundance, with elevated flows during spring providing the most benefit.

51 vegetation sites have been monitored across nine rivers

Objective: examine effects of environmental flows on the distribution, foliage cover, diversity, recruitment and growth of riverbank plant species.

KEY FINDINGS:

Monitoring of riverbank vegetation showed baseflows provided by environmental water deliveries are critical to sustain fringing and emergent vegetation.

Spring freshes expand species distributions higher up the bank and sustain healthy plant populations. They increase riparian plant cover, seed dispersal, and germination, and provide water that young or shallow-rooted plants need.

Monitoring showed:

- The timing and height of flows significantly influences how much germination occurs and the variety of species that germinate. Spring flows increase germination of native riparian species. Low flows in late summer are also important to promote aquatic and emergent plants.
- Rainfall supports germination of many riparian plants. With future hotter and drier conditions predicted, the role of environmental flows in maintaining riparian vegetation populations will become increasingly important.

Many seeds that germinated in autumn are tolerant of long periods of cooler season flooding. However, many seedlings are killed by very high or long duration flows or during summer/early autumn flows. These results reflect what our nursery experiments found.

Above: Fish surveys, by ARI

What about our wetland sites?

Sixty-six wetlands were monitored covering the four themes for vegetation, birds, fish and frogs. Results are still being synthesised, but early findings demonstrate some key outcomes of water for the environment.

INITIAL FINDINGS:

Twenty-two sites were monitored for vegetation

- Environmental watering plays a key role in supporting the growth of wetland plant species and suppressing the growth of terrestrial plant species – in much the same way that natural wetting and drying cycles would.

Thirty sites were monitored for frogs

- Frogs were recorded in higher numbers and great species diversity at sites that received water for the environment.

Twenty-five sites were monitored for birds

- Waterbirds responded quickly and strongly to water for the environment deliveries to wetland sites, turning up shortly after deliveries commenced and leaving once sites became dry.

Fifteen sites were monitored for fish

- Environmental watering of wetlands increased connectivity, productivity and water quality helping to improve feeding and breeding opportunities for native fish species.

Gippsland region

Gippsland region total 2019-20: **152,567 ML**

Water for the environment delivered to the Gippsland region in 2019-20 (megalitres)

- Latrobe system 2,701 ML
- Thomson system 13,661 ML[1]
- Macalister system 18,333 ML
- Snowy system 117,871 ML

[1] Includes passing flows delivered in the Thomson River (739.0 ML)

Gippsland region at a glance
2019–2020

- Heyfield wetlands received it's first delivery in 2019-20; a total of 15 ML was delivered to the site.
- Recent surveys have revealed greater catches of the native tupong upstream of the Horseshoe Bend tunnel.

Above: Thomson River at Coopers Creek, by VEWH

Supporting improved environmental flows

The waterways of the Gippsland region have been important to the Gunaikurnai people for many thousands of years.

Today, water is no less important to the Gunaikurnai. Access to water will enable the Gunaikurnai to restore customary practices, protect cultural values and uses, gain economic independence and heal Country.

GLaWAC has been at the table on the West Gippsland CMA environmental flows study review panels for the Thomson and Latrobe rivers. Collaboration has included GLaWAC working with Gunaikurnai community members to undertake Aboriginal Waterway Assessments in the Latrobe River system, and yarn about how water can protect and further the cultural values and uses of waterways in the Gippsland region.

For the Thomson and Latrobe rivers, GLaWAC has shared species of high cultural value that depend on water and water management that mimics nature. GLaWAC has expressed the importance of the Lower Latrobe Wetlands from a cultural perspective, and the need to protect the freshwater status and manage invasive species that threaten native plants and animals.

Waterway managers:
East Gippsland CMA, NSW Department of Primary Industries, West Gippsland CMA

Traditional Owners:
Gunaikurnai Land and Waters Aboriginal Corporation

Storage manager:
Southern Rural Water, Melbourne Water, Snowy Hydro Limited

Land managers:
Parks Victoria and Field & Game (lower Latrobe wetlands)

Left: Thomson River, by VEWH

Community input is imperative

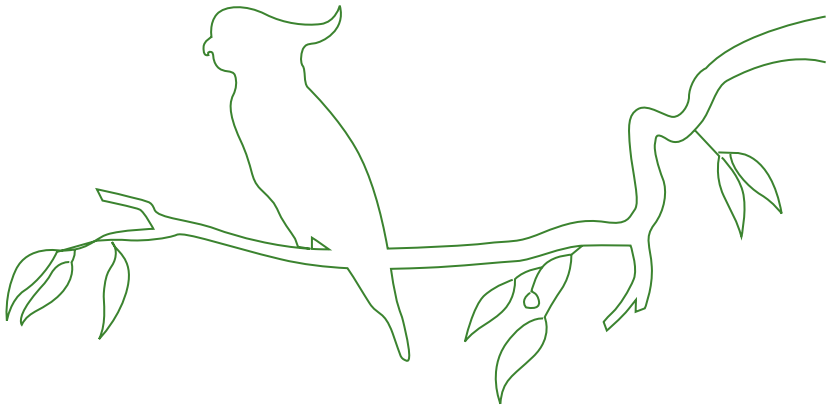
The Macalister River Environmental Water Advisory Group (EWAG) continues to be involved in the annual planning of delivering water in the Macalister River. Macalister EWAG member and long-time resident, Duncan Fraser, has been involved in extensive river restorations works over the years. Duncan has childhood memories of beautiful, clear water running down the river where they could look into the water and see what was at the bottom in places. His long-running advocacy for and commitment to the Macalister River and, in particular, Bellbird Corner is phenomenal.

Above: Macalister River at Lanigans Bridge, West Gippsland CMA

Timing it right in the Thomson

Autumn, winter and spring environmental flows create ideal whitewater rafting conditions for avid canoers and kayakers in the upper Thomson. In 2019, a spring fresh coincided with the Melbourne Cup long weekend, allowing whitewater rafters to take full advantage of paddling conditions. West Gippsland CMA notify of water for the environment releases to ensure these keen adventurers can take advantage of prime conditions.

Above: Whitewater rafting on the Thomson River, by West Gippsland CMA



Tupong love the Thomson

The work to re-connect the upper and lower sections of the Thomson River through the construction of a fishway at Horseshoe Bend is starting to see positive results.

Recent surveys have revealed greater catches of the native tupong upstream of the Horseshoe Bend tunnel. A range of fish sizes (juveniles and adults) were also collected above the tunnel, which is a rare find.

Staff from the Arthur Rylah Institute have been undertaking annual fish monitoring in the Thomson River since 2005 as part of the Victorian Environmental Flows Monitoring and Assessment Program.

"We're delighted with these results," West Gippsland Catchment Management Authority (CMA) CEO Martin Fuller said.

"Our work with the local community over several years is delivering exactly the sort of results we wanted – a healthy, connected river that allows upstream and downstream migration of native species."

The construction of a fishway at Horseshoe Bend was completed in August 2019 after many years of negotiation and consultation with the community. It means fish in the Thomson River and estuary will have access to an extra 22 km of the Thomson River and 64 km of the Aberfeldy River.

This project was funded through the Victorian Government's $222 million investment to improve the health of waterways and catchments.

The Thomson River is one of the region's most significant and ecologically important rivers, and the creation of a fishway to allow passage between the Gippsland Lakes to the Victorian alpine region is a state priority.

"In this year's surveys, numbers of tupong above the tunnel have exceeded anything in the last 15 years. Previously, tupong were more common downstream of the tunnel but now have unimpeded access to the upper reaches of the catchment," West Gippsland CMA Waterways Project Officer David Stork said.

"The female of the species migrates long distances upstream where it grows and matures and then it migrates back downstream to the sea to breed. The fact that so many can now get as far as the Aberfeldy and Thomson Dam indicates that they are using the fishway and exploring new territory, which is what we wanted to see," David said.

The ability of the tupong to move upstream was aided by extra flows of water released from the Thomson Dam under a partnership between the West Gippsland CMA and the VEWH.

"Actions to improve fish passage both up and downstream will contribute to restoring the migratory fish community in the Thomson River," concluded David.

Above: Thomson River fishway, by West Gippsland CMA

"The Horseshoe Bend Tunnel is around four kilometres from Walhalla on the Thomson River," West Gippsland CMA CEO Martin Fuller said.

While visitors to the Thomson area might not be able to easily spot a tupong, they are encouraged to visit the area around the Horseshoe Bend Tunnel and the new fishway.

"It was built in 1911 and 1912 to drain water from the Thomson at Horseshoe Bend to allow for alluvial mining of the riverbed and it gained heritage status in 2002. The newly-constructed paths around the fishway allow great access to view the tunnel and explore some of the area upstream of the tunnel entrance. It's well worth a visit," Martin said.

SPECIES SPOT

NAME	Tupong
STATUS	Common, widespread
PARTY TRICK	Tupong bury themselves in gravel on the riverbed but leave their eyes uncovered to watch for incoming predators.
KEY THREAT	Low river flows; if flows drop to a point where the river becomes a series of disconnected pools, then the fish cannot migrate upstream for habitat, food or to breed.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental flows are released to trigger migration. Adult tupong will migrate from the rivers downstream to the sea to breed and juvenile tupong will migrate upstream taking advantage of additional habitats for feeding, growth and survival.

Above: Tupong, by Glenelg Hopkins CMA

Sale Common gets a fill

The most notable achievement in the lower Latrobe wetlands in 2019-20 was the partial fill of Sale Common. The high river heights observed over October and November 2019 meant that approximately 90% of the surface area was inundated, and about 60% of the volume of the wetland filled. This fill occurred after being dry for over 18 months and resulted in a flourish of aquatic plants.

A male Australian bittern was observed in the wetland in November 2019 through acoustic and photographic monitoring. This is a rare site for Sale Common with the last recorded sighting occurring in 1992!

Above: Bittern at Sale Common, by Heather Alexander

Animals galore at Heart Morass

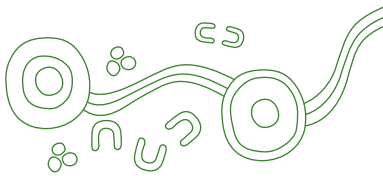
Impressive animal numbers were recorded at Heart Morass after delivery of water for the environment in spring 2019. Up to 50 glossy ibis were seen feeding at the wetland for several weeks, while green and golden bell frogs were heard calling at various times during the year. Monitoring cameras also captured photos of a young wedgetail eagle, a ringtail possum, as well as nesting and grazing black swans.

Above: Monitoring at Lower Latrobe Wetlands, by West Gippsland CMA

Paddling at Dowd Morass

One of the best ways to see Dowd Morass is from the water. This summer, the GLaWAC Cultural Water team and West Gippsland CMA staff went for a paddle on Dowd Morass to check out how it looks away from the banks. The wetland is a significant place for the Gunaikurnai, with many registered cultural sites, and is home to many rare and endangered species, and species of significance to the Gunaikurnai including the pelican and the musk duck.

Above: GLaWAC cultural and water team paddling at Dowd Morass, by GLaWAC



Lower Latrobe wetlands, by West Gippsland CMA (drone image)

Partnerships produce positive outcomes

Nothing says a waterway is in a healthier state than the sight of native animals doing their thing.

The Heart Morass near Sale is a large wetland wedged between two Ramsar sites, at the confluence of the Thomson and Latrobe rivers.

The wetland area was previously used for heavy grazing and it suffers from acid sulphate soils and salinity.

For more than 10 years, a partnership between the West Gippsland CMA, Sale Field and Game and the Williamson Foundation has seen the 1800-hectare site transformed to a wonderful wetland on the doorstep of a major Gippsland town.

Lifelong member of Sale Field & Game, Danny Asmussen, recently spotted a platypus downstream from the Swing Bridge at Heart Morass.

He and his small group saw the platypus from a boat, out on the wetland. Danny says it was "Going under, sitting on top for a while, having a scratch – doing what platypus do."

As far as we know, this is the first time a platypus has been seen at the Morass. Certainly, long-term advocate and volunteer at the Morass, Gary Howard can't remember seeing one before.

Environmental Water Officer at the West Gippsland CMA, Dr. Adrian Clements, says the transformation of the site has been the result of hard work and strong partnerships.

"The platypus being there indicates that the water quality is improving, which is allowing more plants to establish and bugs to move in, which is exactly what platypus love, and a sign we are getting things right."

Danny said it's been amazing to see the transformation at Heart Morass.

"Where it used to be basically paddocks, now the tussocks and things are all there. It's a credit to the guys up there who have done so much work."

"It's less salty now because the Morass is getting fresher because of how they're (West Gippsland CMA) managing it, letting fresher water in through opening and shutting the regulators."

"To think that 14 years ago it was almost a barren landscape with not much more than a few weeds. Since the purchase of the property in 2006, permanent grazing from stock has stopped, the crew from Sale Field and Game have been planted trees and removed weeds, while we (WGCMA) have been managing the water side of things," said Adrian.

Above: Dowd and Heart Morass, by West Gippsland CMA

Heyfield Wetlands gets a helping hand

In the small town of Heyfield, located about 200 kilometres east of Melbourne and with a population of just under 2,000 people, the community has come together to bring water for the environment to the Heyfield Wetlands for the first time.

Heyfield Wetland Committee supported strongly by the local community are currently working towards restoring the site back to a functioning wetland.

"The inflows of around 10 megalitres in August and October 2019, followed by an additional three megalitres in November, has just been wonderful," said Heyfield Wetlands Committee member, Barry Donahoe.

"We've put in two significant ponds and built waterways with the idea of expanding the aquatic habitat for birds and animals. We've planted thousands and thousands of trees and shrubs to achieve this and the water coming in is just putting the icing on the cake for us."

The Heyfield Wetlands provides a space for locals and visitors to be outside and connect with nature. People enjoy walking along the wetland path and birdwatching at the site. These small deliveries of water for the environment will help enhance these values and continue to provide shared benefits for the broader community by boosting tourism and visitation to the area.

"Evidence-based decision making, utilising local knowledge together with river and wetland studies help inform us where water for the environment should be prioritised to get the best ecological benefits we can under prevailing conditions," explained VEWH Commissioner Jennifer Fraser.

"This initiative is a great demonstration of a strong partnership between the Heyfield Wetlands Committee, West Gippsland Catchment Management Authority (CMA) and the Victorian Environmental Water Holder (VEWH) along with the support from Southern Rural Water and Gippsland Water to make a watering event happen."

Above: Community comes together to celebrate environmental flows into Heyfield Wetland, by VEWH

"The VEWH is supportive of watering the Heyfield Wetlands because it is one of the few remaining freshwater marshes present in the Gippsland Plains landscape, and so it is likely to provide an important refuge for aquatic animals and waterbirds, including several migratory species recorded by the Heyfield community," said Jennifer.

Above: Heyfield Wetlands water for the environment delivery October 2019, West Gippsland CMA

People working with and caring for their environment

Just adding water for the environment is not the only factor to consider for improving the health of our rivers, complementary works and measures are also equally important to ensure our river environments, and their surrounds are healthy.

West Gippsland CMA has partnered with farmers along the Thomson and Macalister rivers to work on grazing and soil management, and on nutrient and water-use-efficiency projects that help to improve water quality and river health.

Dairy farmer John Ryan has over three kilometres of Thomson River frontage. "We've taken a small notch out to plant about 6,500 trees and the goal of that from a farmer level and an ecological level is to create more space for habitat and more life in the environment and to control things like pests," he said.

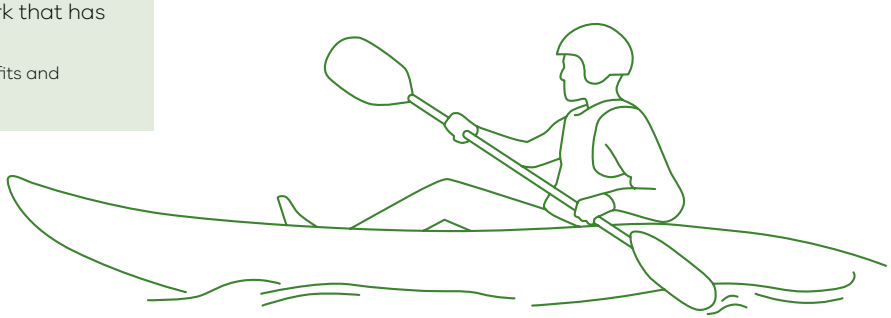
West Gippsland CMA is working with landholders in the Gippsland region to continue enhancing environmental outcomes, which can have great benefit for our rivers. This is just a small glimpse of some of the work that has been under way!

