20 Years of The Living Murray

Program Overview

20 years of The Living Murray
Much achieved, much to do

The Living Murray is one of Australia's largest and longest running river restoration programs. It signalled the beginning of a change in how governments and communities work together with the vision of a healthy working river system.

The program started in 2002 after community and scientific concerns about the declining condition of the river system. Doing nothing was not an option.

The program has acquired an average of almost 500 GL of water for the environment and built a number of environmental works to help deliver this water to iconic sites along the River Murray.

The Living Murray was the first step in a long-term adaptive management approach. The program has transitioned to become an integrated part of Basin Plan implementation, contributing to the aim of returning the whole Murray-Darling Basin to a healthy working system.

The Living Murray First Step

In 2003 the 'First Step' Decision was announced to:

Recover an average of 500 GL per year of **water for the environment** for delivery to improve the health of icon sites.

Deliver **infrastructure works** to increase the environmental benefits from using this water.

Involve First Nations people in planning and management of the icon sites.

20 Years Later

Over **1 billion dollars** has been invested by governments in establishing and running The Living Murray.

480 GL of water makes up the The Living Murray portfolio (long term diversion limit equivalent).

To date over **4,000 GL** of water has been delivered to support rivers, floodplains and the plants and animals that depend on them.

Most icon sites are on a trajectory of improving condition, demonstrating that using environmental water and works help to improve river health.

The package of infrastructure works were all built and commissioned by 2016 to support the delivery of water for the environment at icon sites.

The Living Murray has been monitoring the condition of the icon sites since 2006. Over **1,000 monitoring projects** have been delivered measuring the outcomes of water for the environment on vegetation, waterbirds, fish and more.

The **Indigenous Partnership Program,** established in 2006 supports First Nations involvement in environmental water management.

2002
The Living Murray discussion paper is released and initiates discussion about restoring the River Murray.

2003
The Murray–Darling Basin Ministerial Council announces The Living Murray First Step Decision.

2006-07
First monitoring activities are funded.

2006
The Living Murray Indigenous Partnerships Program is established.

2009
During the Millennium Drought only small volumes of The Living Murray water available (approximately 120 GL) used for drought refuges.

2011-15
Environmental works are built at icon sites.

2015
The Southern Connected Basin Environmental Water Committee is formed to coordinate environmental water across the southern basin and make joint government decisions on the The Living Murray Program.

2021-22
Environmental water holders deliver over 3,000 GL of water across the southern basin.

The Living Murray icon sites

The Living Murray icon sites are important locations along the Murray River. These sites stand out because of their high ecological and economic value and their cultural and heritage significance to First Nations people and the broader community. The sites encompass areas of high conservation value — the floodplains, wetlands and forests along the Murray, the Murray's estuary and the river itself.

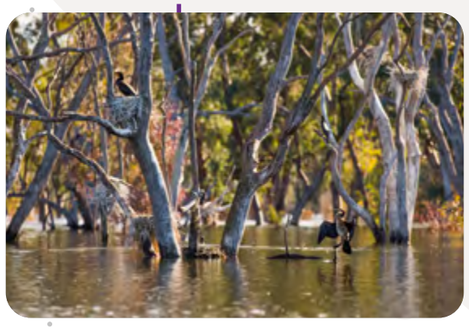


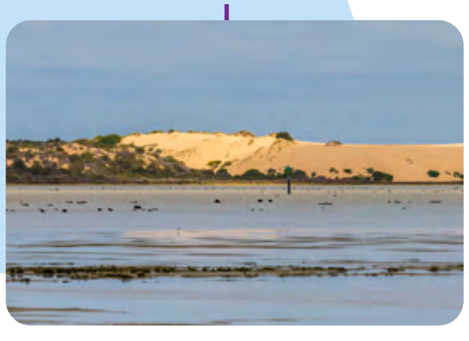




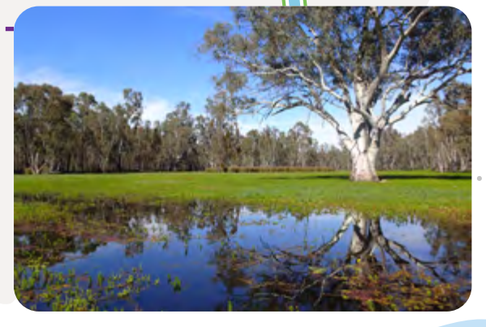












The Living Murray is a joint initiative funded by the New South Wales, Victorian, South Australian and Commonwealth governments, coordinated by the Murray–Darling Basin Authority.

Water delivery and infrastructure

20 years of The Living Murray
Much achieved, much to do

Water and works brings the landscape to life. The objective of the infrastructure works program was to multiply the environmental benefits acheivable from the water available to The Living Murray. The scale of The Living Murray 'works + water' combination was unprecedented anywhere in the world at the time.

Growth in water for the environment over time

The average long-term water availability of The Living Murray water portfolio is 480 GL. Similar to irrigators, yearly allocations depend on water available: lower in dry years and higher in wet years.

In 2009–10 there were only small water volumes available (approximately 120GL) that were used at icon sites to provide drought refuges and support critical habitats and ecological processes. Yet by 2014–15, environmental water holders were collectively able to deliver more than 1,000 GL to icon sites, and in 2016–17 around 1,500 GL, as part of larger coordinated multi-site environmental flows.

Under wetter conditions in 2022-23, more than 384 GL of water for the environment was delivered in a single event through the River Murray in and around higher natural flows, connecting thousands of kilometres of river and floodplains. This highlights how environmental water holders are working together to coordinate and make best use of all available water for the environment.



The need for works as well as water

Under The Living Murray, around $280 million was committed to a highly innovative construction program of environmental works and measures at icon sites. The two fundamental pillars of The Living Murray are the water recovery effort and environmental works and measures. It is the 'works + water' combination that enables the delivery of water to icon sites in a way that maximises the environmental benefits.

Infrastructure such as regulators, pumps, levee banks and fishways were built at icon sites between 2011 and 2015 to increase the efficiency of the delivery of water for the environment.

The water management structures enable controlled landscape-scale flooding using environmental water — often in much smaller volumes and at lower river levels than would be required without these works.

Flooding with works do not always deliver the full range of environmental outcomes provided by a natural flood. However, monitoring has shown that regular operation has contributed to delivering significant environmental outcomes at sites.



The Living Murray environmental works

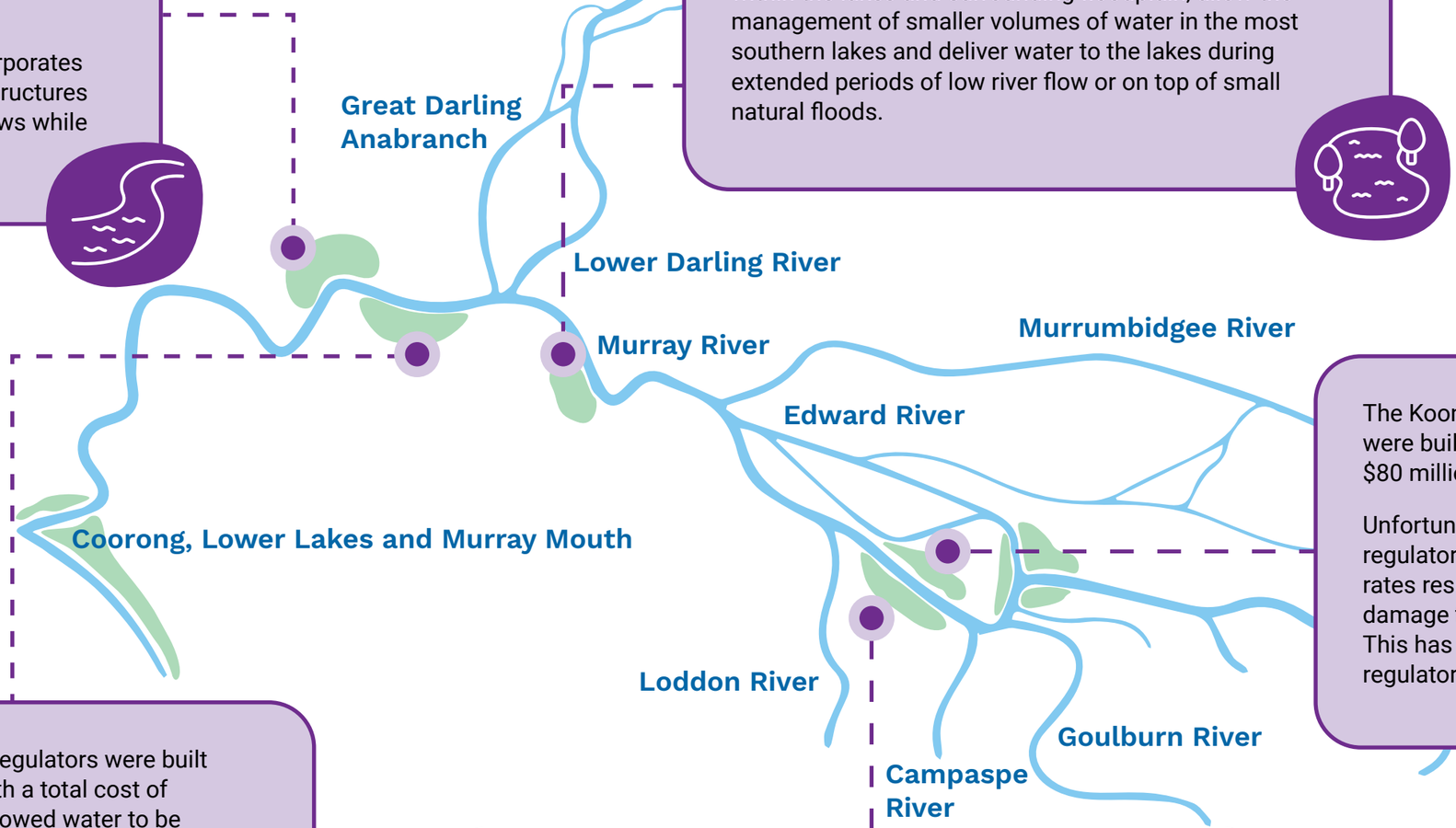
Infrastructure works along the River Murray ensure the most efficient delivery of water for the environment and include things like levee banks, channels, fishways and regulators (which have gates that can be opened and closed to allow flooding and drying of wetlands).



The Chowilla regulator and ancillary structures were built 2010-14 with a total cost of $97million and enable inundation of 30 to 50% of the floodplain under relatively low river flow conditions.

The package of works incorporates fish passage and smaller structures to assist with managing flows while the regulator is operating.

Hattah Lakes regulators were finished in 2013 with a total cost of $37.4 million. The works increase the frequency of natural inflows to the lakes, retain environmental water within the lakes and surrounding floodplain, allow the management of smaller volumes of water in the most southern lakes and deliver water to the lakes during extended periods of low river flow or on top of small natural floods.



The Koondrook–Perricoota regulators were built in 2013 with a total cost of $80 million.

Unfortunately, the use of the regulators, even at very small flow rates resulted in inundation and damage to private infrastructure. This has limited the use of the regulators to date.