Above: Farmer John Ryan chatting about farming benefits and ecological benefits, by West Gippsland CMA

Snowy proves popular for paddling

The Snowy River is a popular spot for whitewater rafting, canoeing and kayaking. Most flows from the upper Snowy River catchment are captured in lakes Eucumbene and Jindabyne. Environmental flows released from Lake Jindabyne are crucial for supporting native fish species including river blackfish and Australian grayling through improving aquatic habitat and additionally provide important paddling opportunities that are rarely provided from natural flows.

Above: Whitewater rafting on the Snowy River, by East Gippsland CMA



Moogji Aboriginal Works Crew

The East Gippsland CMA and Moogji Aboriginal Council have an ongoing partnership to continue work on the lower Snowy River. The Moogji works crew have been working on the river for over 15 years and look after the lower Snowy River from Jarrahmond to the Brodribb. The crew controls weeds and plants native seedlings to improve the health of the Snowy. Complementary works, such as these, are needed to support the achievement of environmental watering outcomes and to help maximise the benefits from environmental flows.

"Moogji are a terrific partner providing opportunities for local people to develop a career path and further employment opportunities while improving the health of the river." said East Gippsland CMA CEO, Graeme Dear.

Above: Moogji NRM Crew controlling invasive Inkweed in Goongerah, by East Gippsland CMA

Corringle Calling

The sun was shining, and conditions were calm as the East Gippsland CMA, Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) and Parks Victoria hosted a walk, talk and paddle at Corringle Foreshore Reserve.

Participants learnt about the joint management arrangements between GLaWAC and Parks Victoria, the cultural significance of the Reserve and the importance that environmental water flows play to the health of the Snowy River.

"Getting out into nature is good for the health and wellbeing of our whole community," said Nicole Thompson, East Gippsland CMA Water Program Team Leader.

"We'd like to thank our partners and all of the community members who helped make this day such a success."

Above: East Gippsland CMA, GLaWAC and Parks Victoria at Corringle Foreshore Reserve, by East Gippsland CMA

Snowy River, by East Gippsland CMA

Central region

Central region total 2019-20: **9,773 ML**

Water for the environment delivered to the Central region in 2019-20 (megalitres)

- Yarra system 4,000 ML
- Tarago system 40 ML
- Maribyrnong system 0 ML
- Werribee system 1,174 ML
- Moorabool system 3,652 ML
- Barwon system 908 ML

Central region at a glance
2019–2020

- At the lower Barwon wetlands Corangamite CMA have recently created an elver pass which helps facilitate eel movement from the Barwon River into Reedy Lake and vice versa!
- Scientists tagged over 150 diadromous fish in the Tarago River and can now track how the Australian grayling, short-finned eels, tupong and common galaxia move in response to environmental flows in real time!
- Rover the platypus, first monitored by Melbourne Water near Healesville in 2016 has had a busy three years on the move - turning up recently in Warburton – more than 55 kilometres away.

Waterway managers:
Corangamite CMA, Melbourne Water

Traditional Owners:
The Bunurong Land Council Aboriginal Corporation, Eastern Maar Aboriginal Corporation, Wathaurung Aboriginal Corporation (trading as Wadawurrung) and Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation are the Registered Aboriginal Parties for the areas incorporating waterways covered in the central region

Storage managers:
Melbourne Water, Southern Rural Water, Barwon Water

A river of mists and shadows

"The Birrarung is a river of mists and shadows – the river and its environs are a living, breathing entity that follows Wurundjeri songlines and forms a central part of the Dreaming of the Wurundjeri. A Dreaming that links the billabongs, wetlands and swamps in the upstream forests, across the meandering plains and out to the salt water. We the Wurundjeri are connected to the Birrarung through spirit, culture and nature. The river follows the paths that our ancestors have travelled for thousands of years - providing for them as now it provides for all Victorians."

- Nhanbu narrun ba ngargunin twarn Birrarung (Wurundjeri's Birrarung Water Policy, page 5)

Above: Yarra River, by VEWH

Left: Yarra River Warrandyte by VEWH

SPECIES SPOT

NAME	Platypus
STATUS	Near threatened
PARTY TRICK	A female platypus can eat up to 80 percent of her body weight in waterbugs per day, when producing milk to feed her young – called puggles!
KEY THREAT	Loss of habitat through land clearing and construction of dams that disrupt the natural flow of water.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Water for the environment helps maintain continuous flows along rivers; this helps the platypus move around and creates good feeding opportunities by sustaining waterbug populations which platypus love to feed on.

Above: Wimmera River platypus, by Paul Carracher

Yering Backswamp

Water for the environment plays a critical role in the survival and growth of native plants at Yering Backswamp, a billabong located along the Yarra River near Yarra Glen.

Melbourne Water's Acting Environmental Water Resources Delivery Lead, Josie McGushin, says delivery of water for the area is vital to its preservation.

"Delivery of environmental flows to this important wetland supports the survival and recruitment of significant plant species such as the Australian basket-grass and austral lady-fern, while also providing habitat and feeding opportunities for waterbirds and frogs," Josie said.

Ongoing bird surveys are undertaken at Yering Backswamp every second month and recorded on the Birdlife Australia database. The February 2020 survey recorded 38 species in vicinity of the billabong, including the notable peregrine falcon and brown goshawk.

Above: Yering Backswamp following spring deliveries 2019, by Melbourne Water

Banyule Billabong: a demonstration of collaboration

Located alongside the Yarra River in Heidelberg, Banyule Billabong holds cultural connection for the Wurundjeri Woi-Wurrung people, is highly valued as a recreational site for walking, running and bike riding, and is home to many plants and animals.

"Working together to bring environmental flows to Banyule Billabong is a great initiative," said Melbourne Water's Environmental Water Resources Delivery Lead Sarah Gaskill.

"We worked together with the VEWH, Parks Victoria and Banyule City Council to make the delivery happen, with Wurundjeri Woi-Wurrung Corporation and the local community providing critical knowledge to understand the many cultural and recreational values at the billabong. The delivery demonstrates the hard work of all the parties involved, and meeting at the site to acknowledge and celebrate the collaboration was fantastic," she said.

Prior to the environmental flow delivery in September 2019, Banyule Billabong was dry, and its understorey vegetation was dominated by terrestrial exotic plants. Following the watering, some areas of the wetland remained inundated for up to a month, which promoted native wetland plants to regenerate and drowned many of the terrestrial plants within the wetland. In January 2020, large numbers of native wetland plants were observed flourishing, with a healthy population of lesser joyweed and knotweed.

On Country learning with Wurundjeri

Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation and Melbourne Water are working towards an integrated approach that includes Wurundjeri as active participants in the planning, delivery, and monitoring of environmental watering on the lower Yarra floodplain. In November 2019, Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation completed the Bulleen-Banyule Flats Cultural Values Study, which details places of Traditional Owner tangible and intangible significance. Melbourne Water has supported this project by attending on=Country visits with Elders and are linking this study and the identified potential cultural benefits with environmental watering.

Wurundjeri's Narrap team is on-ground

Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation's Water Unit engaged the Narrap team to undertake on-ground activities, such as water quality and frog monitoring, through the cultural water program at billabong sites along the lower Yarra floodplain. Monitoring is underway at Banyule Billabong following a delivery of water for the environment in 2019-20 and similar work will likely be undertaken at Annulus Billabong in 2020-21.

Above: Meeting on site at Banyule Billabong, by Melbourne Water

Rover revs up the Yarra

Rover the platypus, first monitored by Melbourne Water near Healesville in 2016 has had a busy three years on the move - turning up recently in Warburton – more than 55 kilometres away.

Melbourne Water's Environmental Water Resources Planner, Tiana Preston, was surprised at the distance, which is the longest journey recorded by a platypus in the Melbourne region.

Rover was first captured as a baby in Chum Creek near Healesville in 2016. He was then recaptured at the same site as an adolescent in early 2017 before turning up in the Yarra River near Warburton in early 2019.

"It's highly unusual to have had success tracking the same platypus across such a vast geographical area and pleasing to see him thriving across several waterways," Tiana said.

"This lengthy traverse we believe has been aided by the regular Yarra River environmental flows Melbourne Water carries out which help animal movement."

This iconic species isn't just being supported in the Yarra River – waterway managers across Victoria are trying to maintain and improve their habitat with the delivery of environmental flows.

Above: Melbourne Water monitoring platypus movement in the Yarra River, by Doug Gimsey

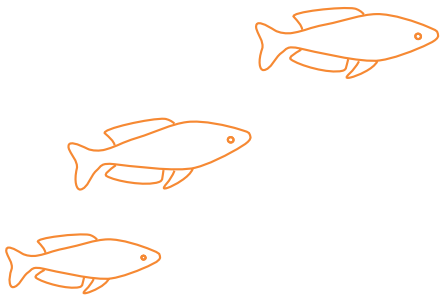
New technology for tagging fish in the Tarago

Diadromous fish spend some of their life in freshwater and some in salty water. Scientists tagged over 150 diadromous fish in the Tarago River in March 2020 and will now be able to track how the Australian grayling, short-finned eels, tupong and common galaxia move in response to environmental flows in real time!

"The 'passive integrated transponder' technology will help inform and support better conservation management," said Melbourne Water's Environmental Water Delivery Lead, Sarah Gaskill.

"It will allow us to better understand the migratory behaviours of these fishes and links to environmental conditions, as well as how delivery of environmental water flows may help them move and thrive. We have been studying the fish in this waterway for around 12 years with the help of the Arthur Rylah Institute and are excited with this new technology."

Above: Arthur Rylah Institute staff capturing the fish using backpack electrofishing to tag and release, by Doug Gimsey



Parts of the Yarra that people love

Did you know more than one-third of Victoria's population lives in the Yarra catchment, which spans about 4,000 square kilometres.

Environmental flows in the Yarra enhance social, recreational and economic values and uses in a variety of ways including through water-based recreation, riverside recreation and amenity and community events and tourism.

Above: Locals value the Yarra River for recreational activities including running, walking, fishing and picnicking

Above: Boating is popular on the Yarra River with rowing clubs, kayakers, canoers, families and friends all enjoying a paddling

Above: The Yarra trail is a popular spot for bike riding, thousands of cyclists use the trail when commuting to work

SPECIES SPOT

NAME	Waterbugs (macroinvertebrates)
STATUS	Common
PARTY TRICK	Waterbugs are a great indicator of water quality. Because of their varying degrees of pollution sensitivity, they can help waterway managers understand the health of a river, stream or wetland.
KEY THREAT	Waterbugs feed on dead or decaying matter, such as fallen leaves and logs; without vegetation in a waterway, waterbug food availability can greatly reduce.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental flows enhance habitat for waterbugs by flushing silt from rocky sections of the river, allowing them to access nooks and crannies where they can feed, breed and hide from predators.

Above: Stonefly, by Parks Victoria

Jumping to action in the Werribee

A planned environmental flow was delivered from Melton Reservoir to disperse a small algal bloom in the Werribee River in February 2020. Blue-green algae blooms are common during the warmer months when flows are reduced in the Werribee River, but blue-green algae are toxic to some animals (including humans). They can also lead to low oxygen levels which can suffocate fish. Environmental flows can help by mixing the water, reducing the water temperature and flushing the blue-green algae out of the system. Zoos Victoria closely monitored the bloom, feeding information to Southern Rural Water, Melbourne Water and the VEWH who were able to adapt the timing of the water release and improve the water quality in the river. Some additional flows from natural rainfall in the area also aided in dispersing the bloom. Results were immediate with a significant reduction in the size of the bloom observed, which had fully dispersed by mid-March 2020.

Above: Werribee River, by VEWH

Let's take a look at the lower Barwon wetlands

Review of four-year watering regime

In 2016-17, Corangamite CMA and the VEWH implemented a four-year trial to reinstate a more variable water regime at Reedy Lake and Hospital Swamps. Filling the wetlands in winter and spring and allowing partial drawdown in summer and autumn aimed to create more variable habitats throughout the year to support a greater mix of plants and animals. Partial drying that exposes mudflats in summer and autumn was considered particularly important to create suitable conditions for a wide range of seasonal wetland plants, create feeding opportunities for wading shorebirds and increase carbon and nutrient cycling, which helps increase the overall environmental productivity of the wetlands. 2019-20 was the fourth year of the trial — three years of partial drying and one year completely full at Reedy Lake.

An independent review of the trial was undertaken in 2020 to examine whether the altered regime had supported improved wetland health and inform future water management. The Lower Barwon Review recommended continuation of a wetting and partial drying regime to improve biodiversity and maintain the ecological character associated with the lower Barwon wetlands Ramsar site listing. The review also recommended further monitoring and modelling to fill identified knowledge gaps and an update of the environmental watering recommendations.

Above: Costal salt marsh at Reedy Lake, by Corangamite CMA

Binoculars were out, bird spotting was on at Reedy Lake

In early 2020, significant numbers of internationally endangered Australasian bitterns were sighted in Reedy Lake. This is exciting news for birdwatchers who often frequent the site to catch a glimpse of rare or migratory bird species. Other exciting spots in 2019-20 included magpie geese (over 50!), glossy ibis and brolga.

Corangamite CMA's Senior Project Officer, Sharon Blum-Caon, said the watering regime supports a diversity of native plant and bird species.

"Water for the environment delivered to Reedy Lake improves feeding and breeding opportunities for waterbirds in the area. As the water level begins to recede, nutrient-rich mudflats are exposed creating ideal foraging habitat for wading waterbirds. The watering regime also encourages a range of vegetation species to grow. A variety of water levels aligned with seasonal variation in river flow is important at the wetlands to support a range of habitats and to maximise biodiversity".

Lower Barwon wetlands receives upgrades

On-ground works have been underway at the Lower Barwon wetlands and were completed in July 2020. A new tidal barrage weir and fishway have been installed on the lower Barwon river and a new outlet structure, fishway and elver pass at Reedy Lake.

What on earth is an elver pass?

An elver pass, or eel pass, is a structure that enables eels to move through waterways freely. Some waterways have been modified by humans over time, and as a result eel movement has been obstructed. The elver pass at Reedy Lake enables short-finned eels to move more freely from the Barwon River into Reedy Lake and vice versa.

Moorabull Yuluk supports important species

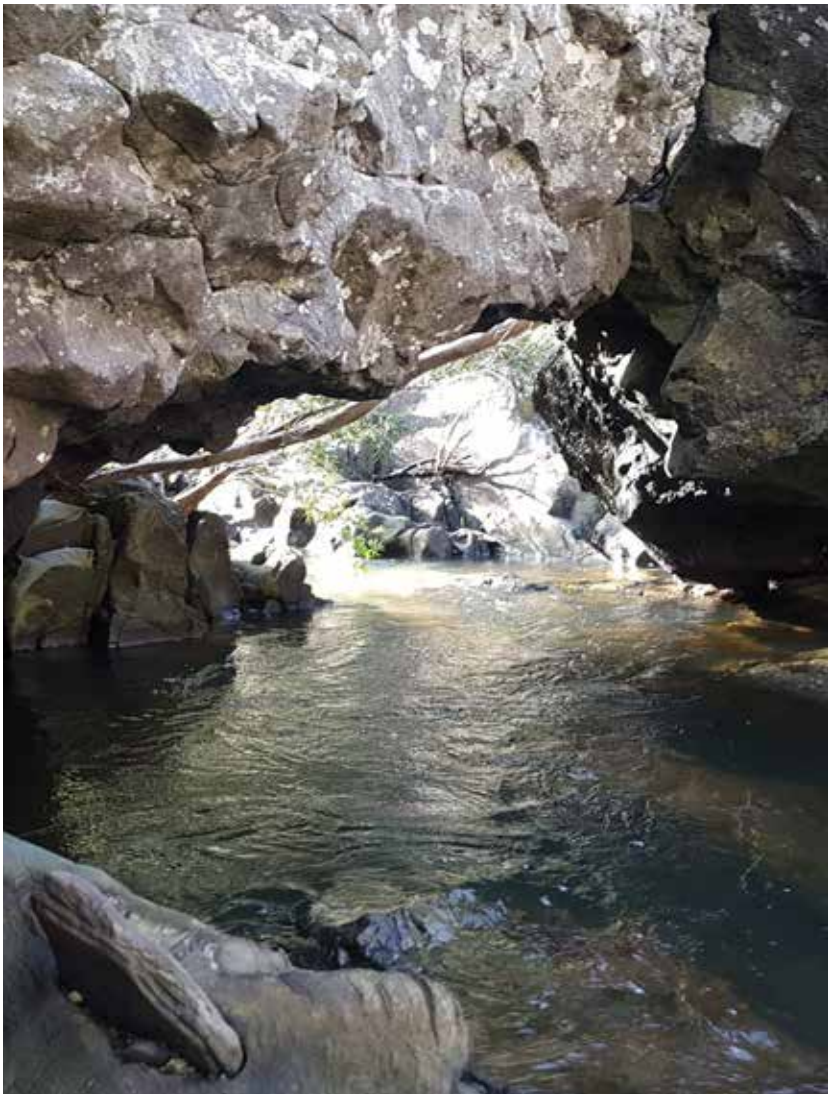
Wadawurrung Traditional Owners have a strong connection to the river and place a high cultural value on the *Moorabull Yuluk*. Wadawurrung are a key partner in advocating to support the health of the Moorabool River.

"I see the health of the lands and waters of the Wadawurrung as an integral part to our existence. Without a healthy and flowing system, we suffer as a Family and it's extremely important that everything stay connected. In a perfect world, we would not need to undertake this work and to me, this is a major indicator that more of this work be carried out to secure more water," said Wadawurrung Traditional Owners Aboriginal Corporation's Water Officer Michael Cook.

Additional flows from the VEWH's water purchase in 2019 have continued to help support cultural outcomes such as:

- supporting movements and habitat for significant species such as *Wad-dirring/ Perridak* (platypus), *Buniya* (Eels), *Turrpurt* (Native trout) and *Ware-rap* (Blackfish) as well as others
- supporting flow through culturally significant confluences and deep pools.

These key cultural objectives and values were identified in Upper Barwon Yarrowee and Leigh River environmental flow study (Alluvium 2019) and are also applicable within the Moorabool river system and across all sites within Wadawurrung country.



Above: Moorabool River, by Michael Cook

Citizen science - watching out for waterbugs in the Moorabool River

Waterwatchers were out wading in the Moorabool River near She Oaks during the National Waterbug Blitz event. Waterwatch scientists and Corangamite CMA, with the help of volunteers from Moorabool Landcare Group and Golden Plains Shire, were conducting a longitudinal analysis, which involves searching for waterbugs along the length of the river at various points. Collecting waterbug data will help inform future management and use of environmental flows.

Above: Waterwatch staff and volunteers conducting a longitudinal survey of waterbugs in the Moorabool River, by Corangamite CMA

A little bit more for the Moorabool

Flows released in February and early March 2020 and another in late April early May 2020 were made available through a one-off temporary purchase of water by the VEWH from Barwon Water. These events were triggers for downstream migration and spawning of Australian grayling and short-fined eels and watered stream-side vegetation. The purchased water also provided increased low-level flows through the lower sections of the river during the driest time of the year, helping to maintain connectivity.

Above: Moorabool River, by Corangamite CMA

SPECIES SPOT

NAME	Short-finned eel
STATUS	Common, widespread
PARTY TRICK	Short-finned eels migrate from Victorian rivers all the way to the Coral Sea to spawn – this can be up to 5,000 kilometres and take over a year!
KEY THREAT	Man-made barriers obstructing movement up and down river systems.
HOW DOES WATER FOR THE ENVIRONMENT HELP	The epic migration of the short-finned eel is supported by environmental flows which help them move from rivers, lakes and swamps out to the ocean.

Above: short-finned eel, by Douglas Gimesy

Citizen science - spotting platypus in the Barwon

Platypus are coming out to play in the Barwon River. Environmental flows are small in the Upper Barwon River, but they play a critical role in enhancing and maintaining habitat, improving water quality and increasing feeding opportunities for our iconic platypus species. In November 2019, citizen scientists were out on the river learning spotting skills from Geoff Williams from the Australian Platypus Conservancy. Community members learnt how to use the Australian Platypus Monitoring App and were lucky enough to spy two platypuses! The Upper Barwon Landcare Network also caught a glimpse of a couple of these critters where they have been undertaking riverside vegetation restoration work. Platypus have also been detected in the Upper Barwon river near Birregurra recently using DNA sampling techniques.

Above: Learning about the Australian Platypus Monitoring App on the Barwon River, by Corangamite CMA

Let's get digital

Corangamite CMA recently launched a new interactive data catchment map on their website.

This is a great initiative that gives people in the Corangamite region (and those across the state, or even the world!) the power to explore trends in environmental flows data at key gauge locations across the Corangamite river catchments.

Senior Project Officer Estuaries and Environmental Water, Sharon Blum-Caon, said "The tool can be used to see the environmental releases being made from reservoirs and what that looks like, together with natural flow, at different places down the river."

"It allows tracking of the water on a landscape scale. At wetlands, the community can see when adjustments are made to add or remove water to benefit the ecology of the whole system."

"The interactive maps of the waterways in the area are great. They provide a very user-friendly way for community to get in touch with how their rivers and wetlands respond to water for the environment. When a gauge point is selected on the interactive map, data can be viewed in a range of ways and time scales."

"Besides water flow and level, many gauges have extra information like salinity, dissolved oxygen and temperature, which allows the user to get a feel for how these parameters change with different water volumes moving through the system" said Sharon.

Western region

Western region total 2019-20: **24,652 ML**

Water for the environment delivered to the Western region in 2019-20 (megalitres)

- **Glenelg system 12,992 ML**[1]
- **Wimmera system 12,272 ML**[1]
- **Wimmera-Mallee wetlands 88 ML**

[1] Includes passing flows delivered in the Glenelg River (1,970.0 ML) and Wimmera River (689.6 ML)

Western region at a glance
2019–2020

- Traditional Owners in western Victoria utilised technology in innovative ways to come together during the coronavirus (COVID-19) restrictions and share knowledge.
- Native fish numbers and distribution have improved since water for the environment began flowing to the Glenelg River.
- Some environmental flows delivered to the Wimmera River were held back temporarily to raise water levels in the Horsham and Dimboola weir pools, improving conditions for community events including fishing competitions.

Waterway managers:
Glenelg Hopkins CMA, Mallee CMA , North Central CMA, Wimmera CMA

Traditional Owners:
Barengi Gadjin Land Council Aboriginal Corporation, Barrandies Aboriginal Corporation, Dja Dja Wurrung Clans Aboriginal Corporation and Gunditj Mirring Traditional Owners Aboriginal Corporation

Storage manager:
Grampians Wimmera Mallee Water

The environment benefits, and so does the community!

Environmental flows are often the only water in the Wimmera River, particularly during dry or drought years.

Without the environmental flows delivered in late spring 2019 through to winter 2020, the Wimmera River water levels and flow rates would have diminished significantly, due to the dry conditions, compromising many values along the river.

The Wimmera River is the lifeblood of communities such as Horsham, Dimboola and Jeparit, where locals regularly enjoy water skiing at the Horsham and Dimboola weir pools including for the Kannamaroo Festival (Horsham), rowing at Horsham and Dimboola, including the Dimboola Rowing Regatta, the Wimmera River Park Run and Wimmera River Duck Race to raise money for Wimmera Health Care Group.

Above: Paddling on the Wimmera River, by Wimmera CMA

Left: Wimmera River at Dimboola, by Wimmera CMA

Traditional Owners in western Victoria

Using innovation to share stories on Country

Traditional Owners in western Victoria utilised technology in innovative ways to come together during the coronavirus (COVID-19) restrictions and share knowledge.

The Traditional Owners from Gunditj Mirring Traditional Owners Aboriginal Corporation, Barengi Gadjin Land Council and Burrandies Aboriginal Corporation are working with Glenelg Hopkins CMA and South Australia's Limestone Coast Landscape Board on the Glenelg River Cultural Flows Project.

"One of the aims of the project is for Traditional Owners to build their knowledge and expertise in water management, so they are shaping the environmental watering process and future cultural water entitlements," said Charlie Davie, Indigenous Partnerships Coordinator at Glenelg Hopkins CMA.

During the current phase of the project it was planned to hold on-Country gatherings at important sites along the Glenelg River.

Barengi Gadjin Water Officer Daniel Clarke explained that the purpose of these gatherings was to identify and discuss cultural values with Traditional Owners who are connected to the river.

"When we understand what people value in the river system and the Country, we can develop a Cultural Flows plan which will help us look after the river and keep it healthy. Cultural flows will benefit the environment and the species that live here, but they also advance the social, cultural and economic interests of the Traditional Owners."

"Because of the coronavirus (COVID-19) restrictions we haven't been able to take people out to the river to share stories and knowledge," Daniel said.

In response to this situation the project partners hit upon an innovative solution – instead of physically travelling on-Country they undertook 'virtual visits', where Traditional Owners visit important places on the Glenelg River to take photos and footage of the site, which are then uploaded to an online Virtual Tour platform. The initial sites to be featured on the platform are Piccaninnie Ponds in South Australia, Jananginj Njaui (Victoria Gap, Gariwerd), and Red Cap Streamside Reserve near Casterton.

Senior Traditional Owners have recorded stories and information at several important sites, about the history and culture of the river and how it needs to be looked after for future generations. The recorded information will help form the Cultural Flows Plan, as well as becoming part of the Virtual Visits accessible online.

Above: Gunditjmara Traditional Owner Shea Rotumah sharing stories on the Glenelg River for Glenelg River Cultural Flows Virtual Visits project, by Glenelg Hopkins

"The reaction to the virtual visits has been very positive," said Nicky Hudson, Aboriginal Water Officer at Gunditj Mirring.

"People with a lot of cultural knowledge have been able to share yarns about Country without the logistical challenges of organising the big group trips. We are really looking forward to the gatherings on-Country again next year, but these Virtual Visits will definitely continue too. It's a really successful approach. We can keep building on the resource, visiting new sites and adding information," Nicky said.

Swans and ducks on the Glenelg River at Moree Bridge, by VEWH

Talk about a fish freeway!

Almost 20 years after the Glenelg Hopkins CMA began to improve the passage for native fish in the Glenelg River, the final piece of the puzzle has been put in place – a fishway near Warrock, north of Casterton.

VEWH Co-CEO Sarina said, "It is fantastic that fish can now move freely along the entire length of the Glenelg River to the Rocklands Reservoir. The fishway will increase the ecological and recreational benefits of water for the environment."

The fishway, funded by the VEWH and Glenelg Hopkins CMA, required creative management of environmental watering actions over summer to support its construction and design refinement. Environmental flows during the construction phase were planned to not only ensure that contractors were able to work safely, but also to provide low flows downstream of the fishway to protect native fish and platypus populations during the warmer months.

Delivering a summer flow late in the fishway construction also helped contractors to refine rock placement for improved outcomes across a range of flows. Fish monitoring undertaken during the flow event showed migratory species using newly completed sections of the fishway.

This fishway – along with the others completed along the river – is part of the award-winning Glenelg River Restoration Project, which has achieved significant outcomes for fish migration and habitat connectivity. As well as environmental flows, the project included landholder partnerships to install fencing along the river to reduce stock damage to bank and planting riverside vegetation to prevent erosion, plus installing screens to stop carp entering the river below Rocklands reservoir.

Local angler Shane Lowery is excited that the fishways are complete,

"Twenty years of foresight and hard work is producing amazing outcomes!"

Fish can now swim from the river mouth through to the Rocklands Reservoir 400 kilometres upstream – perfect for those migratory species such as popular angling fish like estuary perch and culturally-significant species like tupong and the southern short-finned eel.

Waterway managers across the state are working hard to improve fish passage and remove or implement innovative solutions for fish barriers (such as weirs and irrigation channel systems), which hinder movement of native fish and other aquatic animals.

Above: Fishway along the Glenelg River, by Glenelg Hopkins CMA

Monitoring results are positive in the Glenelg River

Native fish numbers and distribution have improved since water for the environment began flowing to the Glenelg River.

Long-term surveys under the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) show important links between river flows and the recruitment, abundance and distribution of native fish populations in the Glenelg River.

Upstream dispersal of juvenile diadromous fish increased significantly in response to environmental flow releases during summer and early autumn in the Glenelg River. There were almost six times as many juvenile common galaxias and short-finned eels and almost 40 percent more juvenile tupong moving upstream during environmental flow releases compared to baseflow conditions.

Importantly, fish population surveys in the Glenelg River have shown that since 2017, when environmental water has been used to deliver these freshes, the abundance of tupong and common galaxias have increased by 16.0 and 5.8 times respectively.

Environmental flows support continuous connectivity along the river downstream of Rocklands Reservoir ensuring fish, especially migratory species such as tupong, can more freely to feed and breed. Maintaining the river's connectivity since its recovery from the dry conditions in 2015-16 remains a priority watering focus for 2020-21. The ecological gains since this time have continued to be significant, particularly the recovering populations of native fish now present throughout the system. There is a risk, that if this connectivity cannot be maintained, these gains would be lost and take several years to recover.

Left: VEFMAP monitoring, by Glenelg Hopkins CMA

Who gives a carp? Casterton Angling Club does!

The sixth annual Red Gum Shield Carp Fishing Competition was held on the Glenelg River in October 2019. The Casterton Angling Club hosted the competition where 65 anglers from five local clubs helped to catch and remove carp from the waterway. Importantly the two-day event, supported by Glenelg Hopkins CMA, provides a great chance for water officers to chat with communities about environmental flow objectives and positive outcomes for native fish, aquatic habitats and river connectivity.

Above: Waiting to reel in a carp at Red Gum Shield Carp Fishing Competition, by Glenelg Hopkins CMA

Above: Camping along the Glenelg River, by Glenelg Hopkins CMA

Can't get enough of camping?

Environmental flows delivered in early December 2019 provided opportunities for native fish, platypus and crayfish to disperse along the river and to access a variety of habitats. It also supported improved conditions at popular riverside campgrounds in the upper reaches of the Glenelg River including Fulham Reserve near Balmoral and the Johnny Mullagh Reserve at Harrow. The release improved amenity and water quality for swimmers and campers during the Christmas and New Year period.

Above: Fishing on the Glenelg, by Glenelg Hopkins CMA

Harrow plays host to community events

A priority environmental water release was scheduled to refresh the Glenelg River environment and support community values in Harrow over the summer-autumn period.

A release of 3,090 megalitres of environmental water in February, delivered as a fresh event, ensured the river, its plants and habitats were in good condition in time for the Harrow community's annual March long-weekend celebrations.

The Johnny Mullagh Cup cricket championship is a feature event of the weekend for the community including Barengi Gadjin and Gunditjmirring Traditional Owner groups. The match commemorates Australia's first cricket team to tour internationally – an all-Indigenous team comprised of stockmen from the Harrow district.

Josie Sangster, manager of the Harrow Discovery Centre, says the community's social, cultural and economic values are closely linked with the condition of the river.

"Harrow is a river town and the Glenelg River is an integral part of the community's cultural and environmental identity. The river is the town's swimming and recreational precinct, a place of congregation, and celebration not only for the people of Harrow but many visitors and campers that come to Harrow for what they explain is a 'pristine, natural, clean environment'."

"Environmental river flows are important to keep the river flowing and at a level that all recreational activities can be enjoyed, especially when visitation is at its highest benefitting the health and wellbeing of our community whilst educating our visitors about what makes this beautiful river the healthy ecosystem it is," Josie said.

The environmental water team supported the Harrow celebrations with an electrofishing demonstration and discussions about flow and habitat requirements of native species, attracting around 100 interested people. Displays of waterbugs and freshwater fish including pygmy perch, blackfish and tupong provided a point of focus to talk with people including landholders, anglers, kayakers and other river users about shared outcomes of environmental watering actions.

Sponsored canoe rides encouraged about 50 people to get out on the river and appreciate its amenity, recreation and habitat values.

A carp dissection demonstration facilitated discussions about threats to river health and management challenges. The Harrow event also provided the opportunity to survey community members about their understanding of environmental water issues and perception of its benefits.

Above: Community members riverside at Harrow, by Glenelg Hopkins CMA

Top: Community members canoeing on the Glenelg River, by Glenelg Hopkins CMA

Hooked on fishing?

Some environmental flows delivered to Wimmera River were held back temporarily to raise water levels in the Horsham and Dimboola weir pools, improving conditions for community events including fishing competitions.