Lindsay and Mulcra island regulators were built between 2015 and 2016 with a total cost of $13.7 million. The works allowed water to be delivered from the Murray River to the island's wetlands and floodplain and improved flow control on the creeks. The works included fish passages and erosion control initiatives.

The Gunbower regulators were finalised in 2013 with a total cost of $5.8 million. The works allow the diversion of water from Gunbower Creek to disperse it through the forest to approximately 4,750 hectares of river red gums and wetlands before spilling back into the creek. The works included fish locks and fishways to facilitate the safe movement of native fish.

20 years of The Living Murray

Much achieved, much to do

Monitoring and outcomes

In 2006 a comprehensive monitoring program was established to track whether the ecological objectives of The Living Murray program were being achieved and how the condition of sites was changing over time.

Ecological objectives

Regulation of the River Murray significantly reduced natural floods and over time, this resulted in a drastic decline in ecological condition and river health.

As part of the First Step Decision to recover water and build works to get water back to key sites, specific ecological objectives and expected outcomes were described. For each icon site they were grouped under the themes of vegetation, waterbirds, fish and others (i.e. productivity and connectivity).

Since then, yearly monitoring has taken place at all icon sites to measure the outcomes from delivery of water for the environment and track condition.

What have we found?

Monitoring has shown that the environment has largely responded well to targeted watering. In 2007, in the midst of the Millenium Drought, all icon sites were either in fair ecological condition or in need of attention. Since then, the overall condition of the sites that have received water for the environment has followed a clear trajectory of improvement with most sites now in good or excellent condition. There is a lot that sits below the headline grades with some areas doing better than others.

While it is still early days towards achieving a healthy Murray River, the monitoring shows the critical role of water for the environment in helping achieve environmental outcomes.

	Barmah Millewa Forest	Gunbower Forest	Koondrook-Perricoota Forest	Hattah Lakes	Lindsay Mulcra Wallpolla Islands	Chowilla	Lower Lakes Coorong Murray Mouth
2022-2023	B	B	D	B	B	A	B
2021-2022	B	A	D	A	B	B	B
2020-2021	B	B	D	A	B	C	C
2019-2020	B	B	D	A	B	C	C
2018-2019	B	A	D	B	B	B	C
2017-2018	A	B	D	A	B	B	C
2016-2017	A	B	C	A	B	A	B
2015-2016	B	B	D	A	B	C	C
2014-2015	B	B	D	A	-	C	B
2013-2014	C	B	D	B	C	B	B
2012-2013	C	B	D	C	C	C	B
2011-2012	C	C	D	B	B	C	B
2010-2011	B	B	D	C	B	B	D
2009-2010	C	C	D	D	D	B	D
2008-2009	D	C	D	D	D	C	D
2007-2008	D	D	D	D	D	-	D

Grades

- A — **Excellent** — Most (75-100%) of ecological objectives have been met
- B — **Good** — More than half (50-74%) of ecological objectives have been met
- C — **Fair** — Fewer than half (25-49%) of ecological objectives have been met
- D — **Needs attention** — Few (0-24%) of ecological objectives have been met
- \- — **Data not available**

- 8-17 ecological objectives per site
- Birds, fish, vegetation and other objectives
- 80-100 monitoring reports each year
- 16 years of data

Site with environmental works/years where works used.

Dry · Very wet · Wet · Moderate

20 years of The Living Murray
Much achieved, much to do

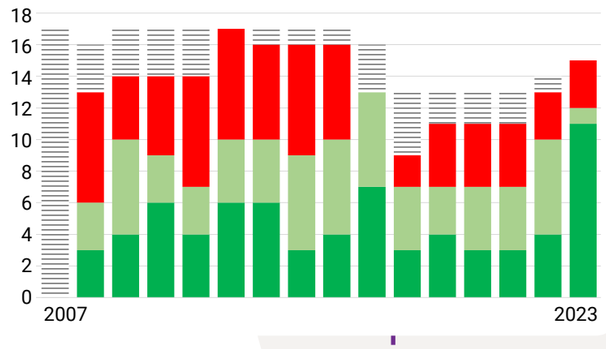
Ecological objectives over time

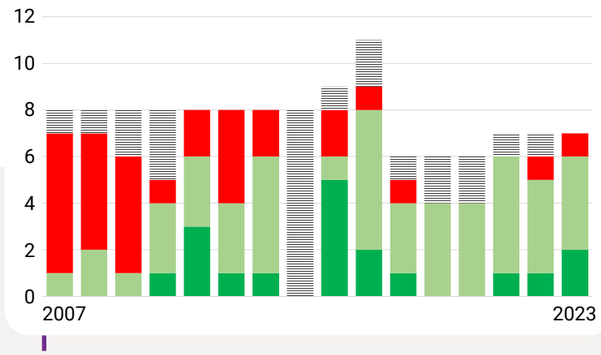
Yearly monitoring has taken place at all icon sites since 2006-2007 to assess the relative condition of each site through measuring a series of environmental objectives. Objectives can be met, partially met or not met and this is tracked over time for vegetation, fish, waterbirds and other environmental functions. The ecological objectives vary between each of the icon sites.

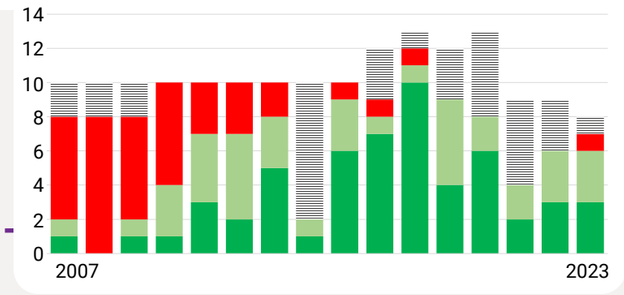
20 years of The Living Murray
Much achieved, much to do

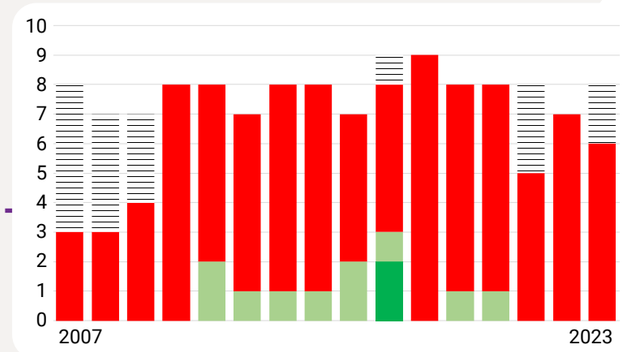
Grades

- Total number of objectives met
- Total number of objectives not met
- Total number of objectives partially met
- Total number of objectives not monitoried









Indigenous Partnerships Program

20 years of The Living Murray
Much achieved, much to do

First Nations people have an ongoing cultural, social, environmental, spiritual, and economic connection to their lands and waters since the time of creation. The Indigenous Partnerships Program provides First Nations whose traditional lands and waters are within an icon site, support to have a meaningful role in the planning and management of the icon site.

The Murray is part of First Nations living cultural heritage

The Indigenous Partnerships Program aims to support First Nations' contribution to the planning and management of environmental watering activities at sites of cultural, ecological and community significance along the River Murray.

The program employs an Indigenous facilitator at most of the icon sites. This facilitator ensures a strong connection between the Traditional Owners and the management of the icon site though active engagement, consultation and knowledge sharing. The program also connects people and Country through activities such as cultural heritage work, Aboriginal waterways assessments, monitoring species of cultural significance, community tours, and support for youth education and inter-generational learning on-Country.



Murray Creation Stories

Many First Nations from the Australian Alps to the Southern Ocean share the story of the River Murray being created as the mighty Murray Cod crashed through the landscape.

First Nations along the River Murray have a deep spiritual connection to the river including its floodplains and wetlands.

Collaboration and partnerships with First Nations can facilitate their rich history, knowledge and lore to contribute to improved water management.

Rivers, the veins of our Country

First Nations have been listening to Country for many thousands of years and can speak for Country so that others can know what Country needs. First Nations values encompass an inherent and living connection to land, water and caring for Country.

Rivers, the veins of our Country is a collection of short stories telling of the deep connection First Nations peoples and Aboriginal communities have to water.

The case studies highlight the work underway to achieve shared cultural and environmental benefits through the delivery of water for the environment.

Importantly, many of the articles are written by Traditional Owners to share their experiences of working in environmental water management to care for Country, both good and bad. This helps us all learn about what works and what doesn't, and how to improve together.



"Our Lands, Our Waters, Our People, All Living Things are connected. We implore people to respect our Ruwe (Country) as it was created in the Kaldowinyeri (the Creation). We long for sparkling, clean waters, healthy land and people and all living things. We long for the Yarluwar-Ruwe (Sea Country) of our ancestors. Our vision is all people Caring, Sharing, Knowing and Respecting the lands, the waters and all living things."

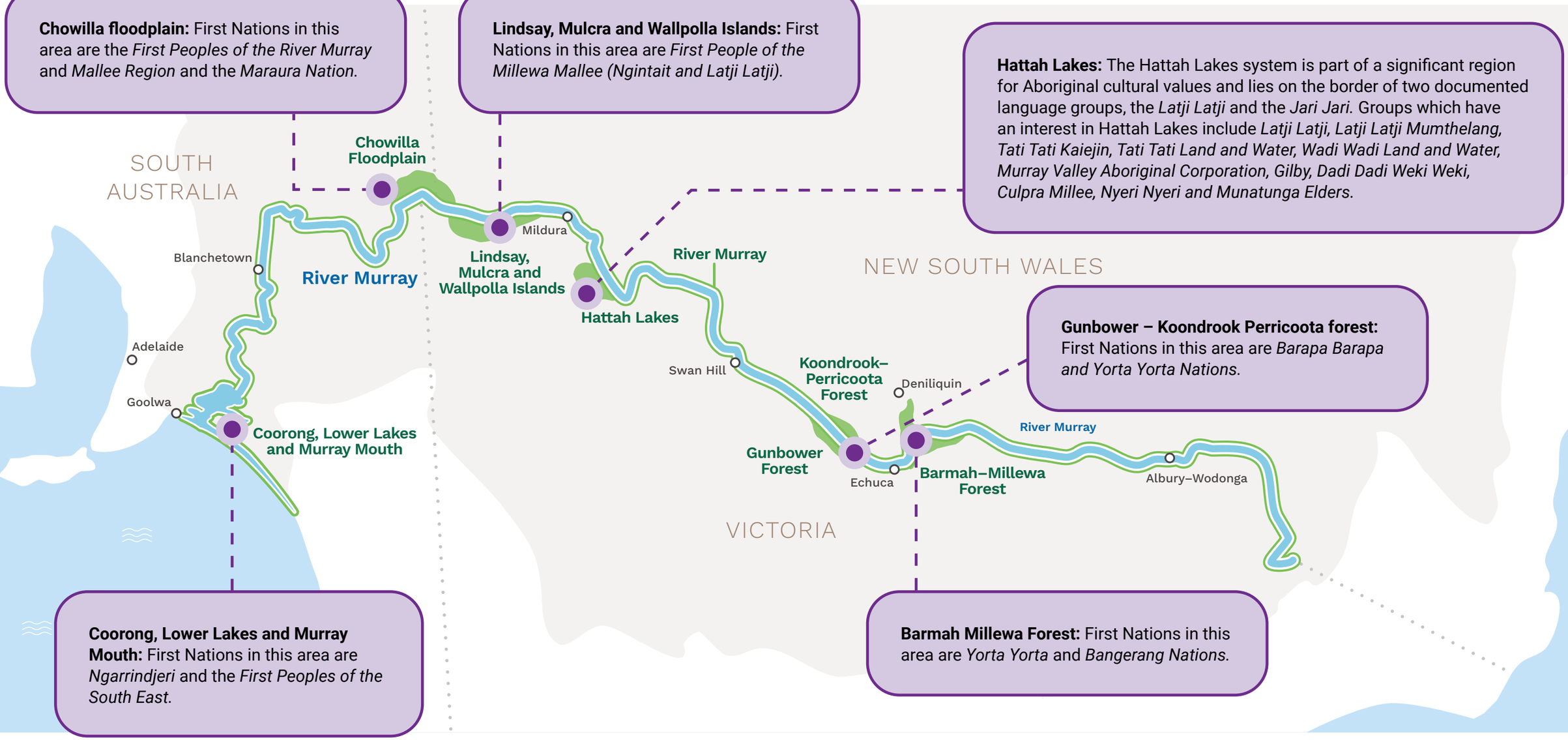
From the Ngarrindjeri Yarluwar-Ruwe / Sea Country Plan (2007)

20 years of The Living Murray
Much achieved, much to do

Chowilla floodplain: First Nations in this area are the *First Peoples of the River Murray* and *Mallee Region* and the *Maraura Nation.*

Lindsay, Mulcra and Wallpolla Islands: First Nations in this area are *First People of the Millewa Mallee (Ngintait and Latji Latji).*

Hattah Lakes: The Hattah Lakes system is part of a significant region for Aboriginal cultural values and lies on the border of two documented language groups, the *Latji Latji* and the *Jari Jari.* Groups which have an interest in Hattah Lakes include *Latji Latji, Latji Latji Mumthelang, Tati Tati Kaiejin, Tati Tati Land and Water, Wadi Wadi Land and Water, Murray Valley Aboriginal Corporation, Gilby, Dadi Dadi Weki Weki, Culpra Millee, Nyeri Nyeri and Munatunga Elders.*



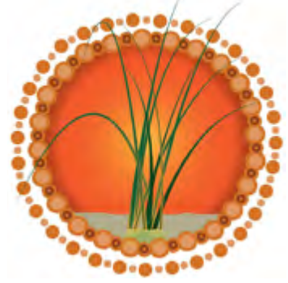
Gunbower – Koondrook Perricoota forest: First Nations in this area are *Barapa Barapa and Yorta Yorta Nations.*

Coorong, Lower Lakes and Murray Mouth: First Nations in this area are *Ngarrindjeri* and the *First Peoples of the South East.*

Barmah Millewa Forest: First Nations in this area are *Yorta Yorta* and *Bangerang Nations.*





20 Years of The Living Murray

Barmah Millewa Forest

20 years of The Living Murray
Much achieved, much to do

The Barmah–Millewa Forest supports the largest river red gum forest in Australia and is the largest and most intact freshwater floodplain system along the River Murray. The forest is an internationally important wetland listed under the Ramsar Convention.

Traditional Owner groups across the icon site include Yorta Yorta Nation Aboriginal Corporation, Bangerang Aboriginal Corporation, Moama Local Aboriginal Land Council and Cummeragunja Local Aboriginal Land Council.

The boom of the bunyip bird

Bitterns are considered a flagship species for encouraging and promoting healthy wetland management.

Barmah-Millewa Forest is estimated to support at least 30% of the Australian population of Australasian bittern and is an extremely significant site for their breeding. This endangered species is estimated to have a global population of no more than 2,500.

Bitterns are of great cultural significance. Their eerie booming mating calls in spring and summer are thought to be linked to Dreaming Stories of the bunyip.

Bitterns are very mysterious and rarely seen. Working out how many and where they are is best estimated using the sound of their distinctive calls.

Together with Traditional Owners, Barmah-Millewa site managers have been monitoring bitterns and their breeding response since 2015.

In years where more water enters the forest, a greater number of bittern calls are detected. Additionally, water levels are crucial for the breeding timing and success for the Australasian bittern.

Findings are being used to manage water in the forest to support this endangered and culturally significant bird.



First Nations caring for Country

The landscape and all it contains are part of cultural beliefs and feature in living cultural stories and practices. It is important that the cultural values of the Barmah-Millewa Forest are protected, and cultural practices continue.

The Millewa Indigenous Partnership Program works with Traditional Owners to:

- Influence water planning and management - Aboriginal Waterways Assessment of rivers and wetlands throughout the forest is a tool designed by and for Traditional Owners.
- Care for ancestors - Careful Edward River Aboriginal burial mound excavation and repatriation work resulted in the permanent protection of ancestral remains, moving them away from areas of high erosion.
- Care for culturally significant species – Education programs involving youth are monitoring culturally significant species such as turtles.

	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	B	B	B	B	B	D	D	B	B	A	A	B	B	B	B	B
Birds	D	D	D	D	A	A	A	A	A	A	A	A	B	B	B	A
Vegetation	D	D	C	B	C	C	C	B	B	B	B	B	B	B	B	B
Other	D	D	D	D	D	D	D	D	B	A	A	B	A	B	B	-

Grades

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- **B** — **Good** More than half (50-74%) of ecological objectives have been met
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2016
First trial of early opening of forest regulators for gradual inundation of creeks.

2016
Water Managers started to target the delivery of water to benefit native perch breeding

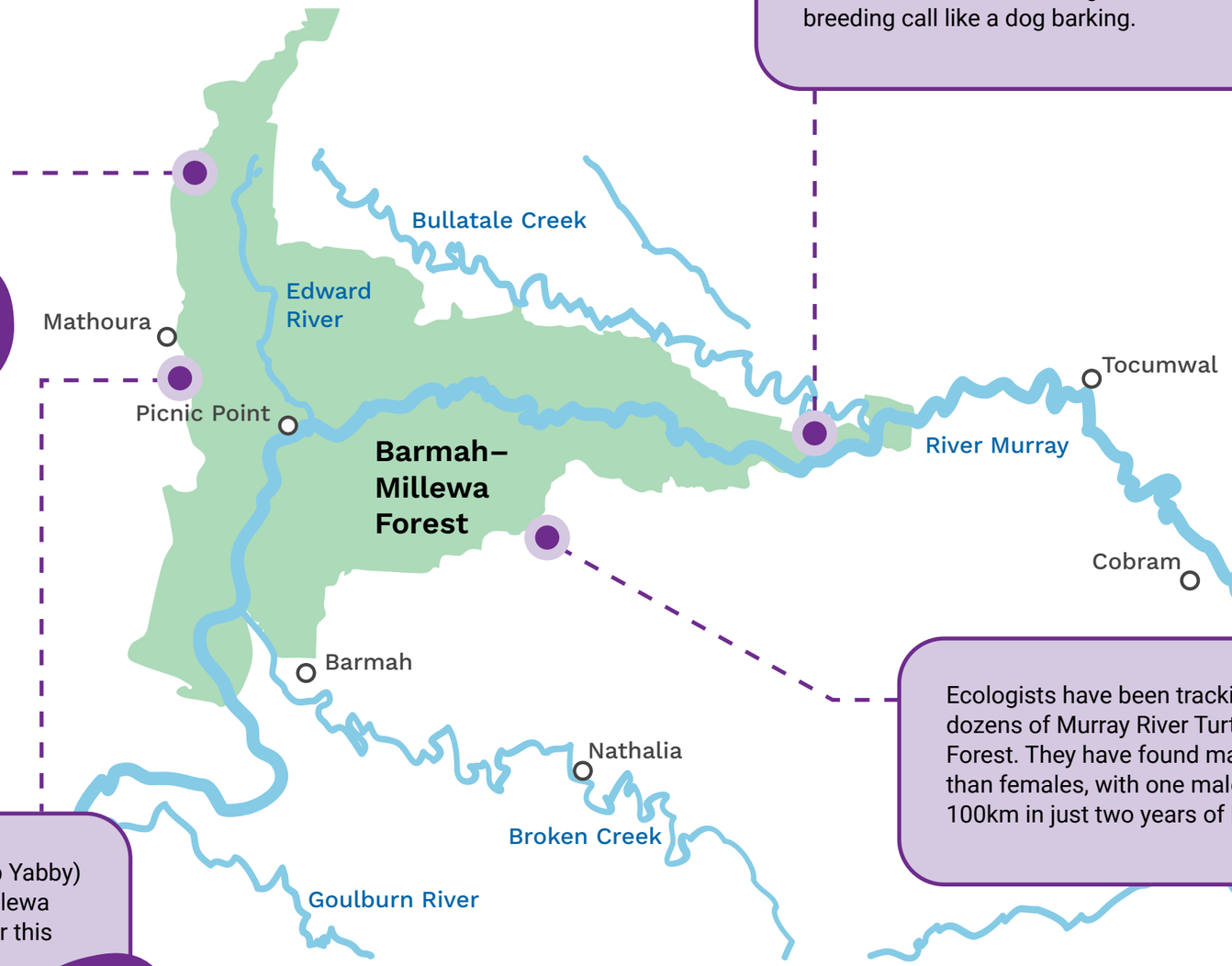
2017
For first time all the site ecological objectives are met or partially met

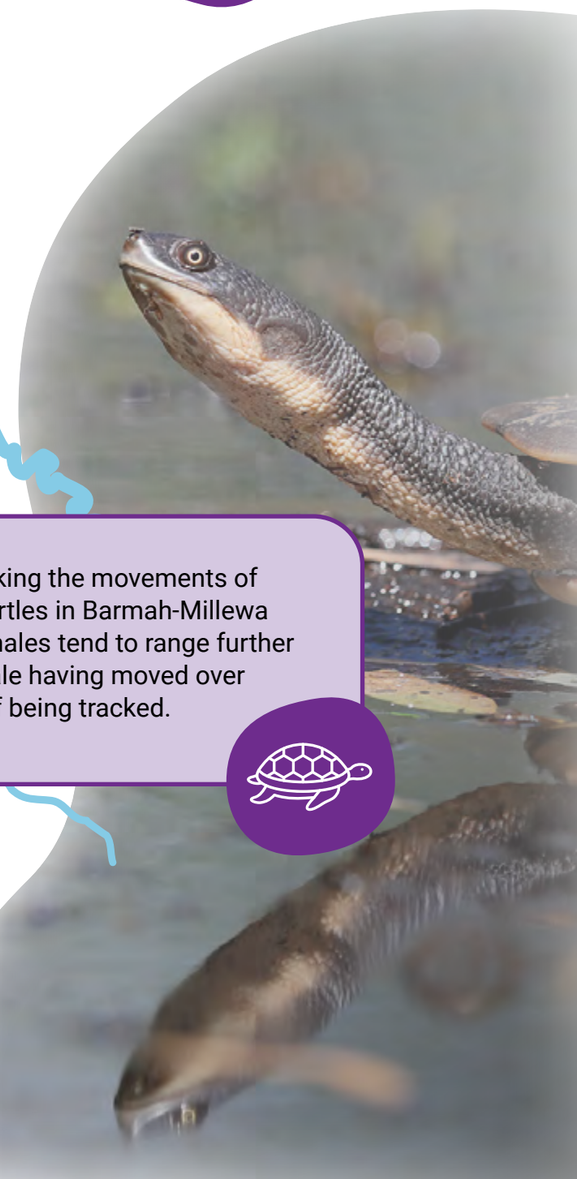
2021
A fish exit strategy was trialled to reduce the risk of native fish being stranded and trapped in the forest when regulators are closed.