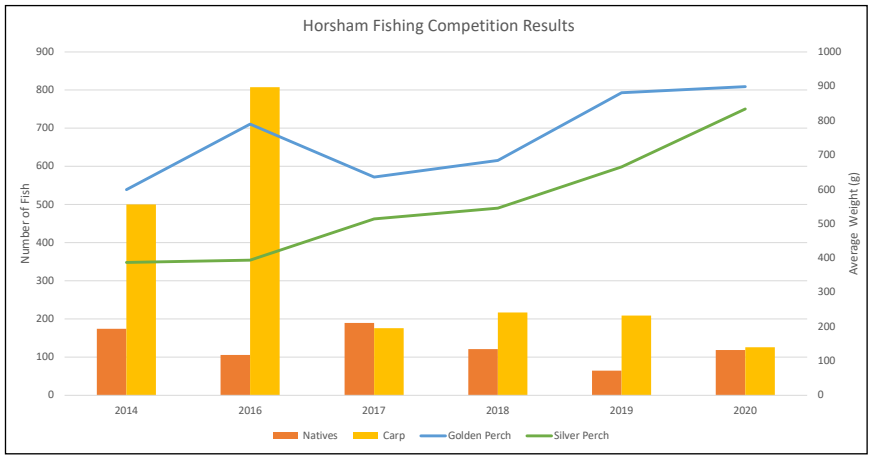
Following the events, the environmental water is released to continue on its way downstream to improve water quality, support native fish and riparian vegetation along the Wimmera River.

The Horsham Fishing Competition is an annual event held on the banks of the Wimmera River during the Labour Day long weekend.

"We've got some really good native fish coming in and it's probably testament to the health of the river. There's been some fish caught in areas that haven't had many fish in recent years." said Horsham tournament organiser Adele Rohde.

When the results were reeled in, it was exciting to see that native fish species, such as golden perch and silver perch have been gradually increasing in weight over the years. Water for the environment is supporting improved water quality and in turn supporting improved populations of waterbugs for native fish to feed on and thrive.

Above: Horsham Fishing Competition on the Wimmera River, by Wimmera CMA



Fish hotels aid native fish populations

Not only are environmental flows helping native fish migrate, spawn and feed but waterway managers are also going to extra lengths to try and rehabilitate and enhance river systems to help support and grow their populations. Recently the Wimmera CMA installed 'fish hotels.' These nifty contraptions are submerged beneath the water in the Horsham weir pool and act as artificial habitat for fish in the river.

Wimmera CMA's Greg Fletcher said, "Typically fish habitat is created by fallen logs or large trees. These structures will create a similar environment and in turn, help grow our native fish populations."

"Initiatives like these along with carefully planned and timed environmental flows in the Wimmera River are supporting increased and sustainable populations of native fish species along our river."

Above: Carp conversations with community members in the Wimmera, by VEWH

Carp control, trying to reduce pesky pests!

The number of carp caught during the Horsham Fishing Competition has significantly reduced in recent years, from 808 in 2016 down to 126 in 2020. Prompting local community members to get involved, the Wimmera CMA offers prize money for the largest carp and most carp caught during the fishing competition, bringing out some participants' competitive nature! Wimmera CMA has continued work to reduce carp numbers by removing them from the system through 'electrofishing' which allows them to capture and remove large numbers of the invasive species at once.

The declining numbers reported during the Horsham fishing competition, coupled with results from the Wimmera Carp Monitoring Program, which began in 2016 and involves repeated surveys at a varying number of sites across the region, indicate that there has not been a large carp breeding event since numbers dropped in 2016.

Carp are known as the 'rabbits of the river' due to their prolific and opportunistic breeding and the damage they do to native aquatic habitats. Waterway managers take steps to minimise their proliferation where possible, but unfortunately complete eradication is often impossible. Community 'catch a carp' days raise awareness and help reduce numbers.

SPECIES SPOT

NAME	Swamp wallaby
STATUS	Least concern
PARTY TRICK	Swamp wallabies actually have webbed feet and are known to swim on occasion. In water, they can move their two jumping legs independently of each other but on land they can only move them together.
KEY THREAT	Destruction of natural habitat through the clearing of land.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Fills and top ups of wetlands with water for the environment can help provide a drinking refuge for swamp wallabies in dry landscapes.

Above: Swamp wallaby at Tarkedia Wimmera-Mallee wetlands, by Michael Gooch

High-priority fish habitat

Victoria's climate has seen a drying and warming trend over the last two decades, and it is predicted this trend will continue in the future. Seasonal shifts in rainfall are expected to continue, with proportionally less rain in the cooler months. Average streamflow is predicted to decline across all parts of Victoria.

Efficient and effective use of environmental flows will be critical to support native species in the upper Wimmera River. When it's very dry – such as during the Millennium drought – these parts of the river dry up completely and native species including fish, platypus and crayfish are lost from the system. Prolonged dry conditions meant that water availability for the system was greatly reduced and water for the environment could not support the plants and animals.

Wimmera CMA has trialled delivery of targeted environmental flows to key refuge pools through monitoring of water levels. Monitoring over a number of years has shown this to be successful. Native fish species such as southern pygmy perch and carp gudgeon and threatened crayfish were not only provided with a watering regime that enabled them to survive, but with one that was suitable for some of them to successfully reproduce.

Above: Drought refuge, by Wimmera CMA

Things are ramping up at the Ranch Billabong

Wotjobaluk Traditional Owners and Wimmera CMA are seeing significant environmental improvements at Ranch Billabong after successful water for the environment deliveries in 2018, 2019 and 2020! Frogs are croaking, waterbirds are flocking to the site and salinity levels in the water have continued to fall. A particularly pleasing outcome has been the vast improvement in canopy condition with river red gums in previously poor condition having a prolific burst of leaf growth. The site has once again become a cultural hub for Wotjobaluk People who celebrated part of the Wotjobaluk Cultural Festival at the site in October 2019.

"With fresh water returning to the billabong through environmental flows over the last couple of years and BGLC's Ranger Crew undertaking regular clean-up works around the property, the Ranch Billabong is looking great. Access has improved and as a community we are on our way to achieving our visions and goals set out in our Country Plan," said Barengi Gadjin Water Officer Daniel Clark.

Above: Wotjobaluk Cultural Festival, by Wimmera CMA

Motion cameras at Wimmera Mallee Pipeline wetlands

Motion cameras were installed at eight Wimmera Mallee Pipeline wetlands sites during 2019-20. Environmental flows delivered to these sites provide a great refuge for native animal and bird species in a typically dry landscape.

The motion cameras captured a huge range of animals spending time at the sites, including hardhead duck, glossy ibis, white-necked herons, breeding behaviours in eastern long-necked turtles, and successful breeding events in Australasian grebes, Australian wood ducks and shelducks.

Not only do our native species value these sites but the community and landholders do too.

"The watering is creating a great environment for all sorts of species. On our property alone, we've seen wallabies and joeys, turtles, possums, lizards and any number of bird species, including the Australian bittern," said local landholder Loughlan Considine.

"But it's the carpet python breeding activity that we think is the most exciting – we've always tried to look after them on our property because they are such fascinating creatures.

"With more reliable water points, their food sources are more plentiful and it's fantastic to see the pythons having the opportunity to bounce back. It means our kids have the opportunity to enjoy having the pythons here around the farm, like we have," Loughlan said.

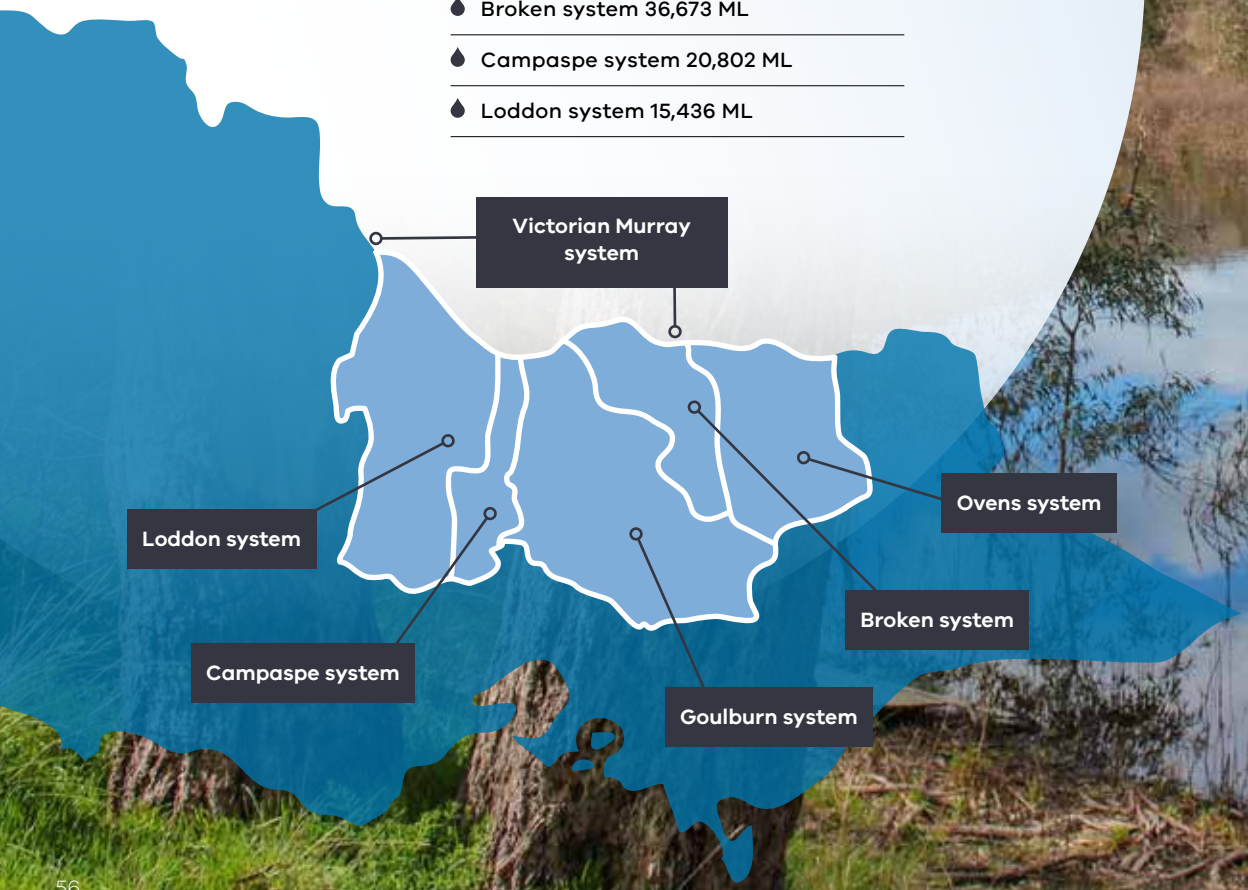
Above: Carpet python, by Loughlan Considine

Northern region

Northern region total 2019-20: **822,679 ML**

Water for the environment delivered to the Northern region in 2019-20 (megalitres)

- Victorian Murray system 345,234 ML
- Ovens system 162 ML
- Goulburn system 403,068 ML
- Broken system 36,673 ML
- Campaspe system 20,802 ML
- Loddon system 15,436 ML



Northern region at a glance
2019–2020

- More than 16 years of monitoring has emphasised the benefits of water for the environment across the Gunbower Forest floodplain.
- Taungurung women danced to welcome the first delivery of water for the environment to the sacred Horseshoe Lagoon, outside Seymour.
- Citizen scientists were lucky to hear the loud booming call of the endangered Australasian bittern at Johnson Swamp, a wetland near Kerang in northern Victoria.

Waterway managers:
Goulburn Broken CMA, Mallee CMA, North Central CMA, North East CMA

Traditional Owners:
The Traditional Owner groups in and around northern Victoria include Barapa Barapa, Dhudhuroa, Latji, Ngintait, Nyeri, Taungurung, Tati, Wadi, Wamba Wemba, Waywurru, Weki, Yorta and Yaithmathang. The Dja Dja Wurrung Clans Aboriginal Corporation, First People of the Millewa-Mallee Aboriginal Corporation (representing Latji Latji, Nyeri Nyeri, Ngintait and Wergaia), Taungurung Land and Waters Council Aboriginal Corporation and Yorta Yorta Nation Aboriginal Corporation are Registered Aboriginal Parties under the *Aboriginal Heritage Act 2006*.

Storage managers:
Goulburn Murray Water, Murray Darling Basin Authority

Using Taungurung water entitlements to deliver environmental flows in the King River

In March 2020, 39 megalitres of water owned by Taungurung Land and Waters Council was delivered as an environmental flow down the King River. This is the second time that Taungurung Land and Waters Council have delivered water to this stretch of river, the first delivery was made in June 2019. The flows have contributed to healing Country by providing a boost to the health and productivity of the waterway.

Taungurung Land and Waters Council's 39 ML of allocation was released from Lake William Hovell in partnership with North East CMA, Goulburn-Murray Water and the VEWH to provide additional water to the King River and assist in healing Country. The flow provided a small variation within the water level to inundate new habitat for instream biota (fish and waterbugs), allowing them to move more freely and find new sources of food.

Above: Taungurung on the King River, by North East CMA

Left: Horseshoe Lagoon, by VEWH

There is something special about the Southern Spring Flow

Environmental water holders across the Murray-Darling Basin joined together to coordinate spring flows in the Murray and Goulburn rivers in August and September 2019.

These events provided refuge habitats, improved water quality and built resilience for native species in the Living Murray icon sites – Barmah-Millewa Forest, Koondrook-Perricoota Forest, Gunbower Forest, Hattah Lakes, Chowilla Floodplains & Lindsay-Wallpolla Islands and the Murray Mouth and Coorong-Lower Lakes.

- Water use: approximately 330 gigalitres
- Six major sites received water for the environment
- Water for the environment travelled 5,080km from its release point at the Hume Dam to the Coorong in South Australia
- Most of the water was reused creating environmental benefits at various floodplains and wetlands before continuing along the Murray River.

The initial flow commenced in the Murray River in August 2019 and was timed to coincide with natural snow melt and rainfall events. Rainfall occurred which resulted in the Ovens River and Kiewa River providing some natural flows to the Murray River and a pause in the delivered environmental flow. A second release was started in September and, through careful planning, storage managers and waterway managers were able to time the release to meet with a flow delivery in the Goulburn River.

Delivery of the Goulburn spring fresh was incorporated into the planning of the Southern Spring Flow in the Murray, to provide a larger and longer-duration flow along the length of the river system.

The combined water deliveries continued along the Murray River. The flow provided environmental benefits, connection to country for Traditional Owners and social and recreation benefits for communities.

Doubling the environmental benefit with return flows

Eighty two percent of environmental flows delivered in northern Victoria were re-used to meet downstream environmental water needs.

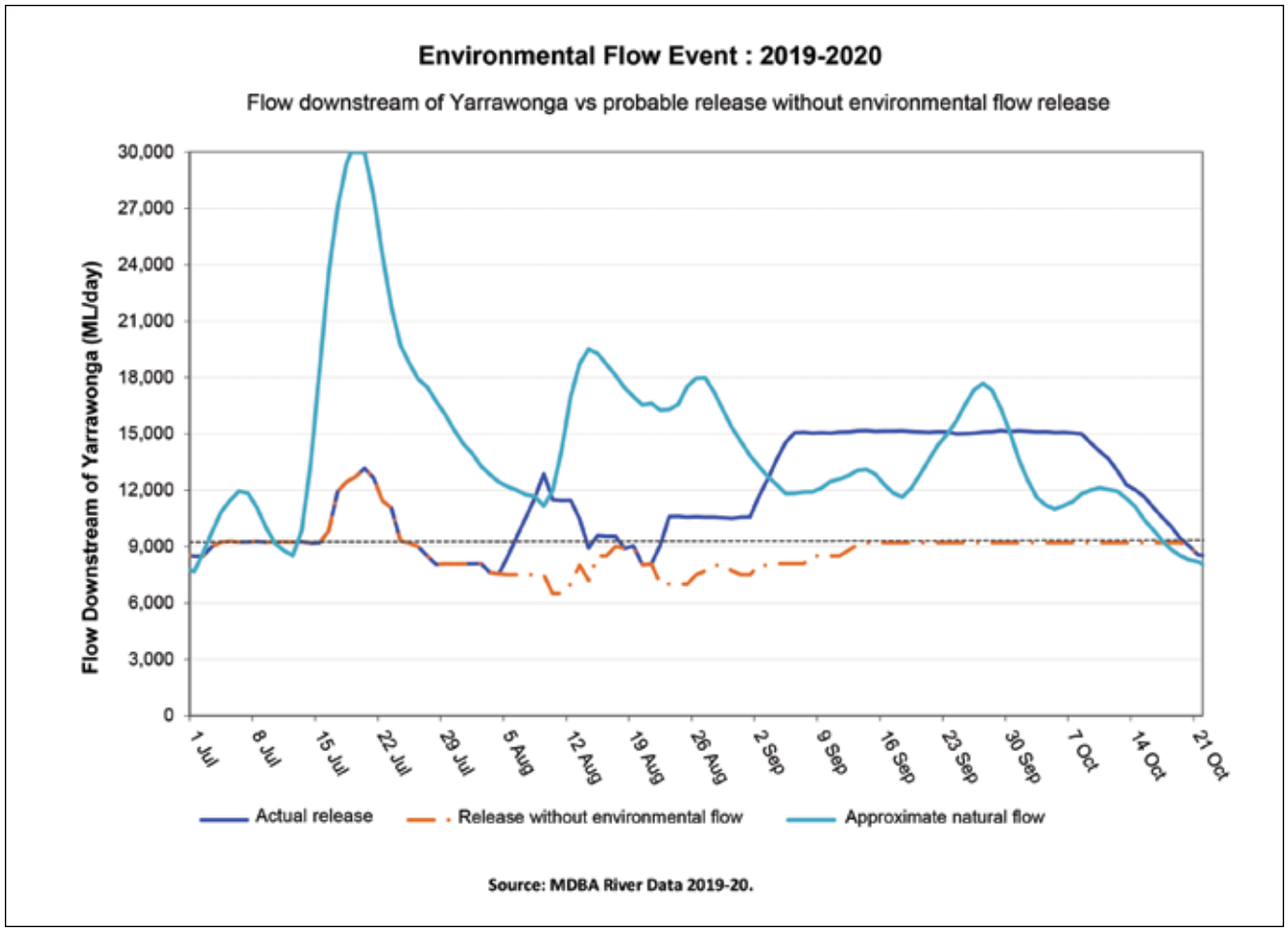
To further increase efficiency, environmental flows are also 'piggybacked' on water delivered for towns and farms. Efficient water use meant that all of the 12,700 ML delivered to Lake Kramen in the Hattah Lakes complex in 2019-20 were return flows from environmental watering actions in the Goulburn River. The same parcel of environmental water helped to meet environmental watering actions in the Goulburn River, Murray River and Lake Kramen. These co-ordinated watering actions meant that carbon, nutrients, native plant seeds and native fish eggs and larvae were directly transported from upstream to downstream sites and from the river channel to the floodplain.