20 years of The Living Murray
Much achieved, much to do

Barking Marsh Frog has steadily increased in numbers over the past five years at Barmah-Millewa Forest. The males of this small frog make a remarkably loud breeding call like a dog barking.

Yellow Bladderwort is a small carnivorous wetland plant common in Barmah-Millewa Forest – it eats small bugs that swim too close to it! When it flowers, it has bright fan-shaped petals above the water surface – this gives the plant its other common name: Fairy's Aprons.





Ecologists have been tracking the movements of dozens of Murray River Turtles in Barmah-Millewa Forest. They have found males tend to range further than females, with one male having moved over 100km in just two years of being tracked.

A new species of freshwater crayfish (Swamp Yabby) has only recently been described. Barmah-Millewa Forest is thought to represent a stronghold for this uncommon and poorly known species.

20 Years of The Living Murray

Gunbower Forest

20 years of The Living Murray
Much achieved, much to do

Gunbower Forest is an internationally important wetland, and together with Koondrook-Perricoota is the second-largest remaining area of River Red Gum Forest in Australia. It is rich in cultural and ecological values, supporting diverse and rare wetland habitats, vulnerable and endangered plants and animals including internationally recognised migratory waterbirds, and large areas of remnant vegetation.

The Barapa Barapa are the Traditional Owners in the middle and lower area of Gunbower Forest, and the Yorta Yorta are the Traditional Owners in the upper Gunbower Forest.

Finding the missing piece of the Murray Cod puzzle in Gunbower Creek

On the surface it appeared that Gunbower Creek would be an excellent habitat for Murray Cod, broad and deep with fast-flowing sections filled with snags. Yet monitoring in the early 2000s revealed that something was not right. The Murray Cod population was poor and numbers of young fish very low, even after trying to restock with hatchery-bred fingerlings. In 2005, fish ecologists and managers started to solve the puzzle of why native fish weren't thriving.

For many years, the creek was primarily managed as an irrigation channel, with large, sudden changes in water levels and long periods without flow in winter off-irrigation season. Ecologists and managers proposed a new more natural flow regime to better support the life cycle of Murray Cod. This included a winter baseflow to help juveniles survive, and a stable high flow in the critical spring spawning season to allow cod to finish nesting successfully. The new flow pattern has been implemented since 2013, and annual monitoring has shown a big change. There are now many more Murray cod and a much greater size and age range of fish. Importantly, it has been possible to integrate these ecological benefits whilst still operating Gunbower Creek as an irrigation system, having big ecological benefits while still supporting communities and industries.



Bringing back from extinction

Reedy Lagoon is of high cultural significance to Barapa Barapa Traditional Owners and supports abundant and diverse aquatic plants. Due to its water regime and excellent habitat for small-bodied native fish, Reedy Lagoon was chosen as a reintroduction site for the locally extinct southern pygmy perch.

In between 2021 and 2022, a total of 1,200 individuals were released, including a joint release of 500 fish by Barapa Barapa and North Central CMA staff in December 2021. The reintroduction program aims to achieve a self-sustaining population over time, with plans to reintroduce other locally extinct species in the future, such as the purple-spotted gudgeon.



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Fish	C	B	D	C	C	C	D	B	B	B	C	B	B	B	A	B
Birds	C	C	C	A	B	A	B	A	B	B	B	A	A	B	A	A
Vegetation	D	C	B	B	C	B	A	A	A	A	A	A	A	B	B	B

Grades

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2005

Water for the environment was first delivered to wetlands and fringing red gum areas.

2013

The environmental works program finished construction.

2013

Barapa Barapa Cultural Heritage Mapping developed a catalogue of cultural heritage assets in the forest.

2014

First managed floodplain watering to about 4,500 ha of forest.

2015

First 'Water for Country' project to investigate how Traditional Owners' cultural and spiritual values can be better represented in water management.

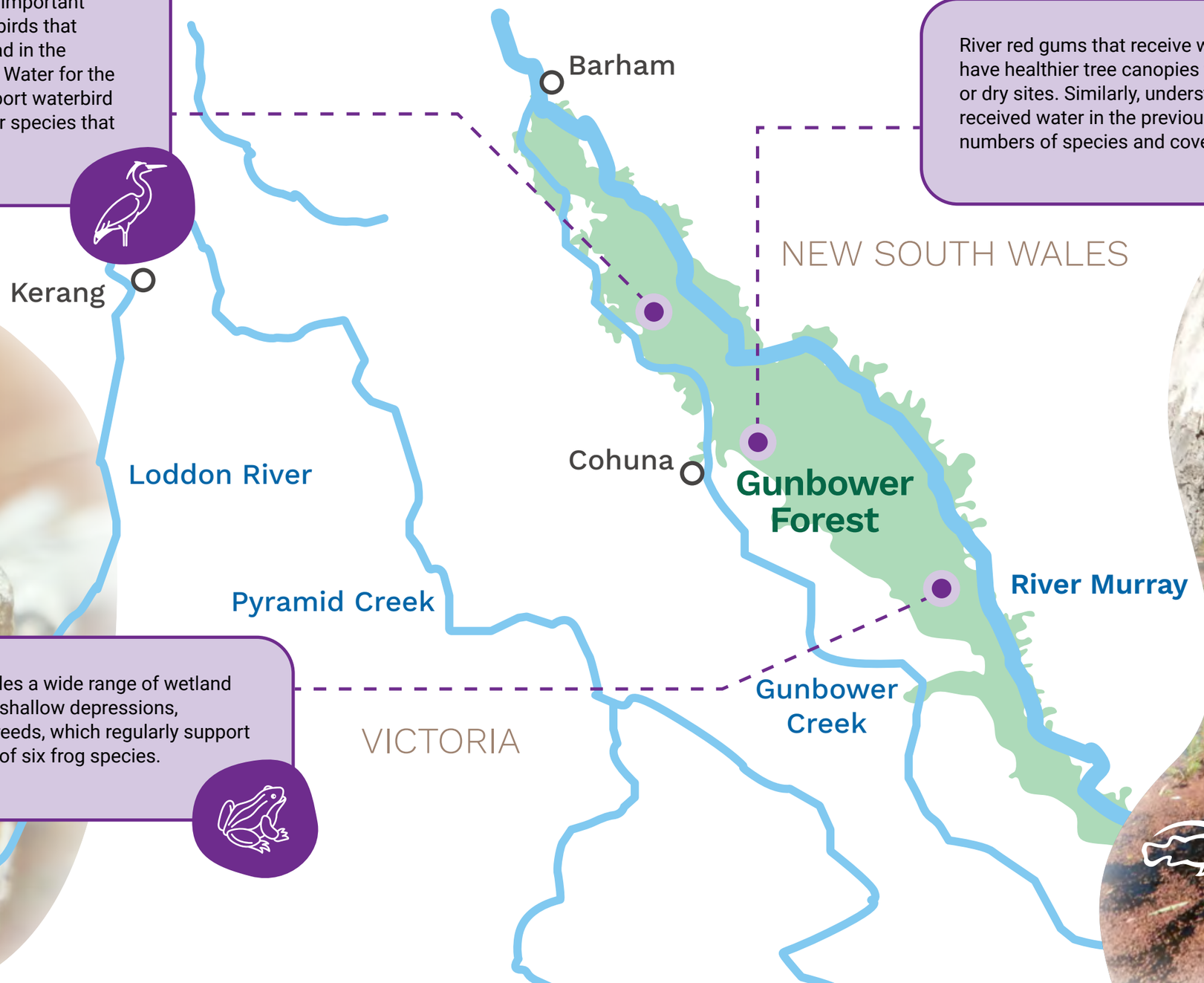
2022

First hybrid event delivered, with environmental water ahead of flooding, making the most of the large natural flows.

Large areas of inundated wetland and fringing habitat provide important habitat for native waterbirds that are no longer widespread in the surrounding landscape. Water for the environment helps support waterbird breeding, particularly for species that nest in colonies.



Gunbower Forest includes a wide range of wetland types including creeks, shallow depressions, open water and dense reeds, which regularly support the different life cycles of six frog species.



River red gums that receive water for the environment have healthier tree canopies than only naturally inundated or dry sites. Similarly, understorey vegetation that received water in the previous 12 months records higher numbers of species and cover than sites that did not.



Koondrook–Perricoota Forest

20 years of The Living Murray
Much achieved, much to do

Koondrook-Perricoota Forest is part of the NSW Central Murray Forests Ramsar site. The forest is a place of ecological diversity, rich with Aboriginal Cultural Heritage and a place for community and industry to thrive and work together.

The Barapa Barapa and Yorta Yorta are the Traditional Owners of the land on which Koondrook-Perricoota Forest is located. The forest is lush with cultural artifacts and sites, including many areas of significance.

Working with communities towards a healthier forest

The Koondrook–Perricoota regulators were built in 2013 and have the capacity to deliver 6,000 ML a day.

However, consistent use of the regulators is not yet possible due to issues around inundation of private land and infrastructure nearby. This has limited the amount of water that can be delivered to the forest and therefore the recovery of the ecological values of the site.

Small scale watering of the forest happened in 2014 and 2019 to reach around 3,500 hectares or 12% of the forest and relied on the trust and goodwill from forest neighbours and agencies to happen.

It has taken time and effort to design a solution for the original infrastructure to work. Funding has now been secured to resolve the issues and allow for greater volumes of water to be delivered to the forest.

Local communities are supportive and keen to finally see an improvement in the ecological health of the site which so far has had to largely rely on rare natural high flows which are not enough to sustain the health of the forest.



Pollack Swamp

Pollack Swamp or Pulitj in Barapa language, is a 700ha State Forest Flora Reserve situated 2km downstream of Koondrook State Forest. The Pollack is a significant wetland that has regularly received water for the environment via private infrastructure.

Regular watering has seen a great improvement in wetland vegetation and native fish with conditions suitable for waterbird breeding.

In 2016, large-scale natural flooding reactivated the Pollack as a significant waterbird nesting site for the first time in 24 years.

Thirty-five waterbird species were recorded, sixteen species successfully bred, and at least 4,000 waterbird chicks fledged. From mapping the nests, it was clear that waterbirds preferred to nest in redgums with healthy canopy condition, helped by the regular small-scale watering prior to 2016.

The success and recovery of the Pollack over time highlights what can be achieved when agencies work well with communities and First Nations.