An epic stretch for ample activities!

Boating, camping, fishing, birding – you name it, someone has probably done it along the banks of the Murray River.

The Southern Spring Flow, as it makes its journey down the river, improves conditions for our native species but also benefits local communities, townships, keen holiday goers and day trippers along the river. Barmah-Millewa Forest, Gunbower-Koondrook-Perricoota forests, Hattah Lakes and Chowilla Floodplains & Lindsay-Wallpolla Islands are all hot spots for camping during the spring and summer school holidays and water for the environment helps maintain these regularlyvisited areas.

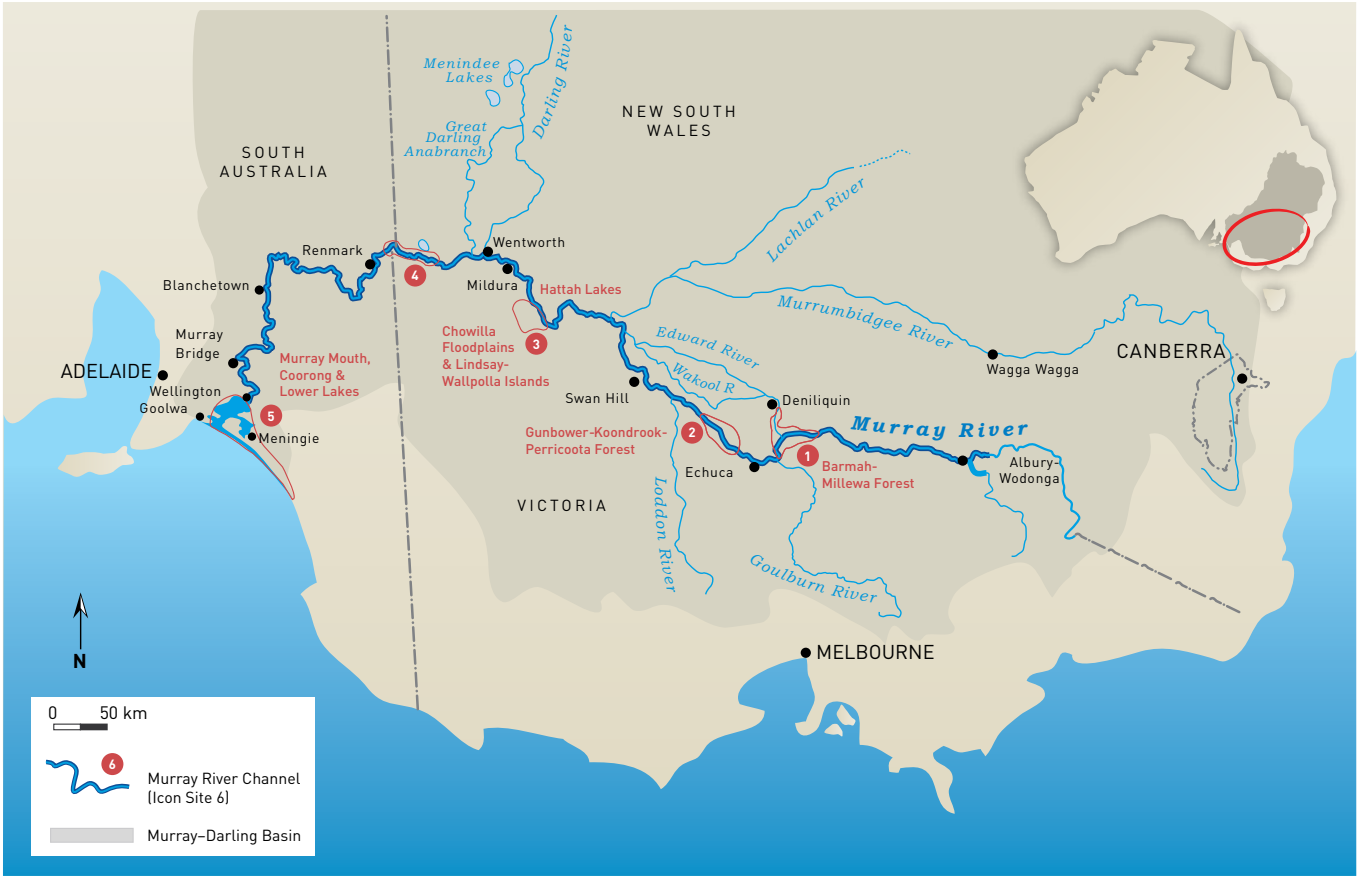
The Living Murray (TLM) program is one of Australia's most significant long-term river restoration projects. The program uses water for the environment to improve the health of the Murray River channel, significant floodplain sites along the river, and the wetland/estuary system near the Murray mouth. The program started in the middle of the Millennium Drought, when all the sites were showing visible signs of stress or ill health. Over 10 years on, we are demonstrating some positive long-term results of the environmental watering program.



Planning flows through change

Understanding how flows would have moved through our river systems prior to being altered by river regulation is complex. The addition of infrastructure such as dams, weirs, pipelines and levees has changed the way water flows through the landscape.

This graph gives an indication of the type of flow (light blue) that would have travelled through the Murray River downstream of Yarrawonga during spring 2019 under natural conditions, with flow above ~9,000 ML/d critical to achieving environmental outcomes in the river and the Barmah-Millewa Forest. The regulated flow downstream of Yarrawonga Weir that would have occurred in 2019-20 without environmental water delivery is shown by the orange line. From August to October 2019, water for the environment (dark blue) was delivered to ensure the river got a portion of what it would have prior to human intervention.



Above: The Living Murray icon sites, map supplied by Murray-Darling Basin Authority

Barmah-Millewa

The Southern Spring Flow aided in watering 25 percent of Barmah-Millewa forest. The endangered Australasian bittern was recorded at 12 out of 16 sites in Barmah-Millewa Forest and good growth of Moira grass was also recorded. If water had not been caught in the Hume Dam, and had instead flowed naturally through the system, the forest would have received a larger amount of water, nearly double what was delivered.

Gunbower-Koondrook-Perricoota Forest

When the Southern Spring Flow arrived at Gunbower, water managers were able to use some of the water to create a 'through-flow' which allowed water to flow from Gunbower Creek into Yarran Creek. This flushed carbon and nutrient-rich water from the Gunbower wetlands into the creek and created a passage for fish movement.

In-stream infrastructure (such as weirs) currently prevent native fish from migrating from the Murray River into Gunbower Creek. However, when a flow is provided through Yarran Creek, it provides a bypass, which allows fish to move from the Murray and recolonise Gunbower Creek, helping to sustain local native fish populations.

Hattah Lakes

No water for the environment was delivered to the Hattah Lakes in 2018-19 or 2019-20. Planned drying is important for enhancing the diversity in plant and animal communities. Prior to drying, watering for five consecutive years helped restore declining blackbox trees and support over 140 native plants, on the Hattah floodplain, as well as an abundance of wildlife.

So why would the lakes be left to dry? Dying allows for understory plants to germinate, grow and set seed. When drying occurs, nutrients and carbon accumulate in the drying lake beds, and once water returns, it promotes a boom in productivity. This is crucial to ensure healthy ecosystems are established from the bottom up. The nutrient- and carbon-rich soil creates the ideal habitat for waterbugs which are a critical food source for many of our native fish, frog, bird and animal species.

Chowilla Floodplains & Lindsay-Wallpolla Islands

Mullaroo Creek, Lindsay River North, Lindsay River South and Potterwalkagee Creek all received flows via weir pool raising associated with the Southern Spring Flow. Lindsay Island and particularly the Mullaroo Creek has long been a prime Murray cod habitat. With the new Mullaroo fishway and regulator, the ability to manage water for the environment through the Mullaroo is improving native fish feeding, breeding and movement outcomes.

Lamprey are on the move

This season, scientists have tagged lamprey to track them as they migrate upstream from the Great Southern Ocean to the upper reaches of the Murray River. Monitoring began in July 2019 and scientists were able to tag 44 pouched lamprey and 8 short-headed lamprey. By October 2019, significant movement up stream was noted. One pouched lamprey travelled over 700km, moving the last 423km in just 16 days!

Above: Gunbower Creek, by North Central CMA

Barmah National Park

Using fire to seek cultural outcomes for traditional weaving species for the Yorta Yorta.

Written by Sonia Cooper, Yorta Yorta TLM Officer.

Access to plant species such as the weaving sedge *(Carex tereticaulis)* for the Yorta Yorta People within Barmah National Park (1.), has been somewhat difficult in recent decades due to various aspects of change.

The weaving sedge is an ephemeral aquatic species which relies on regular seasonal watering and exists throughout the area Yorta Yorta refer to as *Pama*. A changing climate and changing water regimes are having an impact on the resilience of this weaving species and therefore, the availability of this important plant for traditional knowledge and cultural use.

This important plant species relies on factors to maintain conditions that are favourable for healthy growth, such as inundation, soil health, climate, and rainfall. While improved water management is seen as critical to supporting the Carex, fire is a new addition to assist with the recovery of this species and to date, there has been no observation of the weaving sedge's response to fire. The purpose of undertaking the burn as part of this project was to gain a better understanding of the response of the weaving sedge to fire and importantly, for Yorta Yorta to gain further fire knowledge. First Nations People and water managers are exploring how both fire and water are used to look after country. To assist in recovering plants of environmental and cultural importance, we need to better understand the role of fire in diverse landscapes.

This project was a Yorta Yorta traditional ecological, climate and fire adaptation project to follow-on from the Yorta Yorta Elders weaving project in 2018-19 , published as a case study in *Rivers, the veins of our Country 2019-20*.[4] The impacts highlighted above mean that the Yorta Yorta cannot harvest at this site and use the species in the same traditional setting, given that this species is only available for a short period of time. Yorta Yorta Country and the weaving sedge are forced to adapt to change, and the Yorta Yorta People are forced to adapt. Using fire practices will give knowledge on how the species responds to fire, and whether it is stronger because of fire when compared to unburnt weaving sedge.

With support from Yorta Yorta Nation Aboriginal Corporation, The Living Murray Indigenous Partnerships Program and Victorian Department of Environment, Land, Water and Planning (DELWP), a controlled burn was undertaken at Barmah National Park on 18 May 2020 by Forest Fire Management Victoria[5].Yorta Yorta Nation engaged DELWP to utilize this burn to seek a cultural outcome - Yorta Yorta were keen to observe the response of the weaving sedge to fire. Sonia Cooper, the Yorta Yorta TLM Facilitator joined the Forest Fire Management Team on the day to observe the burn:

It should also be noted that a cultural burn is the burning practice applied to Country to keep it healthy by First Nations people and notably should involve no digging up of the earth.

1. Barmah National Park

2. *Carex tereticaulis* Older and cultural trees showing clearing undertaken to provide protection from the burn

3. *Carex tereticaulis Carex tereticaulis* Charred tree stump after burn

4 New regrowth of burnt *Carex tereticaulis* tussock

5. New regrowth of burnt *Carex tereticaulis* tussock

6. New regrowth of burnt *Carex tereticaulis* tussock

7. Unburnt *Carex tereticaulis*

"To see Country burn – I felt a sense of calm; to see and feel fire – my skin felt good; to see and smell smoke – I felt I could breathe; to stand on Country – I felt strong. Country felt good that day, I felt good that day".[6] Sonia Cooper, 2020.

Upon inspection of the site post burn on 26 August, 9 & 11 September, and 2 November 2020 field updates and images of the site were captured by Sonia Cooper, Yorta Yorta TLM Officer. By this time, much welcome rain had been received and some parts of the forest were inaccessible. Where we could access the site, new growth of Carex tussocks (4, 5, & 6) was observed as it re-sprouted from rhizomes (underground stems). Supporting this regeneration, fire acts to recycle nutrients, with nutrients provided by ash from leaf litter and other plant material on the floodplain floor.

"If this plant is no longer available on Country, then my connection to my heritage and our traditional practices have been impacted. If the plants are healthy, we can harvest the reed for weaving. If the plants are not healthy the reeds won't be healthy and cannot be used. This tells us that there is something wrong. This is our barometer check of healthy Country". Denise Morgan-Bulled, 2020.

The *Carex* that was not burnt (7.) noticeably had less re-sprouting compared to the *Carex* that was. It was also noticeable that less leaf litter was on the ground at the burnt site. When a cool, cultural burn is undertaken, efforts are made to protect important trees prior to the burn (2.) and the slow and moderate nature of the burn allows plant regeneration. When the area is not cleared around the tree, fire can burn the trunk below ground. A tree stump (3.) which had been burnt shows how fire can burn the roots of larger trees.

Water is important to Pama and to the weaving species Carex. This project allowed the influence of fire to be investigated by the Yorta Yorta as an additional management tool to help recover the species. Yorta Yorta Nation and water agencies can continue to work together to deliver water to heal Country and to further investigate the role of fire in delivering better cultural and environmental outcomes.

[4] *"Rivers, the veins of our Country, Ten case studies of First Nations involvement in managing water for the environment in the Murray-Darling Basin",* 'Basket weaving on Yorta Yorta Country', Commonwealth of Australia, MDBA, 2019, page 12.

[5] A special thanks to Brooke Ryan (Parks Victoria), Brendan Purcell (DELWP), and Will Bailey (DELWP) and the entire Forest Fire Management Victoria team.

[6] Sonia Cooper, Yorta Yorta TLM Officer.

Protecting the future of our great floodplains

More than 16 years of monitoring has emphasised the benefits of water for the environment across the Gunbower Forest floodplain.

Since 2005, the North Central Catchment Management Authority (CMA) has been supplementing natural flooding with targeted water for the environment programs.

Between 2005 and 2012, water delivery focused on the large permanent and semi-permanent wetlands including Reedy Lagoon. Since the construction of Hipwell Road weir and channel, water has been delivered to about 20 per cent of the forest floodplain twice, in 2014 and 2018, and a smaller one in 2016.

Botanist Kate Bennetts said she had been monitoring Gunbower's vegetation for the past 16 years of water for the environment programs, and the results are positive.

"One of the indicators we measure is the condition of tree canopies. If a tree has foliage over at least half of its branches, its canopy is scored as in 'healthy' condition," she said.

"At the river red gum monitoring sites that did not flood between 2005 and 2020, less than half of the trees were in 'healthy' condition. These trees appear very drought stressed.

"At the river red gum sites that naturally flooded over this period, the trees were in slightly better condition with almost 60 per cent assessed as 'healthy'.

"However, the trees in the best condition and which improved the most over the monitoring period were in the river red gum sites that were both naturally flooded and delivered water for the environment. 75 per cent of trees in these more regularly flooded sites were considered 'healthy'."

Above: Flush of vegetation growth following delivery of water for the environment, by North Central CMA

"But, like large areas of south-eastern Australia, the floodplain has suffered from lack of rain both recently and during the Millennium Drought."

Ms Bennetts said the floodplain understorey flora also responded positively to water for the environment.

"There is a flush of growth with the water, followed by a drying phase where many plants wither back to their root stock and/or seed bank, only to emerge again the next time it floods," she said.

"Furthermore, we recorded more aquatic plants in the wetlands after delivered water for the environment than after natural flooding.

"Floodplains and wetlands are very dynamic ecosystems and can look very different in the different stages of the hydrological cycle.

"Reinstating small- to moderate-sized watering events to parts of the floodplain is an important part of maintaining the ecosystems, but the monitoring results suggest that there are many factors, other than flooding, that affect the health of the forest.

"We need to remember the Gunbower floodplain is a modified environment, with 130 years of logging, levee, channel and road construction, weeds, pests and recreation, all which have, and continue to, alter the vegetation.

"Monitoring the vegetation over the past 16 years has also highlighted the negative effect of many years of low rainfall. Drought crosses all land boundaries."

Screening success at Cohuna

Early results have found countless numbers of native fish have been saved thanks to Australia's first irrigation diversion channel screens at Cohuna. The screens act like a giant tea strainer – allowing water to pass into the channel so it can still be used by irrigators but preventing fish larvae and eggs from passing through. Early monitoring after one full irrigation season has indicated the Cohuna screens are doing their job.

"No Murray cod larvae were detected drifting into the channel during the peak larval drift period after the screen was installed. That is extremely important, especially as we were measuring about 160 cod larvae a day going down before the screens were installed. That's potentially thousands of Murray cod a year that are still in the system and contributing to breeding," North Central CMA Project Manager Nicole Bullen said.

"There were no young-of-year silver perch or Murray cod in the Cohuna Number 3 Channel after the screens were installed, but there was beforehand. There were also decreases in the numbers of smaller fish such as bony bream and the vulnerable Murray-Darling rainbowfish in the channel."

"Importantly, the screens have now successfully operated for a full irrigation season with no impact to irrigation water delivery and no maintenance required. Overall, the project has provided proof-of-concept of this screening technology in relation to Australian fish species under Australian conditions," she said.

Above: Fish screens at Cohuna, by North Central CMA

Drying and wetting, it's all part of the plan

Water for the environment delivered the last flood in the southern Hattah Lakes wetland complex in 2017. The wetlands have been allowed to draw down since then, and the last wetlands to hold water dried in February 2020. The moisture remaining in the lake-bed soils and local rainfall is supporting the growth and recruitment of specialised lakebed native vegetation.

This drawdown represents an important part of restoring a more natural, fluctuating water regime, which includes a complete drying phase. By allowing these wetlands to completely dry before delivering water for the environment, wetland herb species that grow on the dry wetland beds are able to grow and set seed, suspended clays are able to settle and harden, and carp are able to be eradicated.

Lake Kramen is a disconnected wetland at the fringes of the lakes complex that was already dry because it had not received any inflow since 2014. The extended drying phase at Lake Kramen eradicated carp and benefited plants that grow on dry wetland beds by allowing them to complete several life cycles and establish a seedbank before the next flood, however the condition of river red-gum and black box trees surrounding the lake was starting to decline after multiple dry years in a row. Environmental water was delivered to Lake Kramen during winter-spring 2019 to reverse declining tree health and create a water refuge for wildlife in a very dry landscape.

Above: Hattah Lakes, by VEWH

SPECIES SPOT

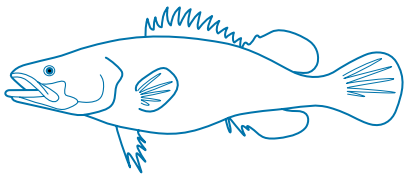
NAME	Murray cod
STATUS	Threatened
PARTY TRICK	Murray cod is Australia's largest freshwater fish. They can weigh up to 113 kilograms and get 1.8 meters long.
KEY THREAT	Overfishing during breeding season, habitat destruction through sedimentation and river regulation.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental flows improve river conditions, enabling Murray cod to move around to find food, shelter and breed.

Above: Arthur Rylah Institute's Graeme Hackett with Murray cod at Broken River, Goulburn Broken CMA

Can't get enough of canoeing at Kramen

The spring 2019 delivery of environmental flows to Lake Kramen provided an ideal opportunity for eager paddlers in the area. Members of the Sunraysia Bushwalkers Club swapped walking boots for paddles and set out for a canoe around the lake for one of their monthly events. Many other locals in the area also took advantage of the water delivery visiting the site for kayaking, swimming, picnicking and walking.

Above: Canoing, by Mallee CMA



A little bit at the right time

Wallpolla Horseshoe Lagoon received two environmental water top ups during 2019-20. Just over 200 megalitres was delivered in spring 2019, to fill the wetland before summer, with another 200 megalitres delivered in autumn 2020. Mallee CMA staggered the delivery to ensure the water at the wetland was sustained to promote growth of aquatic vegetation fringing the wetland and limit the growth of unwanted terrestrial vegetation within the wetland. An added secondary benefit from the environmental water delivery was to support golden and silver perch that were stocked in the wetland by the Victorian Fisheries Authority, in partnership with Mallee CMA and Nyeri Nyeri Traditional Owners.

Above: Horseshoe Lagoon following water for the environment delivery, by Mallee CMA

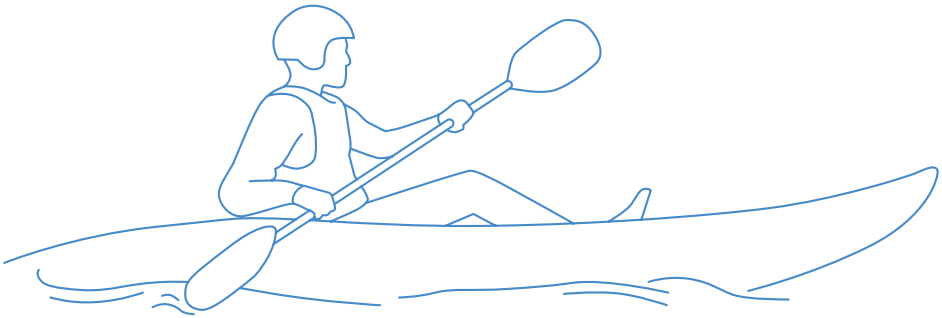
Coordinating flows

The Lindsay, Mulcra and Wallpolla islands floodplain is characterised by a network of permanent waterways, small creeks and wetlands. In their natural state, anabranch waterways like the Lindsay River and Mullaroo Creek would increase flow when flow in the Murray River increased, but regulation of water through Murray River weir pools has changed the relationship between the Murray and these waterways, resulting in significant impacts on the vegetation and the animals that rely on them.

Despite the changes, Mullaroo Creek and Lindsay River are critically important waterways for Murray cod. The most recent fish movement study by Arthur Rylah Institute has shown that a high proportion of Murray cod migrate into Mullaroo Creek during high flows in the spawning season (September to December). This highlights the importance of the reach as a spawning area due to favourable habitat, such as snags and faster-flowing water than in the Murray River.

In spring 2019, when water from large environmental flows being delivered from Lake Hume through to the Coorong and Lower Lakes in South Australia came past the Lindsay and Mulcra Islands, the opportunity to provide increased flows in Mullaroo Creek and the Lindsay River was too good to pass up.

Lindsay, Mulcra, Wallpolla Program Manager, David Wood, said "When the Southern Spring Flow came past the site, we were able to increase water levels in locks 7 and 8 to push some water into the upper Lindsay River. This was done at the same time we were delivering high flows to Mullaroo Creek via the Mullaroo regulator, enabling full connection between the Murray River, Mullaroo Creek and Lindsay River, to maximise Murray cod migration into the system during the spawning period."



SPECIES SPOT

NAME	Giles' planigale
STATUS	Threatened
PARTY TRICK	These little guys are similar in size to a matchbox! They hide from predators and extreme temperatures in cracks in clay floodplains.
KEY THREAT	Changes in flooding regimes, clearing of woodland areas, introduced predators such as foxes and feral cats.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental watering improves floodplain tree health and creates conditions that are beneficial to vegetative reproduction (buds, flowers and fruits). Trees drop their leaves, twigs and bark which planigale's love to fossick for food in.

Above: Gile's planigale, by Gerhard Koertner

Citizen science – out on bat patrol

Did you know there are 18 species of microbats in the Mallee CMA region? In the warmer months these little critters are only active at night and are tiny, making noises outside a human's ability to hear. Microbats live in the bark and hollows of trees on floodplains and feed at night on flying insects. The environmental watering regime at Hattah Lakes is intended to improve floodplain habitat which ultimately increases the food resources available to bats. Mallee CMA has been running a citizen science project at Hattah Lakes and Lindsay-Mulcra-Wallpolla islands. In November and December 2019, seven microbat species were counted. This is encouraging as some of these species, such as the south eastern long-eared bat, are listed as threatened. The project involves working with locals in the area to place "anabats" – bat monitoring equipment – out in the floodplain.

Above: Microbat, by Mallee CMA

Students out on site

Secondary students participated in the Mallee CMA's 'Wallpolla-Wetland Learning' program. This was the fourth successful year of the program. The program involves a field excursion to Wallpolla Horseshoe Lagoon. The students participate in aquatic macroinvertebrate sampling and cultural awareness training. The project aims to build students' and teachers' floodplain ecological knowledge, and awareness of the benefit environmental water has on this ecosystem.

Koorie Engagement Support Officer Orion Hunt, who works with Merbein P10 College, said the event for the 27 Aboriginal year 7 and 8 students was one they won't soon forget. The students took a cultural tour of the Wallpolla Island area, learnt about environmental watering and wetland health, and delved into the world of waterbugs.

"It was a really good day. It was all really hands on," Mr Hunt said.

"I don't think many of the students realised much about waterbugs before, or how much culture is around this area. It was really good to get out and understand this areas got a lot and to see the history."

Left: Secondary school students out on site, by Mallee CMA

Catfish, conservation and community: rehabilitating Mullinmur Billabong

A dedicated community effort followed by a delivery of 10 megalitres of water for the environment in December 2019 prepared a new home for threatened native freshwater catfish at Mullinmur Billabong in Wangaratta.

"It's been an incredible community effort to get to the point that we can translocate freshwater catfish. The project began several years ago when we developed the Mullinmur Wetland Management Plan, it's really exciting to get to this point. We have worked with various groups of people along the way and now the hard work is really worth it," said Wangaratta Landcare and Sustainability Inc's Kelvin Berry.

Water for the environment was delivered to the site in December 2019 and a further 10 megalitres was added in February 2020. The flows support aquatic vegetation and provide a suitable water height and quality to support native fish.

"It is great to be able to bring water for the environment to this site. Wangaratta Landcare Sustainability Network Inc. and the community have been working really hard to create a space that will not only support freshwater catfish but will also support the community. School groups have already been involved in some of the work achieved here and it will be great to see more education opportunities develop – like the water monitoring that is currently underway," said North East CMA's Catherine McInerney.

Sixty catfish were moved to Mullinmur Billabong and will contribute to the future breeding stock of our Victorian rivers.

"It was a unique opportunity to help the recovery of a threatened fish by recreating a new population within their former habitat. We expect that the freshwater catfish re-located into the wetland will survive and breed. There are lots of fallen logs and woody habitat for the catfish to take cover in. Freshwater catfish also prefer aquatic vegetation, so when the new aquatic plants establish that will further improve the diversity of habitat available for catfish," said Arthur Rylah Institute's Renae Ayres.

An Education Hub has recently been built at the site. This provides a great space for school groups and community groups to develop and share knowledge in nature. Six photo points have also been placed around the wetland to enable citizen science opportunities. Anyone can take a photo from the specially made phone holders and upload to Instagram, documenting the changes at site.

Waterwatch citizen scientists are also lending a helping hand. Volunteers monitored water at the site before 60 catfish were translocated into the wetland. The Waterwatch team was also able to provide water quality recordings before a second delivery of water for the environment was made to the site in February 2020, helping to ensure it was in tiptop condition for native fish species. In addition to this, samples collected from the Ovens River helped inform waterway managers about poor water quality following rainfall events in fire affected areas.

Signage funded through *Lower Ovens Our Catchment Our Communities* are dotted along the path describing the natural environmental values at the site

Wangaratta Landcare Sustainability Network Inc's Kelvin Berry at Mullinmur Billabong, by Manifeasto Photography

Waterwatch citizen scientists are also lending a helping hand, by Waterwatch

Protecting the Goulburn River

The lower Goulburn River has been increasingly relied on in recent years as a passage to supply inter-valley transfers (IVTs) from the Goulburn system to the Murray system during summer and autumn.

The amount of water delivered as IVTs has substantially increased, well above recommended environmental flow rates for this time of year, causing significant damage to lower Goulburn riverbanks and native vegetation.

Bank stability is of major concern to the Goulburn Broken CMA and the wider community. More water is not necessarily good for the environment – the timing of high and low flows during the year is important to environmental outcomes. The Goulburn River's environment is healthiest if it is low-flowing for most of summer and autumn, as naturally occurs in these low-rainfall seasons.

Monitoring has focussed on measuring both bank condition and bank vegetation. Bank vegetation plays a critical role in helping hold the banks together.

The monitoring showed there is a narrow band of healthy and diverse vegetation at or slightly above the level influenced by IVT flows, but below this level there is generally no vegetation. Where bank vegetation had been drowned out on the lower banks, bank notching occurred, and tree root structures were being affected. These factors increase the likelihood of erosion and further bank instability.

Once the evidence from the monitoring showed what was happening, the next step of beginning to address the damage could begin.

The Victorian Government applied an operational target on IVT flows over summer and autumn aimed at minimising further damage while still supporting the delivery of water to all water users. The Goulburn Broken CMA continued to provide advice to Goulburn Murray Water on how to shape (vary) the IVT flow targets to further minimise the damage.

Above: Goulburn Riverbank, by Goulburn Broken CMA

In addition, in April 2020, following significant welcome rainfall in the catchment, the Goulburn Broken CMA released an environmental flow to ensure the natural high flow event in the river tapered off slowly, allowing water levels to gradually recede rather than dropping dramatically in a short space of time. Slowing the speed that the water level drops reduces bank slumping, which maximises vegetation recovery on the lower levels of the bank. Enabling vegetation to grow helps to stabilise the banks reducing erosion and enhancing habitat for our native fish species.

Continuing the monitoring will help keep track of the health of the lower Goulburn River. With winter-spring environmental flows designed to deposit seed on the banks and ongoing careful management of summer and autumn IVT deliveries, the recovery of vegetation on the lower banks can begin, which is an important step in restoring a healthy lower Goulburn River.

The monitoring work is supported by the Goulburn Broken CMA, the VEWH, the Department of Environment, Land, Water and Planning and the Commonwealth Environmental Water Office's Monitoring Evaluation and Research (MER) program, in partnership with the Arthur Rylah Institute and Streamology.

Above: Goulburn Broken CMA's Dan Lovell monitoring vegetation in the Goulburn River by Goulburn Broken CMA

What are inter-valley transfers?

In the big river systems that connect to the River Murray, part of the water stored in systems like the Goulburn and Campaspe contributes to supplying water users downstream in the Murray. Storage managers account for how much water is available to support the Murray, balanced with the water needed to supply water entitlements in the Goulburn and Campaspe.

Water allocation trade affects the balance of these accounts. For example, when water is traded from the Goulburn to a water user in the Murray, the account increases to record the change in location of the demand.

When water from these upstream systems is delivered to meet the needs of the downstream system, this is known as an 'inter-valley transfer'. When the demand for water is high, like it is during irrigation season, large volumes can be released over a short period of time.

Citizen science - out on the Goulburn spotting platypus

Citizen scientists have been out along the mid Goulburn monitoring platypus during 2019-20. Led by The Platypus Conservancy, the project involves local residents logging platypus sightings on a phone application or website. Initial results are indicating that good platypus numbers have been observed by the community in the mid Goulburn.

"I really enjoyed the platypus monitoring training. It was great to see so many local people interested in learning about local populations of platypus and keen to help preserve them. It was a great way to bring community members together to work towards a common goal," said Allison Trethowan, RiverConnect Education Officer.

"This has been a great way for residents to add extra value to their regular walks along the river. Many advised that they already saw platypus regularly but enjoy developing their scientific skills and contributing to research about their part of the river," said Meg Pethybridge, RiverConnect Project Officer.