	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	-	-	-	D	D	D	D	D	C	D	D	D	D	-	D	D
Birds	D	D	D	D	D	D	D	D	D	B	D	D	D	D	D	D
Vegetation	D	D	D	D	C	D	D	D	D	B	D	D	D	D	D	D

Grades

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- **D** — **Needs attention** Few (0-24%) of ecological objectives have been met
- **-** — **Data not available**

2011
Construction of structures to deliver water for the environment in the forest starts.

2013
Construction finishes.

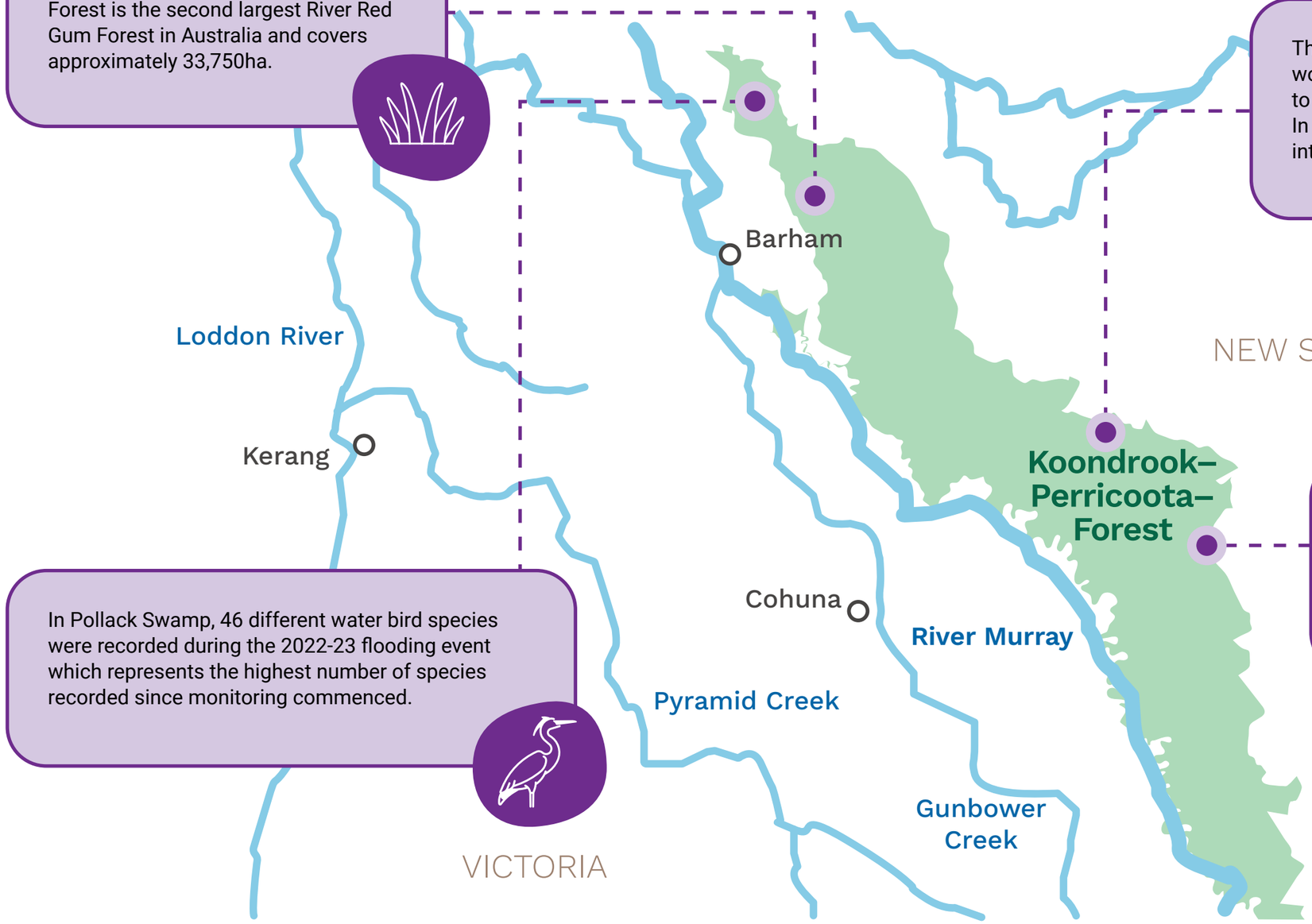
2014
First water for the environment is delivered via new structures, watering 4,500 ha of forest.

2017
Approval for a works project to increase flow and help mitigate third party impacts.

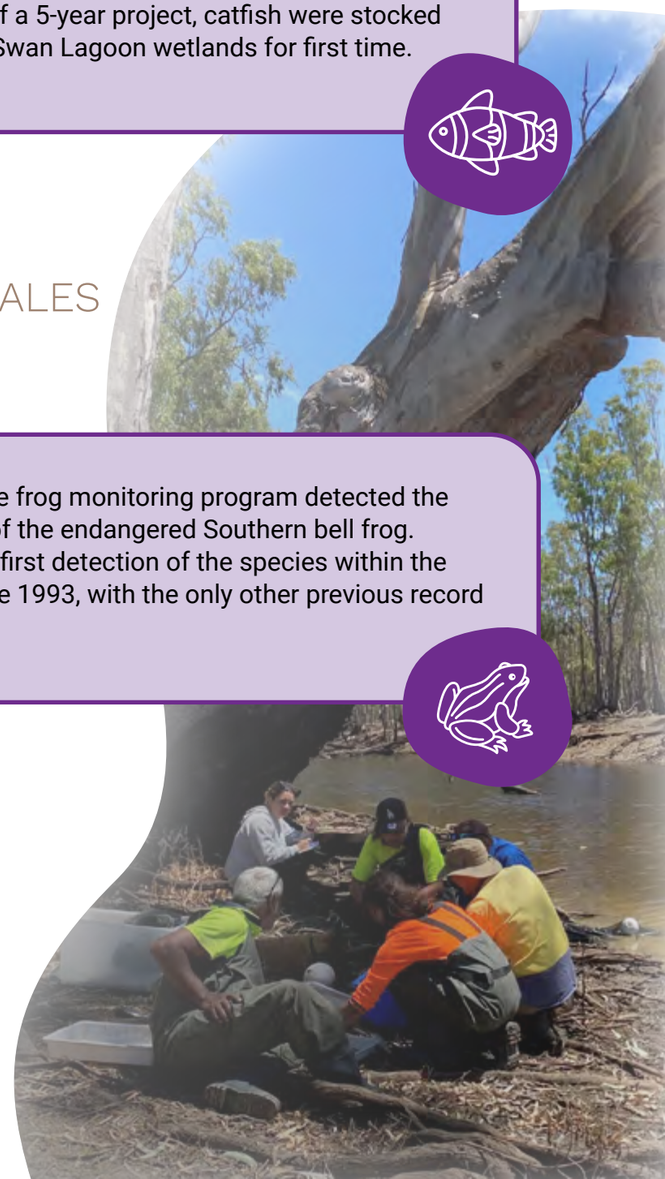
2022
Largest natural over bank event recorded since 1956, which watered the entire forest.

20 years of The Living Murray
Much achieved, much to do

Koondrook-Perricoota with Gunbower Forest is the second largest River Red Gum Forest in Australia and covers approximately 33,750ha.



The local Edward-Wakool River Angling Association is working with Traditional Owners and Forestry Corporation to restore habitat for the threatened eel-tailed catfish.
In 2023, as part of a 5-year project, catfish were stocked into Pollack and Swan Lagoon wetlands for first time.



In 2023, the frog monitoring program detected the presence of the endangered Southern bell frog.
This is the first detection of the species within the forest since 1993, with the only other previous record in 1961.

In Pollack Swamp, 46 different water bird species were recorded during the 2022-23 flooding event which represents the highest number of species recorded since monitoring commenced.

20 Years of The Living Murray

Hattah Lakes

20 years of The Living Murray
Much achieved, much to do

Hattah Lakes includes over 20 semi-permanent freshwater lakes and is listed as an internationally important wetland. The lakes are very important as drought refuges and as breeding places for waterbirds, regent parrots, frogs, turtles, and native fish.

The Hattah Lakes system is a significant region for First Nation cultural values and lies on the border of two language groups, the Latji Latji and the Jari Jari. Groups with an interest in Hattah Lakes include Latji Latji, Latji Latji Mumthelang, Tati Tati Kaiejin, Tati Tati Land and Water, Wadi Wadi Land and Water, Murray Valley Aboriginal Corporation, Gilby, Dadi Dadi Weki Weki, Culpra Millee, Nyeri Nyeri and Munatunga Elders.

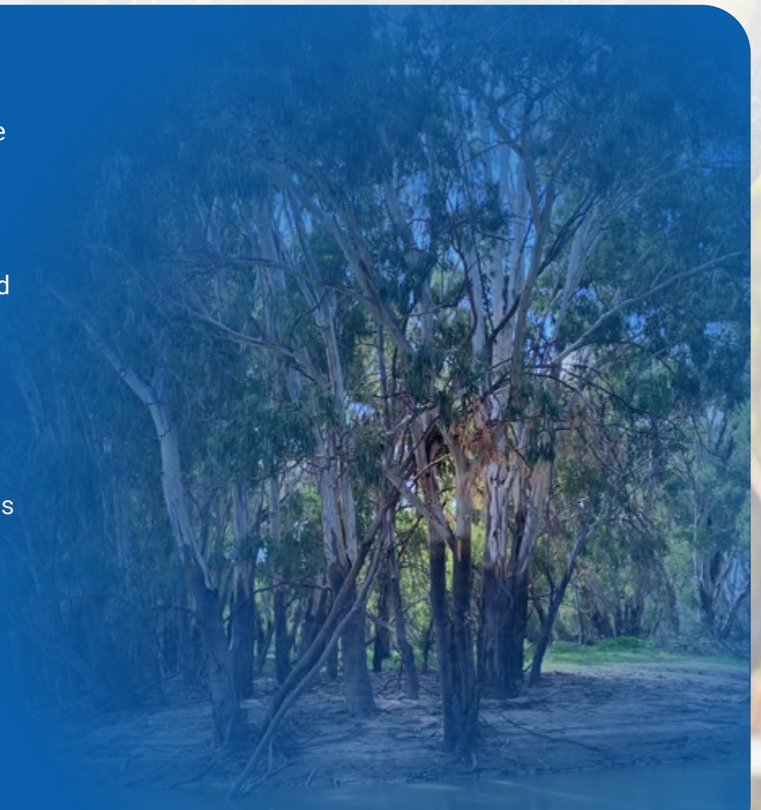
Improving health of floodplain trees

Hattah Lakes is a living example of how environmental infrastructure can be used to preserve iconic Australian species such as river red gum and black box.

Both species were suffering the impacts of severely reduced overbank flooding when a pump station and regulators were installed in 2012/13. This infrastructure makes it possible to deliver water for the environment effectively and efficiently, without impacting other river users.

Since the first watering in 2014, the growth, flowering and seed production of trees at watered sites has demonstrated a marked improvement in comparison to trees at unwatered sites. Flooding has prompted the trees to produce more flowers, which are a source of nectar for birds and insects. They in turn become food sources for other animals, keeping the food web alive.

Bush birds such as parrots, honeyeaters, and wrens have also benefited. Monitoring has shown the total numbers of bush birds were 60% higher for up to 3 years after a flood event, which demonstrates the lasting effects of watering on tree health and the food resources they provide.



We all love to be around water

Local businesses are among the biggest fans of Hattah Lakes. The direct economic value to the Hattah Lakes from recreation and tourism has been estimated at $1.5 million per year.

Water in the lakes results in bigger visitor numbers and this also delivers benefits for local businesses. Tourism operators offer bus tours, hiking, birdwatching, and kayaking adventures when water is present, while schools and universities also visit for parts of their curriculum. In addition to this, apiarists often rest bees at the lakes prior to the busy pollination season in nearby almond orchards; this generates beautiful honey and contributes to Australia's $640+ million almond export industry.



	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	D	D	D	A	A	D	A	-	A	A	A	A	-	-	B	D
Birds	D	D	D	D	D	C	D	A	B	B	A	A	A	A	A	A
Vegetation	C	D	C	D	B	B	A	-	A	A	A	B	A	B	B	B

Grades

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2006

Water for the environment first used as an emergency measure to prevent further deterioration of river red gums.

2013

Permanent pumping infrastructure built to manage and deliver water for the environment, allowing watering of ~6,000 hectares of floodplain.

2015

Lake Kramen received water for the first time in nearly 40 years thanks to works and water for the environment.

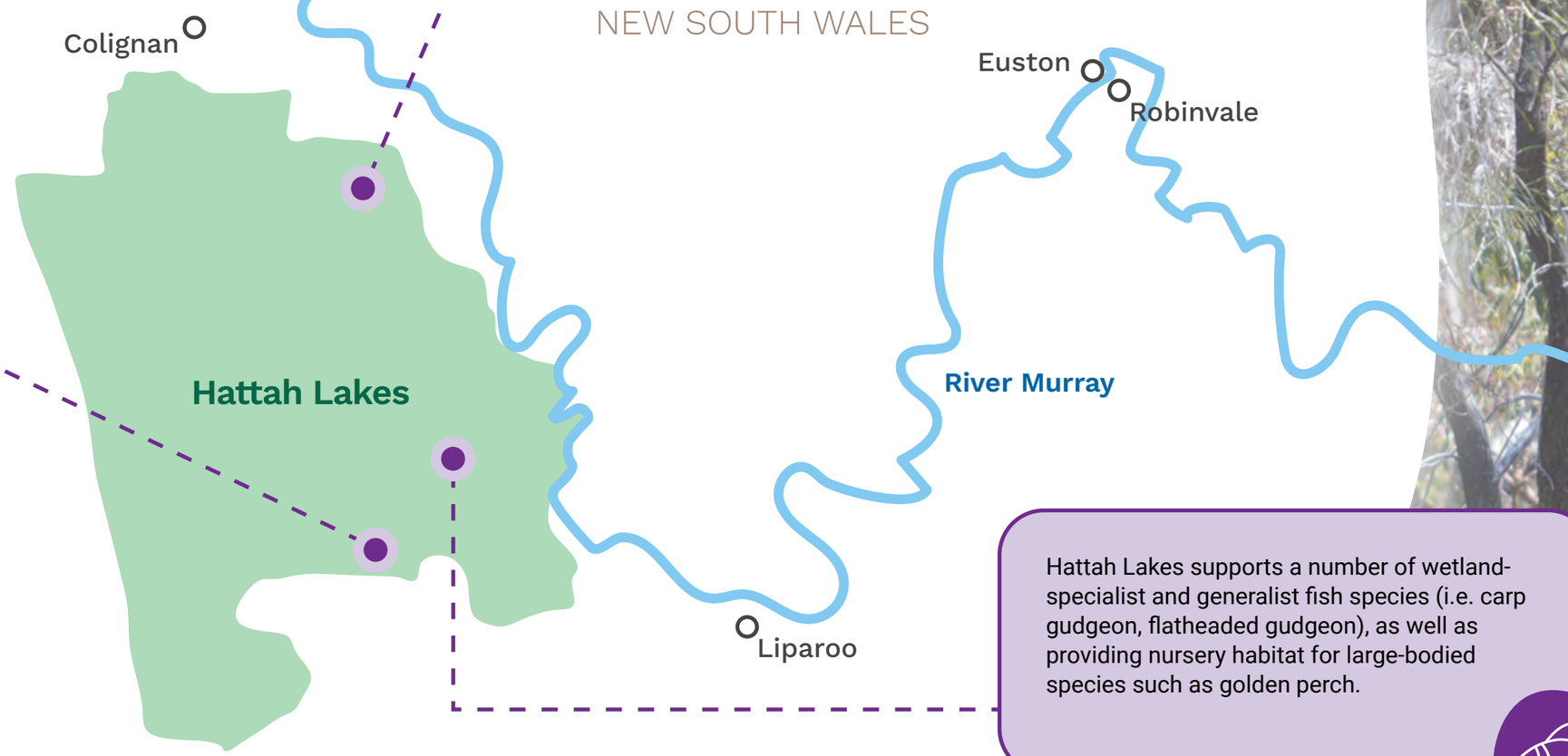
2017

Largest delivery of water for the environment to date enabling the water to reach stressed black box trees that had not received water since 1993.

Lake Kramen supported a large black swan breeding event in 2020-21, following the delivery of water for the environment. Black swans are a common but culturally important species. There were over 40 swan nests established on the lake and around 100 young swans fledged.

Ongoing monitoring has demonstrated that lignum (an important floodplain shrub) is in better condition at sites receiving water for the environment compared to those outside the management reach of water for the environment.





Hattah Lakes supports a number of wetland-specialist and generalist fish species (i.e. carp gudgeon, flatheaded gudgeon), as well as providing nursery habitat for large-bodied species such as golden perch.

20 years of The Living Murray
Much achieved, much to do

Lindsay, Mulcra and Wallpolla Islands

20 years of The Living Murray
Much achieved, much to do

The Lindsay, Mulcra and Wallpolla Islands cover over 26,100 hectares of floodplain woodlands with a network of permanent waterways, small creeks, wetlands and swamps. In this remote corner of Murray-Sunset National Park, the dry Mallee meets the rich wetlands of the Murray River and its islands.

The Traditional custodians are the First People of the Millewa Mallee Aboriginal Corporation (Latji Latji and Ngintait peoples).

Murray cod at the Mullaroo Creek

Mullaroo Creek, a permanent anabranch on Lindsay Island, supports one of the most significant populations of Murray cod in the lower River Murray. By building supporting infrastructure, The Living Murray program is helping to ensure a healthy, working Murray River into the future and the survival of the flora and fauna that rely on it.

In 2015, a regulator was installed at Mullaroo Creek to enable independent control of flow in the creek. From 2009 to 2015, no fish younger than one year old had been recorded in the creek, indicating very limited breeding. However, since 2015, fish younger than one year old have been recorded in the Mullaroo Creek in all but two years.

Despite improvements in the Murray cod population in Locks 6–8 in recent years, the Mullaroo Creek population remains the stronghold of the species in the area, both in terms of abundance and recruitment.



Talking Water

Over the past five years, Traditional Owners have regularly taken part in 'Talk Water' on Country events to add their voices to water management and planning for Lindsay-Mulcra-Wallpolla Islands.

Aboriginal Waterway Assessments have also been undertaken at Lindsay Island, in addition to community activities such as native fish re-stocking. These cultural activities are planned to continue, including extending into new youth projects to support inter-generational learning. This is a practical demonstration of how First Nations' knowledge, cultural values and perspectives can be heard and included in environmental planning for icon sites.



	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	B	D	D	B	B	D	D	-	A	B	B	B	B	B	B	B
Birds	-	-	-	B	B	B	B	-	A	A	B	B	B	A	A	A
Vegetation	D	D	D	B	B	C	B	-	B	B	B	B	B	B	C	C

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2006
The first infrastructure to manage water for the environment was completed.

2010
The status of Mulcra and Wallpolla Islands changed from State Forest to become part of the Murray-Sunset National Park.

2013
Seven regulator structures were completed in the Mulcra Island section.

2015
Completion of Lindsay Island water management infrastructure.



Maintaining wet-dry phases across many wetlands that would otherwise remain dry for long periods of time is an important consideration when planning the delivery of water for the environment. Appropriate wet-dry phases support understory vegetation, fringing trees such as river red gum and black box and shrubs such as lignum.

SOUTH AUSTRALIA

NEW SOUTH WALES

VICTORIA

Lake Victoria

Great Darling Anabranch

Renmark

River Murray

Lindsay Island

Mulcra Island

Frenchmans Creek

Wallpolla Island

Wentworth

River Murray

Cullulleraine

An olive pechlet was detected in the Mullaroo Creek at Lindsay Island during condition monitoring in 2022. This is the first record of this species in Victoria in 93 years.

Over 200 species of water-dependant birds are known to use the floodplain for breeding, feeding, and roosting. Several of them are listed under international migratory bird agreements.

20 Years of The Living Murray

Chowilla Floodplain

20 years of The Living Murray
Much achieved, much to do

The Chowilla Floodplain is a site of immense cultural significance which has an array of diverse terrestrial and aquatic habitats. The site is home to populations of rare, endangered and threatened species.

The Traditional Owners of the Chowilla Floodplain are the First Peoples of the River Murray and Mallee Region, and the Maraura Nation.

Water that rings a bell

The southern bell frog, once common throughout south-eastern Australia, has suffered a decline in recent decades and is now nationally vulnerable.

At Chowilla, annual surveys have consistently recorded bell frogs, indicating a relatively stable population, and marking Chowilla as one of the last remaining strongholds for the species in South Australia. Environmental water has been instrumental in creating this haven including small-scale temporary pumping to ephemeral wetlands regularly generating productive habitat in an otherwise dry landscape. Monitoring indicates that breeding is occurring at these wetlands, which are complemented by the refuge provided in the permanent creeks and pool connected wetlands.

Since 2014 the operation of the Chowilla regulator has intermittently inundated much larger areas of floodplain, multiplying the availability of breeding habitat and triggering successful widespread recruitment of tadpoles through to frogs.

Water for the environment delivered to the site creates a mosaic of floodplain habitats at Chowilla, allowing exchange of individuals to help sustain a healthy population critical for the species ongoing survival in South Australia.

Aboriginal Waterways Assessment

Traditional Owners undertook an Aboriginal Waterways Assessment at Coombool Swamp in 2020. This coincided with the delivery of water for the environment and a number of culturally significant black swan were recorded nesting on the lake.

As water levels began to draw down, there were concerns that the swans would not complete their breeding cycle. Traditional Owners worked with Chowilla site managers to request additional water for the environment. The extra water was pumped into Coombool Swamp to mantain water levels, providing swans with the resources to hatch and sustain cygnets. Undertaking the Aboriginal Waterways Assessment enabled the sharing of valuable cultural and ecological knowledge and improved the management of the site.



	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	-	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Birds	-	A	A	A	A	B	B	C	B	A	A	B	B	B	B	A
Vegetation	-	D	C	C	C	C	C	C	C	A	C	C	C	C	C	B
Other	-	C	B	A	D	C	B	B	B	B	-	A	B	B	A	A

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2004
First delivery of water for the environment through temporary pumping in South Australia.