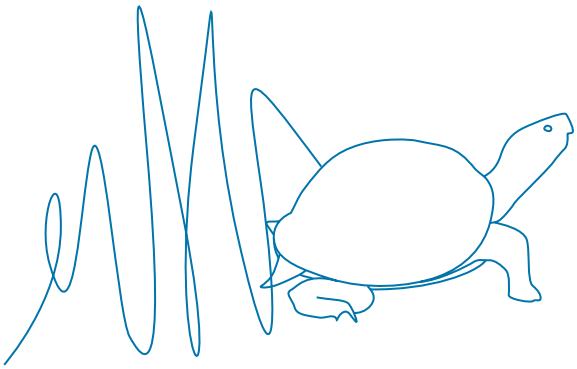
Above: Out on the Goulburn River looking for platypus, by Goulburn Broken CMA

Lower Broken Creek

Delivery of environmental flows to the lower Broken and Nine Mile Creeks in 2019-20, resulted in environmental outcomes for native animals, fish and vegetation and improved water quality. The delivery of minimum low flows during the off-irrigation season provided foraging habitat and instream refuge areas, especially important for young-of-year fish, platypus, rakali and turtles.

"I've never seen so many fishermen on lower Broken Creek. The kids are catching Murray cod. It's great for the community," said a Broken Environmental Water Advisory Group community member in March 2020.

Above: Lower Broken Creek, by Goulburn Broken CMA



Dry conditions meet adaptive management in the Broken River

A short-term change to the minimum amount of low flows being used in the Broken River ensured the river's health was maintained throughout the irrigation season.

Goulburn Broken CMA's Simon Casanelia said the CMA had worked with river operators, Goulburn Murray Water, to reduce the amount of water released from Lake Nillahcootie from 30 megalitres per day to 15 megalitres per day.

"Under our agreement with Goulburn Murray Water, we'd normally see 30ML per day of 'environmental passing flows' released during winter and spring to maintain the health of the river just downstream of the storage," Simon said.

"However, given inflows into Nillahcootie were still pretty low and there were no operational releases, the Goulburn Broken CMA and Goulburn Murray Water negotiated to reduce the passing flow to 15 megalitres per day. This was the minimum amount needed to maintain water quality and bank vegetation, provide shelter and food for native fish and wildlife such as platypus, and support water bugs."

The additional water (above 15 megalitres per day) was recorded and become available for use later in the season when the forecast risk of low or no flows was higher.

"This careful approach to managing the limited amount of water available this year was able to help us to maintain water quality and critical habitat for wildlife throughout the year when inflows into Nillahcootie remained low."

"Adapting management and delivery of environmental passing flows is a valuable way of protecting rivers, and the wildlife and people who rely on them, during tough times," said Simon Casanelia.

Above: Broken River, by Goulburn Broken CMA

Loch Garry gets a splash

Loch Garry, 20 kilometres north of Shepparton, has received its first environmental flow delivery in autumn 2020 – a shallow inundation of 500 megalitres to support native animals such as frogs, turtles and various waterbirds including ducks, grebes, cormorants, darters, ibis and spoonbills. Many locals were happy with the delivery too, with local families, birdwatchers and game hunters all planning to visit the wetland following the fill.

Simon Casanelia from Goulburn Broken CMA was pleased with the quick vegetation and frog response following the delivery.

"The vegetation in this wetland, the giant rush in particular, desperately needed a drink. The frogs responded straight away - there was quite a chorus, especially from the pobblebonks," Simon said.

Loch Garry receives water naturally from the Goulburn River when flows in the river are high enough to flow into the wetland. Due to river regulation, the frequency of these higher river flow events has been reduced impacting the plant and animal species that use the site.

In the last nine years, Loch Garry has only received water from natural inundation twice, filling naturally after the floods in 2011-12 and partially filling following heavy rain in 2016.

To ensure the wetlands health is maintained, and plants and animals can continue using the site, it requires a more regular inundation, which is where this shallow inundation with environmental water comes in.

Above: Loch Garry prior to watering, by Goulburn Broken CMA

Loch Garry day six of receiving water for the environment, by Goulburn Broken CMA

Reedy Swamp proves a positive site for birds and people

Birds and keen birdwatchers are flocking to Reedy Swamp near Shepparton! Five hundred megalitres of water for the environment were delivered to the wetland to provide a refuge for birds in an otherwise very dry landscape.

The crimson chat, a remote inland bird species, was spotted and had keen birdwatchers on the lookout! Glossy ibis, currently listed as vulnerable, and superb parrots and freckled ducks, both listed as endangered, were also seen taking refuge at the wetland.

Community members, school students, birdwatching groups and environmental organisations all took advantage of the flow-on effects of environmental flow deliveries made during spring 2019.

The River Basin Management Society (RBMS) celebrated Breakfast with the Birds while munching on pastries and managed to spot spoonbills, herons, black winged stilts and a variety of duck species.

"It was fantastic to learn just how important ecosystems like Reedy Swamp are to provide a refuge for bird migration especially during times of drought. Both Jo from the Goulburn Broken CMA and Bradley from Birdlife Australia shared their amazing knowledge on the area, and it was great to learn about the local wildlife and pretty incredible just how many birds we spotted in such a short space of time," Christian Borovac, RBMS member, said.

"Monitoring has confirmed that waterbirds have responded well to the environmental watering, with bird surveys indicating some species with over 100 individuals such as chestnut teal, grey teal and black-winged stilt." said Jo Deretic.

Jo Deretic from Goulburn Broken CMA was happy to see the recent bird numbers recorded at the wetland.

"Following a natural inundation of the swamp in early spring 2019, the proposed environmental water delivery for autumn 2020, was brought forward. This was due to the positive response from waterbirds to the natural inundation."

Water for the environment was delivered incrementally to extend the watering as long as possible, to allow the swamp to act as a drought refuge over the summer months.

Left: Female rainbow bee-eater, by Goulburn Broken CMA

Cultural values and native species are both winners at Horseshoe Lagoon

Taungurung women danced to welcome the first delivery of water for the environment to the sacred Horseshoe Lagoon, outside Seymour.

In September 2019, Taungurung Traditional Owners and local landowners welcomed representatives of Goulburn Broken CMA, Parks Victoria, and the VEWH to a celebration to mark the historic occasion.

The event was the culmination of work by the Taungurung water knowledge group Baan Ganalina (Guardians of Water), who have been working closely with Goulburn Broken CMA and other partners to bring water back to the lagoon and are delighted to see first-hand the birds and other animals that have already started to return to the site.

Taungurung Elder, Aunty Patsy Smith says the watering of the lagoon is especially significant because of the site's cultural significance.

"This is a women's place, and for me to bring my grandchildren to sing and create ceremony, it's like revival for our ancestors. It just feels as though it's brimming with life now," she said.

Taungurung Traditional Owners are not the only members of the community who are happy to see the changes that have taken place.

Local landholders such as Greg Smith have been campaigning for several years to have a small amount of water for the environment delivered to the site, which under natural conditions would have been inundated six years out of 10.

"It hasn't been full since 2012. Thistles and other vegetation have grown up all around the edge of the lagoon because there hasn't been a watering here, so if we had waited much longer it would have been too late," Greg said.

Simon Casanelia from Goulburn Broken CMA agrees that it was a really important time to add water to the wetland.

"We were seeing weeds start to dominate the area, and if a billabong like this is dry for too many years, the seeds of native species start to die – so they won't come back even if you get water in the lagoon," he said.

"Horseshoe Lagoon is a significant habitat for rare and threatened species such as the pied cormorant, azure kingfisher and eastern great egret, along with a wide variety of other plants and animals that depend on the water for survival, so we were really excited when we heard that Horseshoe Lagoon is also really important to the Taungurung and to local landholders."

Simon is excited by the immediate impact that the water is having.

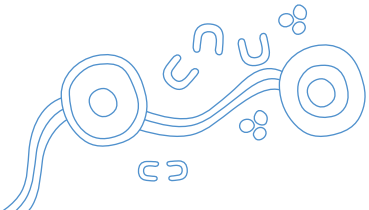
"The results so far are even better than we expected – already today we've spotted ducks, ibis and kingfishers, and we're expecting to see many more species over the next few months. It's not just wetland species who benefit.

We've also encountered kangaroos, wallabies and an echidna which have been attracted by the new water in the lagoon. Adding water to a billabong – especially in dry times like we're experiencing at the moment – is really important because it becomes a refuge for animals throughout the entire region. The new plant growth and the insects that emerge from the water become a food source for all sorts of woodland species. It's like a honeypot," he said.

The benefits of these partnerships were summed up by VEWH Commissioner Rueben Berg. At the event, Rueben spoke about the cultural significance and environmental benefits of the delivery of water for the environment to the site.

"Horseshoe Lagoon is a great example of where we can attain shared benefits from water for the environment. This is a fantastic spot where there are really important environmental elements we want to be taking care of with our water, and there's also powerful cultural connections to this place," he said.

"It's also a fantastic demonstration of what can be achieved when Traditional Owners, government agencies and local landowners work together to protect something they all agree is important."



Taungurung women dance to welcome water to Horseshoe Lagoon, by VEWH

SPECIES SPOT

NAME	Royal spoonbill
STATUS	Vulnerable
PARTY TRICK	In the breeding season, royal spoonbills grow a crest of feathers that sprout from the back of their head. During mating displays, they raise and spread the crest like a crown!
KEY THREAT	Destruction of habitat through land clearing, drainage and increased salinity all pose a threat to royal spoonbills; they do not welcome disturbances to their feeding and breeding areas.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental flows delivered to wetlands can provide refuge for royal spoonbills providing them with opportunities to forage for food, breed and roost in the vegetation at the wetlands edge.

Above: Royal spoonbill adult with chick, by Keith Ward

What is an otolith and what can it tell us?

The Arthur Rylah Institute and citizen scientists have been collecting otoliths (ear bones) from fish in the Campaspe River. Rather than catching extra fish, anglers have helped by extracting the fish ear bones from the fish they keep for eating. Otoliths collected from the Campaspe River showed that Murray cod have been breeding successfully there and that stocked golden perch are surviving and growing well – when combined with other research, this shows that flow management is working well in this river.

Above: Extraction of fish ear bones, by Arthur Rylah Institute

Every bit counts: Campaspe Carp Catch

For the fifth year in a row, the annual Campaspe Carp Catch was hosted by North Central CMA along the banks of the Campaspe River. Held on National Gone Fishing Day, 20 October 2019, more than 50 community members turned out to cast their rods in the river with the aim of trying to reduce pest carp numbers.

Above: Campaspe catch a carp day October 2019, by North Central CMA

Campaspe Environmental Water Advisory Group look at the bigger picture

Scientists from Arthur Rylah Institute involved in the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) actively work with Environmental Water Advisory Groups (EWAGs) to ensure accurate, clear and timely information is shared with interested audiences, to support effective adaptive management of water resources and demonstrate the value of environmental water to stakeholders.

The Campaspe EWAG is keen to see environmental outcomes continue to improve on the Campaspe River. This EWAG plays a critical role in ensuring that the environmental water planning incorporates local community and stakeholder knowledge and expertise and is in accordance with their understanding of the system. It also provides an avenue for the dissemination of information to the broader community, in particular the purpose of environmental watering actions and the associated outcomes.

"The key researchers from Arthur Rylah Institute ... have been able to provide innovative and complex science information and data in a very clear and easily-understood manner. They regularly present this information to the Campaspe EWAG. All the partners in this project value the ability to interact with the scientists and to be involved..." said Ted Gretgrix, Chairperson, Campaspe EWAG.

Cultural values and ecological values can align in the Campaspe

Taungurung's Baan Ganalina Advisory Group and Dja Dja Wurrung's Kapa Gatjin Advisory Group recently completed an Aboriginal Waterway Assessment along the Campaspe River. This will help feed into future water management plans and highlight valuable ways to collaboratively work together to understand how environmental values and cultural values align.

Caring for Campaspe

Local community members are at the forefront of reviving and improving the health of the Campaspe River. Recent efforts through the North Central CMA's Caring for Campaspe project are proving successful with some sections of the river seeing the return of fish such as the Murray-Darling rainbowfish and increased numbers of the iconic Murray cod.

Over 50 individual landholders and public land managers have contributed to the project through a variety of initiatives including willow removal, revegetation, weed control and riverside fencing, Combined with environmental flow delivery, these activities have greatly improved the health of the streamside vegetation which in turn, improves the health of the river.

A Project Reference Group guides the planning of community engagement activities and prioritisation of on ground works and future project funding opportunities. The group meets quarterly and involves representatives of the community, local government, Dja Dja Wurrung Clans Aboriginal Corporation, Taungurung Land and Waters Council, Yorta Yorta Nation Aboriginal Corporation, Department of Environment, Land, Water and Planning (DELWP), and Goulburn-Murray Water.

The project has also supported the expansion of the River Detectives program to more than eight schools along its length. About 150 students are involved in collecting and sharing monthly water quality data.

Above: Caring for Campaspe, by North Central CMA

Room for two more at Wirra-Lo Wetland Complex?

Two new wetlands within the Wirra-Lo wetland complex were added to the watering program in 2019-20, Bunyip Swamp East and Bunyip Swamp West. These wetlands have been included as part of the national Bring Back the Bitterns project, which aims to restore local populations of the endangered Australasian Bitten.

Wirra-Lo wetland complex received environmental water during the spring and summer 2019-20 that primarily targeted growling grass frogs and wetland vegetation communities. Wetting and drying regimes are being staggered across the eight wetlands within the Wirra-Lo wetland complex based on their ecological condition and site-specific watering needs, including to support revegetation projects and the feeding and breeding habitat of various species..

Photo's: Bunyip Swamp East and Bunyip Swamp West, by North Central CMA

Murray hardyhead haven

Round Lake and Lake Elizabeth received environmental flows during 2019-20 to maintain salinity within the target range for endangered Murray hardyhead. Murray hardyhead are a small native fish species that were once widespread and abundant in the Murray and Murrumbidgee river systems in southern NSW and northern Victoria. These lakes are part of a program to re-establish their population in northern Victoria. Environmental flows are managed to support salinity levels in Lake Elizabeth and Round Lake between 25,000 and 40,000 EC (electrical conductivity in micro siemens or ⍰S/cm) - roughly half as salty as the sea. This is helpful for Murray hardyhead because it excludes less salt-tolerant fish that prey on them or compete with them for food, such as carp, redfin and gambusia.

Above: Murray Hardyhead, by North Central CMA

Barapa Barapa continue work at wetland sites

North Central CMA and Barapa Barapa Traditional Owners are collaborating to deliver the DELWP-funded Decision Support Tool (DST) project which involves revegetation works and vegetation monitoring on McDonalds Swamp, Lake Leaghur and Lake Yando. The project has tested the revegetation DST and also aims to incorporate cultural aspirations into revegetation outcomes. Environmental watering decisions at these wetlands have been able to support the DST project by delivering the watering requirements of the revegetation resulting in a positive vegetation response and enabling monitoring to be completed by Barapa Barapa.

Above: Planting occurring at McDonalds Swamp in May 2020, by North Central CMA

Citizen scientists – bringing back the bittern

Citizen scientists were lucky to hear the loud booming call of the endangered Australasian bittern at Johnson Swamp, a wetland near Kerang in northern Victoria. North Central CMA called on volunteers to help record the presence of bitterns at a collection of wetlands. Surveys were undertaken in the early evening with citizen scientists waiting patiently to see what they could hear and recording the time, frequency of calls and estimated location of where the bittern might be. Using this information, scientists from the CSIRO were able to fit a bittern – which was named 'Boomby' – with a satellite tracker allowing them to follow his journey for the next 12 months.

North Central CMA Project Manager, Amy Russell, said, "Conditions were perfect for bitterns after the season's delivery of environmental water. The flows inundated the wetland encouraging the growth of plant species, such as reeds and rushes, increasing habitat, feeding and breeding opportunities for this threatened species."

Above: Boomby the bittern being fitted with a satellite tracker, by North Central CMA

Johnson Swamp trifecta: fill, through flow and top up

Coordinated environmental flow deliveries at Johnson Swamp and Pyramid Creek provided an opportunity to activate the connectivity between the wetland and the creek and deliver outcomes for waterbirds, native fish and other aquatic animals.

Johnson Swamp was filled in October 2019 to provide food and breeding habitat for waterbirds, especially the endangered Australasian bittern. Subsequent monitoring detected Australasian bittern breeding calls as well as large numbers of small-bodied native fish, waterbugs, frogs and eastern long-neck turtles.

A spring flow in Pyramid Creek was partly diverted through Johnson Swamp to help move nutrients, carbon and waterbugs from the wetland into the creek which is important for providing food for native fish and other aquatic animals. North Central CMA measured the carbon content levels in the water that had flowed through Johnson Swamp when it was re-entering Pyramid Creek – it was four times higher than the carbon content that had not passed through the swamp.