2012
Tree condition monitoring program for culturally significant trees initiated.

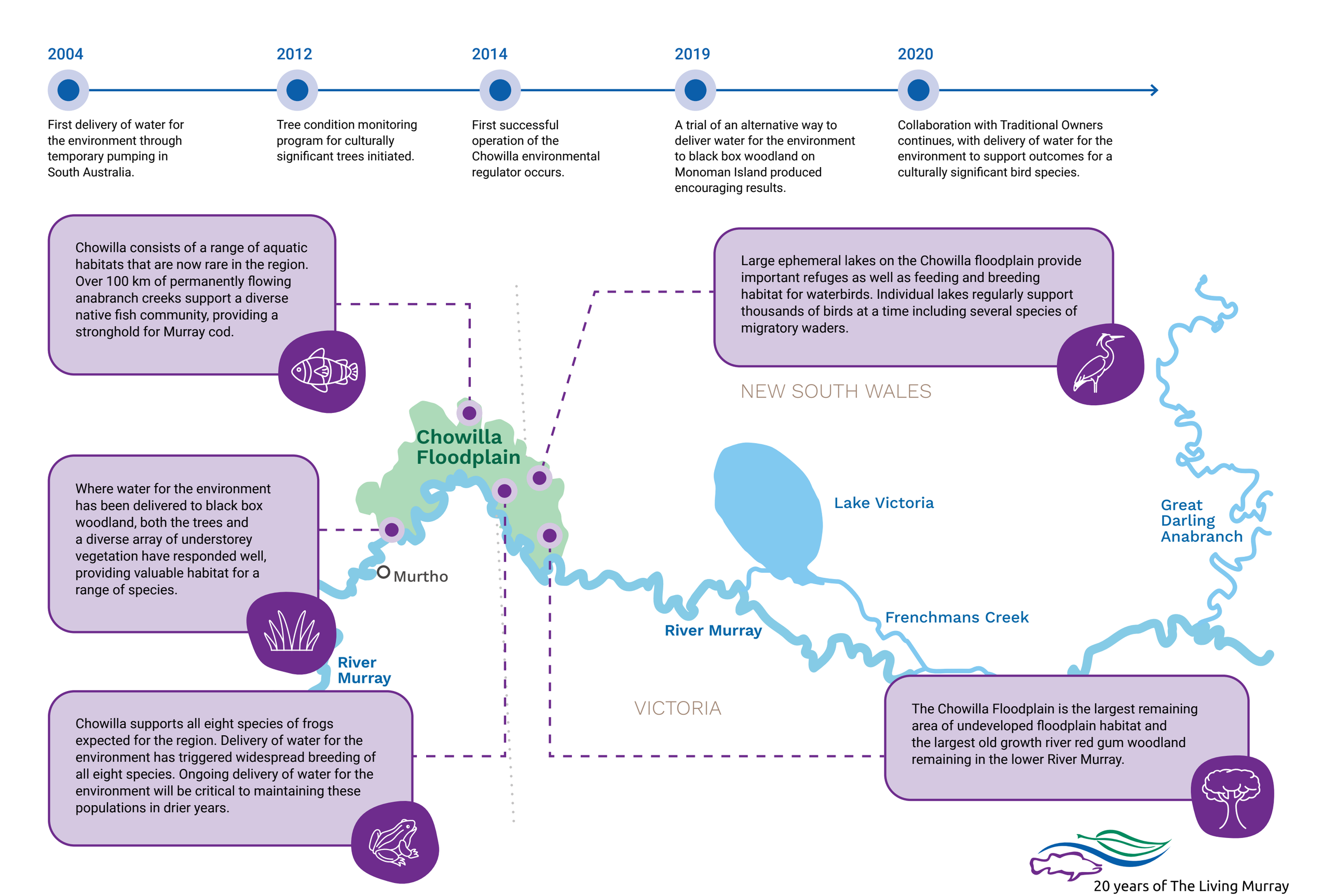
2014
First successful operation of the Chowilla environmental regulator occurs.

2019
A trial of an alternative way to deliver water for the environment to black box woodland on Monoman Island produced encouraging results.

2020
Collaboration with Traditional Owners continues, with delivery of water for the environment to support outcomes for a culturally significant bird species.

Chowilla consists of a range of aquatic habitats that are now rare in the region. Over 100 km of permanently flowing anabranch creeks support a diverse native fish community, providing a stronghold for Murray cod.

Large ephemeral lakes on the Chowilla floodplain provide important refuges as well as feeding and breeding habitat for waterbirds. Individual lakes regularly support thousands of birds at a time including several species of migratory waders.



Where water for the environment has been delivered to black box woodland, both the trees and a diverse array of understorey vegetation have responded well, providing valuable habitat for a range of species.

Chowilla supports all eight species of frogs expected for the region. Delivery of water for the environment has triggered widespread breeding of all eight species. Ongoing delivery of water for the environment will be critical to maintaining these populations in drier years.

The Chowilla Floodplain is the largest remaining area of undeveloped floodplain habitat and the largest old growth river red gum woodland remaining in the lower River Murray.

20 years of The Living Murray
Much achieved, much to do

Coorong, Lower Lakes and Murray Mouth

20 years of The Living Murray
Much achieved, much to do

The Coorong, Lower Lakes and Murray Mouth is an important biodiversity hotspot and is one of 10 major havens for large concentrations of wading birds in Australia. The site contains a unique mosaic of 23 wetland-types ranging from the freshwater Lower Lakes to the Coorong's hypersaline south lagoon.

Traditional Owners in this area are the Ngarrindjeri and First Nations of the South East.

Black bream recruitment in the Coorong

Black bream are estuarine fish common across southern Australia, however the Coorong population has been in severe decline since the late 1980s.

In October 2017, commercial fishers reported aggregations of black bream below the barrages. The fish were in good condition and ready to spawn. This prompted water managers, scientists and the community to work together to deliver water to the Coorong to support their spawning and recruitment.

Between October 2017 - February 2018, around 500 GL of water for the environment was delivered. The summer flows created a 'salt wedge', where freshwater sits above salt water. Salt wedges are needed to keep black bream eggs and larvae buoyant so they can develop and grow. The following autumn, scientists recorded more than 100 tiny black bream in the Coorong, meaning the targeted flow delivery was a success.

A similar flow event was delivered in summer 2021/22, with an even bigger recruitment response recorded the following autumn. The Coorong's black bream population is possibly in the best condition in 40 years, thanks to water for the environment and targeted fishing restrictions.



Ngarrindjeri Yarning Circles

The Ngarrindjeri Aboriginal Corporation's Yarning Circles project documented Ngarrindjeri cultural values and priorities, to inform water management on Ngarrindjeri Ruwe (Country). In 2021, six Yarning Circles were held with members of the Ngarrindjeri community and departmental staff.

Key themes that emerged included the importance of conserving Ngartjis (totemic species) including Pondi (Murray cod), Kultawari (yabbies) and Kungari (swans), along with maintaining water quality, the need to practice culture; and looking after Yarluwar-Ruwe (sea-country). The findings have guided The Living Murray program priorities, increasing the monitoring of Ngartjis and community engagement on Ngarrindjeri Ruwe.

"Sitting on the banks of the river, connecting to country and family, yarning and triggering our memories of what the land and river looked like. Brothers, grandchildren, and my great grandson all there participating in our journey from the past. Yarns about the river, the land, food, hunting and how the environment was our food source for our survival." - Vicki Hartman.

	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Fish	D	D	C	D	B	B	C	C	C	B	C	C	C	B	A	TBC
Birds	D	D	D	D	A	A	A	A	D	D	D	D	D	D	D	D
Vegetation	B	B	B	C	C	B	B	B	C	B	C	C	D	B	B	A
Other	D	D	D	B	A	A	A	B	A	B	B	B	C	C	B	B

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20 years of The Living Murray

Much achieved, much to do

2007

Hunters Creek small vertical slot fishway installed at Hindmarsh Island.

2014-2016

Six new fishways installed providing fish passage to all barrages.

2019

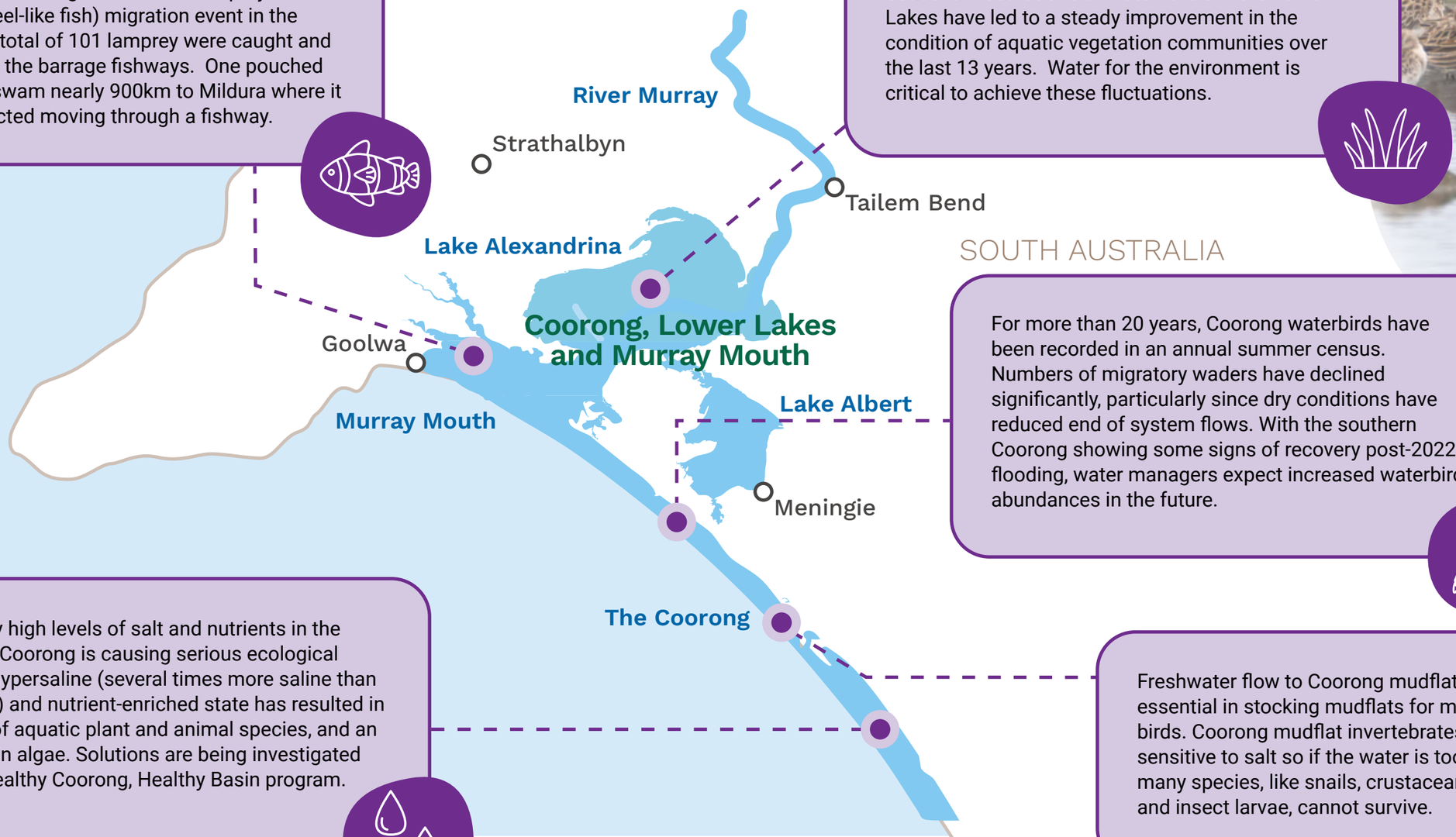
South East Flows Restoration Project completed, increasing the average annual volume of flow to the Coorong south lagoon.