Connectivity between river and wetland environments is critically important for the exchange and transportation of nutrients, but unfortunately, river regulation and land drainage has reduced opportunities for this, limiting the ability of our waterways to support the animals that live within them. The final and third delivery to the wetland was a small top up with water for the environment in February 2020 to provide refuge for waterbirds over summer. Some of the significant species recorded at Johnson Swamp in 2019-20 include Australasian bittern, Australian little bittern, brolga, glossy ibis, sharp-tailed sandpiper, great egret, royal spoonbill, great cormorant, white-bellied sea eagle and nankeen night-heron.

Monitoring at Johnson Swamp, North Central CMA

SPECIES SPOT

NAME	Australasian bittern
STATUS	Endangered
PARTY TRICK	Bitterns are extremely cryptic and rarely seen. While they may be hard to spot, the distinctive 'booming' call of the male in breeding season is the best sign of their presence.
KEY THREAT	River regulation, water diversion and ongoing dry conditions has led to a decrease in the shallow floodplain and wetland areas where bitterns like to breed and feed.
HOW DOES WATER FOR THE ENVIRONMENT HELP	Environmental flows inundate wetlands and floodplains encouraging the growth of wetland vegetation species increasing habitat and feeding opportunities for bitterns.

Above: Australasian bittern at Sale Common, by Heather Alexander

Little Lake Meran make way for our waterbirds and frogs

Little Lake Meran saw environmental flow deliveries in spring 2018 produce significant bird and frog outcomes in 2019 and 2020. The wetland provided many species with water refuge, with much of the surrounding area (north-western Victoria) experiencing very dry conditions. Throughout 2018-19 and 2019-20, Arthur Rylah Institute recorded several significant waterbird species including freckled duck, pink-eared duck, hard head, blue-billed duck and musk duck. As the wetland water levels began to recede in 2019-20, wading waterbirds such as yellow-billed spoonbill, black-winged stilt, red-kneed dotterel, masked lapwing and egret have increased in appearance, feeding in shallow water and exposed mudflats. Results from the 2018-19 Wetland Monitoring and Assessment Program for environmental water (WetMAP) frog surveys found up to 166 frogs of four species: Peron's tree frog, spotted marsh frog, eastern common froglet and eastern banjo frog.

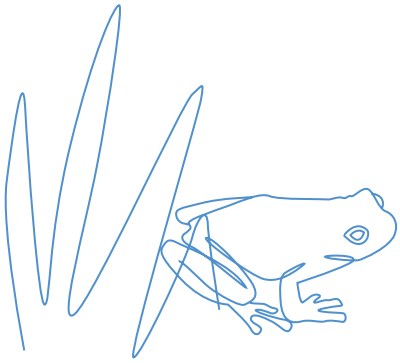
Above: Wading waterbirds at Little Lake Meran, by North Central CMA

Careful planning along the Loddon

Environmental flow releases were critical to avoiding blackwater events during summer 2019-20 in the Loddon River. High flows targeted during periods of extremely hot weather reduced the risk of low oxygen levels in the water, which can occur when water temperatures rise. If oxygen levels in the water drop too low, low oxygen blackwater events and fish deaths can occur.

Flows were ramped up from 25 megalitres a day to 50 megalitres a day for a short period of time. North Central CMA and the VEWH had to make careful use of the available water for the environment to ensure that late summer and autumn actions could also be delivered, and that there was some water left for use in 2020-21.

Above: Loddon Weir, by North Central CMA



Let's take a look at the Northern rivers

Environmental water plays a key role in improving the connectivity and availability of habitats for fish. This is particularly important in highly regulated systems such as the Loddon River in northern Victoria, where low flows and barriers can fragment populations.

Monitoring fish in northern Victorian rivers has improved our understanding of how both large- and small-bodied fish species respond to flows. We now know that environmental water can be used to:

- stimulate fish to move to complete steps in their life cycle (spawning, dispersal and recruitment)
- provide suitable conditions for fish to move past barriers and through fishways
- maintain suitable habitat to encourage fish to remain in a river reach.

Monitoring before and during environmental flow releases showed the upstream movement of fish between river reaches increased substantially during freshes. This response was evident in both large-bodied species, such as golden perch, and small-bodied species such as Australian smelt.

Above: Loddon River, by VEWH

Water for the environment to the rescue at Guttrum

In the spring of 2019, a wetland rescue mission was undertaken to deliver life-giving water to Reed Bed Swamp in Guttrum Forest, after more than twenty years of a severely reduced flooding regime that has pushed the wetland ecosystem to the edge - but not beyond recovery!

The delivery was a long time in the making after five years of patience, persistence and a collaborative effort from the Barapa Barapa and Wemba Wamba Traditional Owners, the North Central Catchment Management Authority and the Victorian Environmental Water Holder to bring this new site into the watering program. In 2019, the proverbial ducks lined up (as did the real ducks when the water arrived!) and the first step towards a long-term cultural and ecological goal of reinstating a more natural watering regime was finally achieved.

As recently as the 1990s, the local Traditional Owners recall the swamps in Guttrum Forest as home to an abundance of important food, fibre and medicinal plants such as old man weed, and the giant rushes the swamps are named after. The number of culturally significant, old river red gums on the fringes of the wetlands, and the surrounding archaeological evidence including large mounds and middens, indicate that the area was once a highly productive landscape for local Aboriginal communities.

Environmental water managers and Traditional Owners were becoming increasingly worried that the wetland plants and large old red gum trees surrounding the wetlands were being stretched beyond their tolerances under persistently dry conditions. The reduced flooding regime meant that many of the values, such as the giant rush and carpets of mudflat species, had all but disappeared.

Until 2019, that is. The delivery of water for the environment in spring was cause for great celebration amongst the Traditional Owners and environmental water managers. Traditional Owners were employed to assist CMA staff with the delivery and monitor the response to the watering. Over the duration of the watering event, waterbirds returned to the wetland in great numbers, including a few thousand ducks and several threatened species such as glossy ibis, great egrets and Australasian shovelers. The canopies of the large old fringing trees - including scar and ring trees - that were in very poor condition put out new epicormic growth. The difference in the vibrant green of the watered trees was stark compared to the surrounding dry forest. One Traditional Owner exclaimed `I had to stop the car and take a photo!' Due to the degraded state of the wetland, impacted by years of livestock grazing and reduced flooding frequency, there was a limited response from emergent and semi-emergent species, though two rare or threatened species were recorded - the rare water nymph and the nationally threatened river swamp wallaby grass.

Above: Monitoring at Guttrum Forest, by North Central CMA

Guttrum Forest, by North Central CMA

Glossary

Acid sulphate soils – Naturally occurring soils containing high quantities of iron sulphates. When these soils remain underwater, they are stable, but if they are exposed to the air, sulphuric acid is generated and can result in severe environmental impacts.

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.

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

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.

Inter-valley transfers – The transfer of water between river systems to meet demands as a result of water trade between river systems.

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 2011.

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.

Water trade – The process of buying, selling or exchanging water allocation or entitlements.

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

Summary of water for the environment delivery 2019-20

System	Site	Total (ML)	VEWH (ML)	TLM (ML)	CEWH (ML)	Other (ML)[1]
Gippsland region						
Latrobe system	Latrobe River	2,701.7	2,701.7	-	-	-
	Dowd Morass	Water was diverted into Dowd Morass from the Latrobe River[2]				
	Heart Morass	Water was diverted into Heart Morass from the Latrobe River[2]				
	Sale Common	Water was diverted into Sale Common from the Latrobe River[2]				
Thomson system	Thomson River[3]	13,646.0	13,646.0	-	-	-
	Heyfield wetlands	15.0	15.0	-	-	-
Macalister system	Macalister River	18,333.0	18,333.0	-	-	-
Snowy system	Snowy River	117,871.0	-	-	-	117,871.0
Gippsland region total		**152,566.7**	**34,695.7**	**-**	**-**	**117,871.0**
Central region						
Yarra system	Yarra River	3,931.0	3,931.0	-	-	-
	Banyule Billabong	51.0	51.0	-	-	-
	Yering Backswamp	18.0	18.0	-	-	-
Tarago system	Tarago River	40.0	40.0	-	-	-
Maribyrnong system	Jackson Creek	-	-	-	-	-
Werribee system	Pyrites Creek	178.4	178.4	-	-	-
	Werribee River[4]	995.2	995.2	-	-	-
Moorabool system	Moorabool River	3,652.0	3,652.0	-	-	-
Barwon system	Upper Barwon River	907.6	907.6	-	-	-
	Hospital Swamps	Water was diverted into Hospital Swamps from the Barwon River[2]				
	Reedy Lake	Water was diverted into Reedy Lake from the Barwon River[2]				
Central region total		**9,773.2**	**9,773.2**	**-**	**-**	**-**

System	Site	Total (ML)	VEWH (ML)	TLM (ML)	CEWH (ML)	Other (ML)[1]
Western region						
Glenelg system	Glenelg River[3]	12,292.1	12,292.1	-	-	-
Wimmera system	Wimmera River[3]	8,381.1	6,819.4	-	1,561.7	-
	Lower Mount William Creek	1,137.1	1,137.1	-	-	-
	MacKenzie River	2,178.3	2,178.3	-	-	-
	Upper Burnt Creek	424.6	424.6	-	-	-
	Upper Mount William Creek	139.0	139.0	-	-	-
	Ranch Billabong	11.7	11.7	-	-	-
Wimmera-Mallee wetlands	Barbers Swamp	7.6	7.6	-	-	-
	Carapugna	10.3	10.3	-	-	-
	Challambra Swamp	1.9	1.9	-	-	-
	Chirrup Swamp	1.2	1.2	-	-	-
	Clinton Shire Dam	0.5	0.5	-	-	-
	Cokum Bushland Reserve	2.5	2.5	-	-	-
	Corack Lake	4.2	4.2	-	-	-
	Considines	3.8	3.8	-	-	-
	Coundons Wetland	0.5	0.5	-	-	-
	Creswick Swamp	1.1	1.1	-	-	-
	Crow Swamp	5.0	5.0	-	-	-
	Davis Dam	0.8	0.8	-	-	-
	Fieldings Dam	1.4	1.4	-	-	-
	Harcoans Swamp	0.1	10.1	-	-	-
	Homelea	0.8	0.8	-	-	-

System	Site	Total (ML)	VEWH (ML)	TLM (ML)	CEWH (ML)	Other (ML)[1]
Western region						
Wimmera-Mallee wetlands	Jeffcott Wildlife Reserve	2.8	2.8	-	-	-
	Jesse Swamp	6.1	6.1	-	-	-
	Kath Smith Dam	0.6	0.6	-	-	-
	Mahoods Corner	0.9	0.9	-	-	-
	Mutton Swamp	9.5	9.5	-	-	-
	Opies Dam	0.7	0.7	-	-	-
	Pam Juergens Dam	0.4	0.4	-	-	-
	Paul Barclay	5.3	5.3	-	-	-
	Pinedale	1.8	1.8	-	-	-
	Rickard Glenys Dam	1.8	1.8	-	-	-
	Tarkedia Dam	2.1	2.1	-	-	-
	Tchum Lakes Swimming Pool (North Lake - Dam)	3.6	3.6	-	-	-
	Towma (Lake Marlbed)	0.7	0.7	-	-	-
Western region total		**24,652.2**	**23,090.5**	**-**	**1,561.7**	**-**
Northern region						
Victorian Murray system	Barmah Forest	282,118.1	45,740.1	5,710.0	230,668.0	-
	Gunbower Creek[4]	21,231.2	-	-	21,231.2	-
	Little Gunbower wetland complex[4]	1,119.9	485.4	634.5	-	-
	Green Swamp, Corduroy Swamp and Little Reedy Lagoon[4]	1,877.6	361.7	1,515.9	-	-
	Yarran Creek[4]	1,413.1	1,413.1	-	-	-
	Guttrum Forest[4]	498.2	498.2	-	-	-
	Johnson Swamp	3,240.4	3,240.4	-	-	-
	Lake Cullen[4]	6,385.0	6,385.0	-	-	-
	Lake Elizabeth	960.0	960.0	-	-	-

System	Site	Total (ML)	VEWH (ML)	TLM (ML)	CEWH (ML)	Other (ML)[1]
Northern region						
Victorian Murray system	McDonalds Swamp[4]	293.0	293.0	-	-	-
	Third Reedy Lake[4]	3,760.0	3,760.0	-	-	-
	Round Lake	300.0	300.0	-	-	-
	Wirra-Lo wetland complex	245.1	245.1	-	-	-
	Lake Kramen[4]	12,701.7	7,164.4	5,537.3	-	-
	Southern Hattah Lakes	145.0	-	145.0	-	-
	Brickworks Billabong	320.0	320.0	-	-	-
	Bridge Creek	776.1	776.1	-	-	-
	Carina Bend	877.8	877.8	-	-	-
	Lake Hawthorn	1,460.2	1,460.2	-	-	-
	Lake Koorlong	147.8	147.8	-	-	-
	Liparoo East	392.4	392.4	-	-	-
	Liparoo West	271.5	271.5	-	-	-
	Neds Corner Central	148.6	148.6	-	-	-
	Neds Corner East	98.1	98.1	-	-	-
	Neds Corner Woolshed	21.0	21.0	-	-	-
	Lindsay River Mullaroo Creek Potterwalkagee Creek	387.0	-		387.0	-
	Finnigans Creek	950.2	950.2	-	-	-
	Sandy Creek	1,311.9	1,311.9	-	-	-
	Wallpolla East	1,383.2	1,383.2	-	-	-
	Wallpolla Horseshoe	399.7	399.7	-	-	-

System	Site	Total (ML)	VEWH (ML)	TLM (ML)	CEWH (ML)	Other (ML)[1]
Northern region						
Ovens system	King River	89.0	39.0	-	50.0	-
	Ovens River	53.0	-	-	53.0	-
	Mullinmur Wetland	20.0	-	-	20.0	-
Goulburn system	Goulburn River[4]	401,880.8	56,237.1	24,885.4	320,758.3	-
	Doctors Swamp	67.0	67.0	-	-	-
	Horseshoe Lagoon	121.0	121.0	-	-	-
	Loch Garry	499.8	499.8	-	-	-
	Reedy Swamp	499.8	499.8	-	-	-
Broken system	Broken River	-	-	-	-	-
	Upper Broken Creek	597.3	484.9	-	112.4	-
	Lower Broken Creek	35,752.3	17,582.0	-	18,170.3	-
	Kinnairds Wetland	258.6	258.6	-	-	-
	Black Swamp	65.0	65.0	-	-	-
Campaspe system	Campaspe River	20,438.3	16,794.7	-	3,643.6	-
	Coliban River	363.5	-	-	-	363.5
Loddon system	Loddon River[3]	12,356.3	11,415.2	-	941.1	-
	Pyramid Creek	122.7	122.7	-	-	-
	Serpentine Creek	1,345.7	1,160.1	-	185.6	-
	Lake Meran	1,611.7	1,611.7	-	-	-
Northern region total		**821,375.7**	**186,363.7**	**38,428.1**	**596,220.5**	**363.5**

Total water use	**1,008,367.8**	**253,923.0**	**38,428.1**	**597,782.2**	**118,234.5**

1 Other source means water not accounted for under the VEWH's environmental Water Holdings. This includes environmental flows released in the Snowy River by the New South Wales Department of Planning, Industry and Environment using water made available by the VEWH and New South Wales, and passing flows from Malmsbury Reservoir delivered to the Coliban River under the Bulk Entitlement (Campaspe River - Coliban Water) Conversion Order held by Coliban Water.

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

3 Includes passing flows delivered in the Thomson river (739.0 ML), Glenelg River (1,970.0 ML), Wimmera River (689.6 ML) and Loddon River (4,260.2ML).

4 Delivery in these systems included use of return flows.

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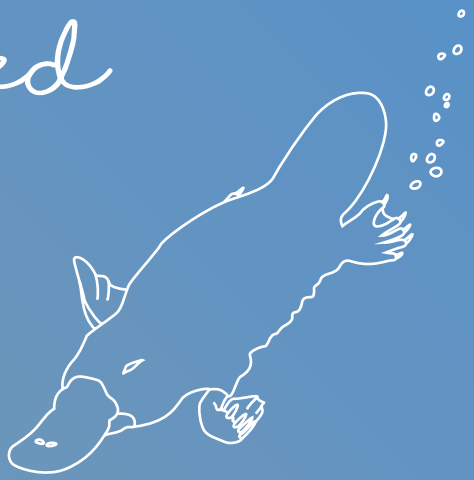

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