2020

Community, scientists, Ngarrindjeri and government gather to celebrate 10 years of continuous flows from the river to the Coorong.

In winter 2020, water for the environment supported the largest recorded lamprey (ancient eel-like fish) migration event in the region. A total of 101 lamprey were caught and tagged at the barrage fishways. One pouched lamprey swam nearly 900km to Mildura where it was detected moving through a fishway.

Seasonal fluctuations of water levels in the Lower Lakes have led to a steady improvement in the condition of aquatic vegetation communities over the last 13 years. Water for the environment is critical to achieve these fluctuations.



For more than 20 years, Coorong waterbirds have been recorded in an annual summer census. Numbers of migratory waders have declined significantly, particularly since dry conditions have reduced end of system flows. With the southern Coorong showing some signs of recovery post-2022 flooding, water managers expect increased waterbird abundances in the future.

Extremely high levels of salt and nutrients in the southern Coorong is causing serious ecological harm. A hypersaline (several times more saline than seawater) and nutrient-enriched state has resulted in the loss of aquatic plant and animal species, and an increase in algae. Solutions are being investigated via the Healthy Coorong, Healthy Basin program.

Freshwater flow to Coorong mudflats is essential in stocking mudflats for migratory birds. Coorong mudflat invertebrates are sensitive to salt so if the water is too salty, many species, like snails, crustaceans, worms and insect larvae, cannot survive.

20 Years of The Living Murray

River Murray

20 years of The Living Murray
Much achieved, much to do

The River Murray is essentially the main artery, weaving through and linking the other icon sites. It is over 2,000 km long from Hume dam to the estuary and ocean and connects many floodplains and wetlands along the way. The river is highly regulated by dams, weirs and barrages.

Many First Nations have connection to the River Murray with distinct cultural boundaries, languages and cultural practices.

Monitoring the river that joins us

For a long time the River Murray did not have dedicated ecological monitoring as an icon site in its own right. This changed in spring 2019, when a consortium of scientists across NSW, Victoria and South Australia came together for a first trial of monitoring responses to water for the environment along the length of the Murray.

A five-year monitoring plan for the River Murray quickly followed in 2020, to learn from and improve the management and coordination of environmental flows at a system scale.

The River Murray monitoring plan builds on existing monitoring programs by filling in key location gaps and bringing the results from different projects together, like a jigsaw, to evaluate the whole river's response to flow.

Monitoring is just getting started, but reconnecting the Murray with its floodplains is already demonstrating clear outcomes to support a healthy, working River Murray.



Coordinated watering across the Southern Basin

Since 2018 environmental water holders have been working to deliver a coordinated spring flow across the Southern Basin. The multi-site event aims to connect the River Murray and its tributaries, from dams to the Murray Mouth, watering floodplains along the way.

In 2019, 330 GL of water for the environment was actively coordinated between the Goulburn and Murray Rivers benefiting over 2,500 km of rivers and creeks, as well as providing targeted water at key sites along the way, including 6 Ramsar listed wetlands of international significance.

By spring 2020, coordination between Murray and Goulburn had grown to include environmental flows from the Murrumbidgee River to provide an even bigger system-wide boost and improve connectivity all the way along the river down to the Coorong and Murray Mouth.

The River Murray multi-site has grown to be the largest environmental flow action coordinated across the Murray-Darling Basin. Volumes of water used for this event have grown to nearly 400 GL each year!



2010

The first trial of a multi-site environmental flow in the Murray, with water released from Hume Dam protected through to the Lower Lakes.

2018

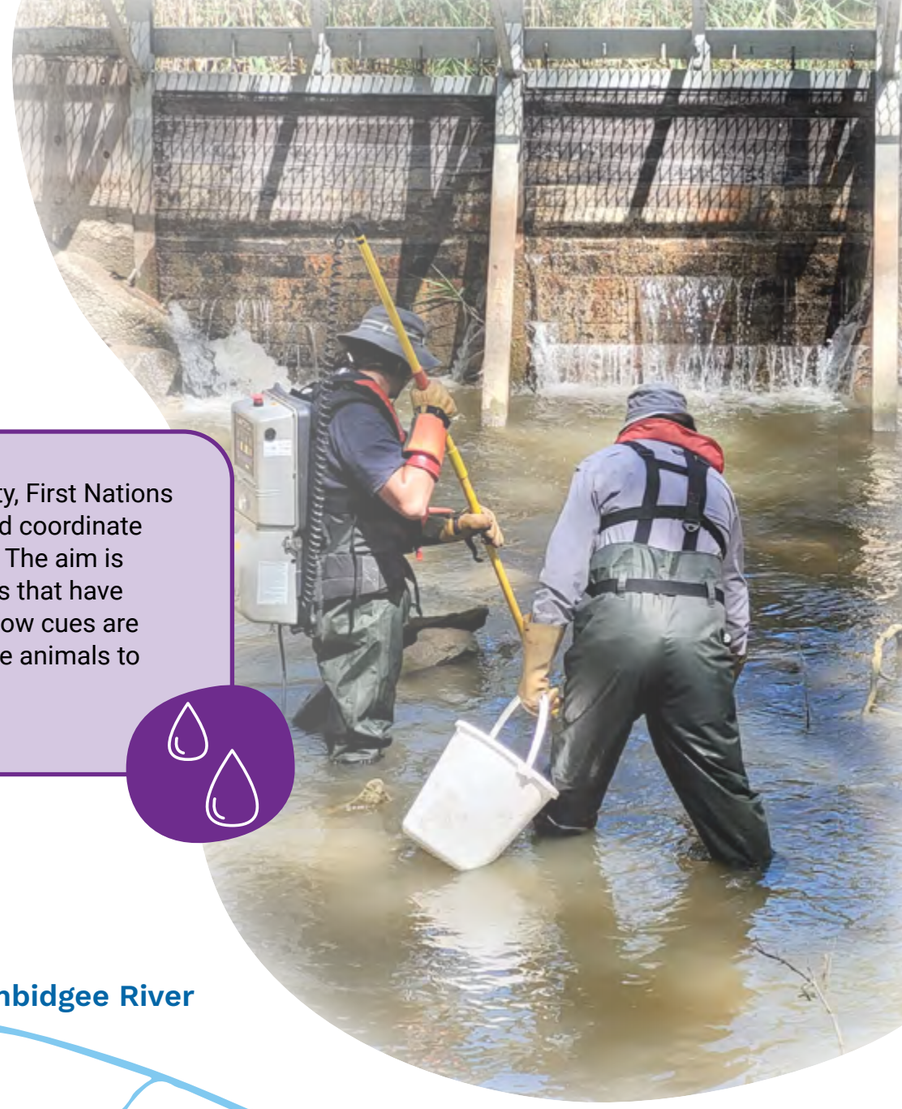
Environmental flows are now coordinated between Southern Basin rivers to create flow pulses along the length of the River Murray.

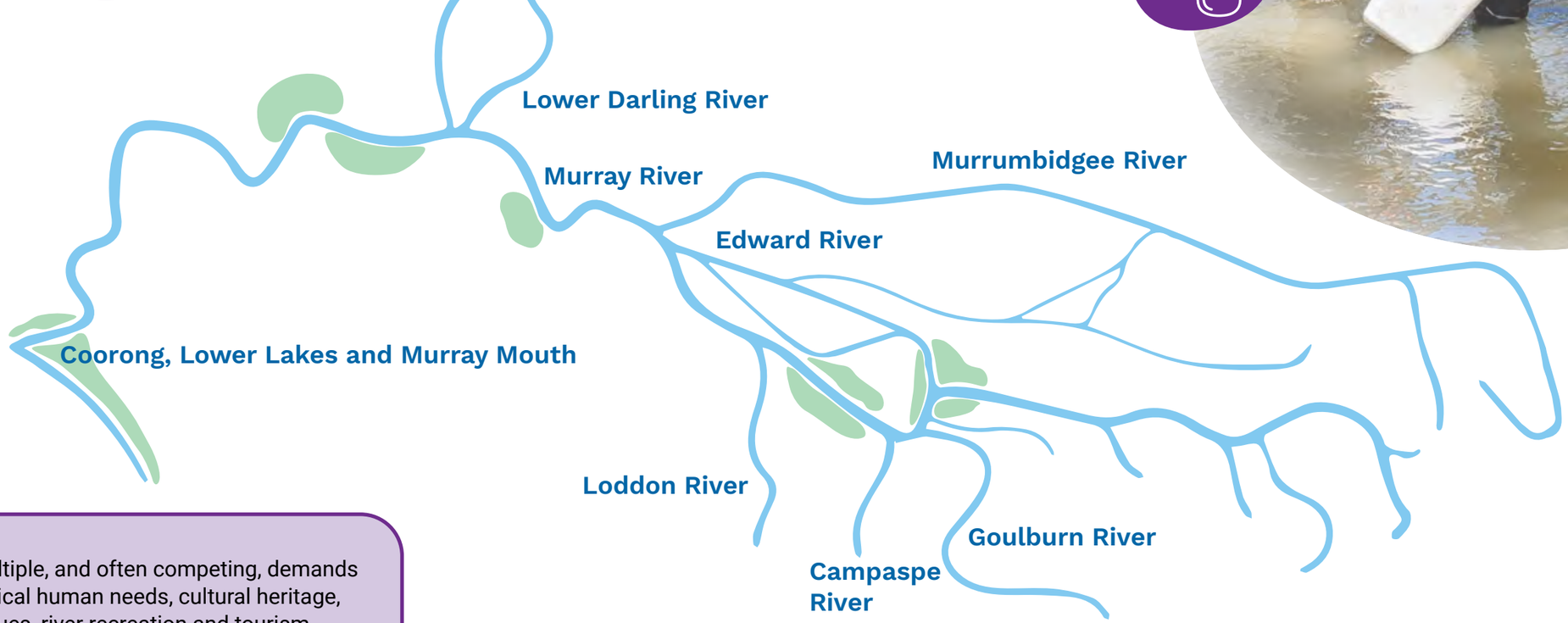
2020

Development a five-year monitoring plan for the River Murray.

The primary objective of the River Murray monitoring plan is to better understand ecological responses to flow and inform the coordination and adaptive management of water for the environment.

Environmental water managers, community, First Nations and ecologists work together to design and coordinate flows along the length of the River Murray. The aim is to reintroduce higher flows and flow pulses that have been lost through river regulation. These flow cues are important as they provide signals for native animals to feed, breed and move.





The River Murray serves multiple, and often competing, demands for water. These include critical human needs, cultural heritage, irrigation, environmental values, river recreation and tourism, hydro-power generation and flood mitigation.